

ABC Options with Dead Discards and Potential Female Landings – June 7, 2010

#3- Red Crab

**PDT Analysis of Dead Discards and Potential Female Allowable Landings to be Added to the Interim ABC for Red Crab****Prepared by the Red Crab PDT for Consideration by the SSC****June 2010****Introduction**

The reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires fishery management plans (FMPs) to account for all removals from a fished stock. For this reason, dead discards of both male and female red crabs must be incorporated into the allowable biological catch (ABC). In the case of red crab, the long-term average landings of male red crab were used as the basis for the interim ABC. The New England Fishery Management Council's (Council) Scientific and Statistical Committee (SSC) noted that historical landings of male red crab and historical discarding practices appear to be sustainable, and that the recommended ABC would have to be increased to include discards if it were intended to include total catch. Whereas ABC is intended to include total catch, this paper provides an estimate of the dead discards that are likely to have been associated with the long-term landings of male crabs that formed the basis for the interim ABC. This estimate includes dead discards from both the directed red crab fishery and from other fisheries for which red crab discards have been observed. The methodology employed to estimate discards from other fisheries is explained in the attached analysis from the Northeast Fishery Science Center (NEFSC) (Chute 2010). Estimates of dead discards in the directed fishery are taken primarily from the Report of the Data Poor Stocks Working Group (Northeast Data Poor Stocks Working Group 2009).

The red crab fleet is currently operating under an exempted fishery permit (EFP) that allows non-egg-bearing female red crabs to be retained, up to 1 million lb, in the course of normal fishing directed at large male crabs. In a separate Working Paper (Red Crab PDT 2010 attached), the red crab PDT analyzes the impact of retaining females on the fishing mortality rate, given different assumptions about the normal sex ratio in the catch and the discard mortality rate. This paper includes options for the allowable landings of females.

**Scientific Background**

Two surveys of red crab abundance have been conducted, one in 1974 and one in 2003-2005.

The SSC considered the available scientific information on red crab during multiple meetings in 2009 and 2010. The SSC then recommended that "landings of male red crabs should be limited to an interim ABC of 1,775 mt." The SSC noted that "the two survey estimates of abundance and their variance do not provide evidence of significant depletion from 1974 to 2003-2005." The SSC also concluded that "an interim ABC based on long-term landings is safely below an overfishing threshold and adequately accounts for scientific uncertainty."

Biomass estimates from the 1974 and 2003-2005 surveys for both male and female crab are given in Table 2 (Table 2 from the DPSWG Report). The DPSWG summarized the biomass estimates as follows:

Comparisons of biomass estimates from the two surveys are uncertain due to uncertainty about the effective area sampled by cameras during 1974. However, biomass estimates from the two sets of surveys (table 2) indicate that male fishable biomass (based on current fishery selectivity) increased by about 20% during 1974 to 2003-2005. Female biomass (total, 90+ and 114+ CW) increased substantially by 150%-250%. In contrast, total male biomass increased by only 75% and biomass of large (114+ CW) males decreased by about 43%. Size composition data from the surveys indicates that both male and female red crabs have benefitted from recruitment in recent years (figure 2). The loss of large (114+ CW) male biomass and relatively modest increase biomass of males 90+ mm CW can probably be attributed to size-selective fishing (Weinberg and Keith 2003).

To the extent that these biomass estimates represent biomass levels that can be expected during 2011-2013, they allow calculation of fishing mortality rates that would result from different levels of landings and discards by sex and size.<sup>1</sup>

Total removals from the red crab stock during the period used to calculate the long-term historical landings have included some level of discard mortality inflicted by both the directed fishery for red crab and by fisheries directed at other species. The PDT recognizes that discard rates in the directed fishery have varied through time in response to changes in the size distribution of the population and the selectivity practiced by fishermen in response to market requirements. Changes in size distribution have occurred as a result of the thinning out of the large male population that had accumulated before the fishery began, and as a result of abundant year-classes coming into the fishery, as was evident in the 2003-2005 survey. The 2003-2005 survey also showed more of an increase in the biomass of female crabs compared to males relative to the 1974 survey. We can assume that discards of male crab likely declined over time as smaller crabs became marketable, but would have increased during strong pulses of recruitment. Discarding may have declined as experienced fishermen became better at targeting large males. In the absence of data throughout the time period, and with some expected increases and some decreases, we treat the proportion of discards as having been constant over the period 1973-2007 for the purpose of estimating average annual dead discards.

An estimate of total annual mortality due to red crab fishing is presented in Table 1, which is taken from the report of the Data Poor Species Working Group (DPSWG). The DPSWG Report indicated that discard rates used in Table 1 were from sea- and port samples during 2003-2004 (Table D4.5 in NEFSC 2006a). The DPSWG reported that, "based on limited log book, sea- and port sample information, discards of female and undersize male red crabs appear to average about 30% of total catch but can range from about 10% to 69% of total red crab catch." The DPSWG also reported that discard mortality from being brought to the surface and handled on deck averages about 5% (Tallack 2007), but noted that discard mortality is a major uncertainty. For purposes of estimating total annual mortality associated with landings, the DPSWG used a discard mortality rate of 0.50 in its peer-reviewed report. NMFS scientists have pointed out that

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<sup>1</sup> Anecdotal reports from the red crab fleet indicate that catch rates during early 2010 have been higher than the current fishery participants have ever seen.



the Tallack study may not represent typical commercial fishing operations covering a range of seasonal conditions, and thus may underestimate discard mortality.

As with discard rates, discard mortality rates have likely varied over time. Prior to 2002, the red crab fishery experienced sporadic surges in new participants that would have required a period of time to learn how to target larger males and to adopt practices to reduce discard mortality, assuming the operators were sensitive to the desirability of reducing discard mortality. This history lends credence to the “worst case” mortality estimates from the DPSWG Report for application to the early history of the fishery. Participation in the fishery has been stable since 2002 and the industry has shown a clear interest in research and practices to support sustainability. This is especially true with regard to discard mortality, and implies that discard mortality rates going forward are unlikely to be “worst case.”

**Table 1- Total annual mortality due to directed red crab fishing (landings and mortal discard) during 2003-2005 by sex. (Table 1 from Data Poor Species Working Group Report. The label “5 x best estimate” is from the original table 1 in the DPSWG Report and should read “10 x best estimate.”)**

|   | <b>Males</b> | <b>Females</b> | <b>Total</b> |
|---|--------------|----------------|--------------|
| <b>Average 2003-2005 landings (mt)</b>            | 1,992        | 0              | 1,992        |
| <b>Discard/(total male + female catch)</b>        | 0.11         | 0.18           | 0.29         |
| <b>Catch (mt, includes all discards)</b>          | 2,238        | 2,429          | 4,667        |
| <b>Discard (mt)</b>                               | 246          | 2,429          | 2,675        |
| <b>Discard mortality rate (5 x best estimate)</b> |              | 0.5            |              |
| <b>Mortal discard (mt)</b>                        | 123          | 1,215          | 1,338        |
| <b>Landings + mortal discard (mt)</b>             | 2,115        | 1,215          | 3,330        |
| <b>Total biomass (mt)</b>                         | 56,443       | 74,689         | 131,132      |
| <b>90+ CW biomass (mt)</b>                        | 38,220       | 55,279         | 93,499       |
| <b>F relative to total biomass</b>                | 0.04         | 0.02           | 0.03         |
| <b>F relative to 90+ biomass</b>                  | 0.06         | 0.02           | 0.04         |

**Table 2- Biomass estimates, standard errors and CVs from deep-sea red crab camera/bottom trawl surveys. The standard errors for 1974 estimates are approximations based on the assumption that CVs for variability among samples was the same during 1974 as during 2003 to 2005. The differences in CVs between the two periods are due to differences in assumed effective sample size. (From table 2 in DPSWG Report)**

|              |         | Males |      |         | Females |      |         | Total  |      |  |
|--------------|---------|-------|------|---------|---------|------|---------|--------|------|--|
| Year         |         |       |      |         |         |      |         |        |      |  |
| Size Groups  | Biomass | SE    | CV   | Biomass | SE      | CV   | Biomass | SE     | CV   |  |
| (mm CW)      | (mt)    | (mt)  | (mt) | (mt)    | (mt)    | (mt) |         |        |      |  |
| 1974         |         |       |      |         |         |      |         |        |      |  |
| 90+          | 29,991  | 6,298 | 0.21 | 15,654  | 3,719   | 0.24 | 45,645  | 7,314  | 0.16 |  |
| 114+         | 23,794  | 4,303 | 0.18 | 2,106   | 433     | 0.21 | 25,900  | 4,325  | 0.17 |  |
| Fishable     | 30,302  | 6,363 | 0.21 | NA      | NA      | NA   | NA      | NA     | NA   |  |
| All          | 32,190  | 5,001 | 0.16 | 20,674  | 5,221   | 0.25 | 52,864  | 7,230  | 0.14 |  |
| 2003 to 2005 |         |       |      |         |         |      |         |        |      |  |
| 90+          | 38,220  | 4,298 | 0.11 | 55,279  | 7,033   | 0.13 | 93,499  | 8,242  | 0.09 |  |
| 114          | 13,770  | 1,334 | 0.1  | 5,224   | 576     | 0.11 | 18,994  | 1,453  | 0.08 |  |
| Fishable     | 36,247  | 4,612 | 0.13 | NA      | NA      | NA   | NA      | NA     | NA   |  |
| All          | 56,443  | 4,646 | 0.08 | 74,689  | 10,102  | 0.14 | 131,132 | 11,119 | 0.08 |  |

Table 3, below, follows from table 1 in the DPSWG Report and serves two purposes. First, by replacing the 1,992 mt average landings from 2003-2005 with the 1,775 mt average landings from 1973-2007 we obtain estimates of the average annual discards and mortal discards that might have accompanied the long-term average male landings. Secondly, if the 2003-2005 survey biomass is taken to be the biomass going forward, if there are no female landings, and if the discard rate and discard mortality indicated in Table 1 of the DPSWG Report are assumed to continue into the future and are added to the male landings ABC to get total removals by the directed red crab fishery with landings of 1,775 mt, the resulting fishing mortality rate is 0.049 when applied to the male biomass over 90 mm CW (Table 3). The total removals by the directed fishery would be 2967 mt and the overall fishing mortality rate would be 0.032. This would represent a continuation of the “worst case” alternative highlighted in the DPSWG Report with regard to the discard mortality rate.

**Table 3- Total annual mortality associated with male landings of 1,775 mt based on Table 1 from the DPSWG Report (metric tons).**

|  | Males | Females | Total  |
|--|-------|---------|--------|
| Total Allowable Landings*                  | 1775  | 0       | 1775   |
| Discard Rate                               | 0.11  | 0.18    | 0.57   |
| Catch (mt, includes all discards)          | 1994  | 2165    | 4159   |
| Discard (mt)                               | 219   | 2165    | 2384   |
| Discard mortality rate (10x best estimate) | 0.5   | 0.5     |        |
| Mortal discard (mt)                        | 110   | 1082    | 1192   |
| Landings + mortal discard (mt)             | 1885  | 1082    | 2967   |
| Total biomass (mt)                         | 56443 | 74689   | 131132 |
| 90+ CW biomass (mt)                        | 38220 | 55279   | 93499  |
| F relative to total biomass                | 0.033 | 0.014   | 0.023  |
| F relative to 90+ biomass                  | 0.049 | 0.020   | 0.032  |

\* Total allowable landings (TAL) are the catch limit less discards.

### **Dead Discards from Other Fisheries**

Estimated dead discards of red crabs caught incidentally in the lobster trawl, lobster trap, monkfish trawl, monkfish gillnet, and silver hake trawl fisheries averaged 24 mt from 1974-2007 (Chute 2010 attached). This number is intended to represent the average annual discards from bycatch fisheries that were a component of the combined average annual landings plus historical discards that have been deemed sustainable by the SSC.

### **ABC with Dead Discards Included**

#### **ABC Option 1 Using Historical Removals as the Basis for ABC**

The addition of estimated dead discards at historical levels to the interim ABC based on historical male landings would result in an ABC estimate of 2991 mt (Table 4). These values were derived by applying the sex ratio and discard mortality rate from table 1 in the peer-reviewed DPSWG Report to the average annual directed red crab landings from 1973-2007 to determine total removals from the directed fishery. 24 mt of dead discards from bycatch fisheries were then added to the directed fishery removals.

**Table 4- Historical male landings plus estimated dead discards from the directed fishery and from other fisheries in metric tons using the sex ratio and discard mortality rates from table 1 in the DPSWG Report.**

| ABC Option 1 (0.50 Historical Disc Mort) | mt   |
|--|------|
| 2010 Interim ABC (Male Landings Only)    | 1775 |
| Directed Fishery Male Dead Discards      | 110  |
| Directed Fishery Female Dead Discards    | 1082 |
| Other Fisheries Dead Discards            | 24   |
| ABC Including Dead Discards              | 2991 |

#### **ABC Option 2 Using Historical Removals as the Basis for ABC**

The DPSWG Report noted that the mortality “estimates are “worse-case” scenarios because they assume that 50% of discarded red crabs die, whereas the current best estimate of discard mortality indicate that about 5% of discarded red crabs die from being brought to the surface and handled on deck (Tallack 2007).” The DPSWG did not suggest or calculate alternative mortal discard estimates and staff from the NEFSC have repeatedly stressed issues that may cause the Tallack discard mortality rate to be underestimated. The Peer Review Report of the DPSWG Report notes that “the female size structure has not changed substantially suggesting discard mortality may not be a significant factor.” The Peer Review Report did not question the values in table 1, which constitutes the only peer-reviewed calculation of mortal discards in the directed red crab fishery. However, the PDT provides Table 5 as an alternative calculation of mortal discards using a discard mortality rate that is one-half the rate used in the DPSWG Report. Table 5 presents the resulting ABC.



**Table 5- Historical male landings plus estimated dead discards from the directed fishery and from other fisheries in metric tons using the sex ratio from table 1 in the DPSWG Report and a discard mortality rate of one-half that used in the DPSWG Report .**

|  |      |
|--|------|
| ABC Option 2 (0.25 Historical Disc Mort) | mt   |
| 2010 Interim ABC (Male Landings Only)    | 1775 |
| Directed Fishery Male Dead Discards      | 55   |
| Directed Fishery Female Dead Discards    | 541  |
| Other Fisheries Dead Discards            | 24   |
| ABC Including Dead Discards              | 2395 |

**Forward Looking ABC and Implications of Possible Female Allowable Landings**

On June 23, 2009 the Northeast Regional Office of NMFS approved a request from the red crab industry and cooperating researchers for an exempted fisheries permit that would allow the retention and sale of up to one million lb (454 mt) of non-egg-bearing female red crab to be taken in the course of normal fishing for males. The purpose of the EFP is to test the market for female crab and to provide funding for additional biological research on red crab. The red crab industry has an expectation that the management system will incorporate procedures to establish a science-based annual catch limit for female crab if some retention of females is considered to be scientifically acceptable. If an allowable harvest level for female crab is not given serious consideration, the red crab industry would not find it to be economically justifiable to continue to fund the research that is being supported by the EFP.

The research that is being conducted during, and supported by the EFP will be helpful in the long-term understanding and management of the red crab resource. It is not likely to provide any near-term guidance on sustainable levels of female harvest.

The PDT notes that most fisheries take both sexes, including many crustacean fisheries. The PDT did not review the literature pertaining to the harvesting of female crustaceans. The PDT analysis and options presented here focus on the impact of alternative levels of female retention on total removals and fishing mortality rates. For each of the options, the intent would be for any females to be taken in the course of fishing for males, and that fishing would cease when the allowable male landings were reached. The intent is not to increase fishing effort or to expand the scope of the fishery. Rather, the intent is to increase the efficiency of the red crab fleet by retaining more of the catch and discarding less. Among other benefits, this would reduce the energy used per lb of landed crab.

The implications of retaining a portion of the female catch are difficult to relate to the historical removals because the sex ratio and discard mortality rate going forward may differ from the historical patterns. If the discard mortality rate will be the same as that used to calculate historical removals, any retention of animals previously discarded will increase total removals. Every retained animal represents a removal of 1, whereas a discarded animal represents a removal that is a fraction of 1 (0.50 using the discard mortality rate used in table 1 of the DPSWG Report). If the discard mortality rate going forward is expected to be less than that which was used to calculate historical removals, some retention of females could take place without exceeding historical removals.

Female Option 4 from the accompanying paper on Options for Female Harvest is a conservative approach to the retention of female crabs caught incidentally in the course

of normal fishing directed at large male crab. Female Option 4 uses a higher ratio of females to males than has been indicated in the most recently observed trips, which has the effect of increasing the calculated fishing mortality rate compared to the most likely value. By combining the higher estimate of the expected female catch with the female retention that would result from the lower estimate of the female catch, we avoid overestimating the appropriate female retention. The 719 mt take of female crab is based on retention of 75% of the females that would be expected to be caught in the course of normal fishing for 1,775 mt of large males, with a sex ratio equal to that observed during 2007 and 2008.

The options for ABC with female harvest presented below provide an analysis of the impact of adopting Female Option 4 on the relationship between total removals going forward depending on different assumptions about future sex ratios and discard mortality rates compared to historical rates.

### **ABC with Female Landings Option 1**

The PDT provides the values in Table 6 as Option 1 for the inclusion of an allowable landings specification for female red crab. If we assume that the sex ratio and discard mortality rate that was used to develop table 1 in the DPSWG Report is appropriate for 2011-2013, any allowable landings of females will require some increase in the ABC compared to the historical removals basis. In this case, female dead discards will come down by 360 mt and total female mortality will go up by 360 mt. The fishery will produce the benefits from an additional 719 mt of landings with additional mortality of 360 mt.

**Table 6- Implications of Option 1 for Female Allowable Landings based on the assumption that the sex ratio and discard mortality rate going forward will be the same as the rates used in Table 1 and as the historical basis for ABC.**

|                                  |      |
|----------------------------------|------|
| ABC Including Dead Discards      | 2991 |
| Male TAL                         | 1775 |
| Male Dead Discards               | 110  |
| Female TAL                       | 719  |
| Female Dead Discards             | 723  |
| Bycatch Dead Discards            | 24   |
| Total Removals                   | 3351 |
| Buffer or Excess compared to ABC | -360 |

**Table 7- If the biomass estimates from the 2003-2005 survey are taken to represent the biomass in 2011-2013, the Option 1 specifications would result in the exploitation rates shown in Table 7.**

| Estimated Projected Fishing Mortality Rates | Males | Females | Total  |
|---|-------|---------|--------|
| Total Allowable Landings                    | 1775  | 719     | 2494   |
| Discard Rate                                | 0.11  | 0.18    |        |
| Catch (mt, includes all discards)           | 1994  | 2165    | 4159   |
| Discard (mt)                                | 219   | 1446    | 1665   |
| Discard mortality rate                      | 0.5   | 0.5     |        |
| Mortal discard directed fishery (mt)        | 110   | 723     | 833    |
| Mortal discard by-catch fisheries           |       |         | 24     |
| Landings + mortal discard (mt)              | 1885  | 1442    | 3351   |
| Total biomass (mt)                          | 56443 | 74689   | 131132 |
| 90+ CW biomass (mt)                         | 38220 | 55279   | 93499  |
| F relative to total biomass                 | 0.033 | 0.019   | 0.026  |
| F relative to 90+ biomass                   | 0.049 | 0.026   | 0.036  |

### **ABC with Female Landings Option 2**

Table 8 uses the sex ratio from five observed red crab trips with 81 hauls in 2007-2008 as the basis for the expected sex ratio that will be realized by the fleet while fishing for male crab with the recent population structure and fishing strategies. The sex ratio observed on these recent trips has a lower ratio of females to kept males than that used in table 1 in the DPSWG Report. This fact, combined with a rule that requires the fleet to stop fishing when the male landings limit has been reached, will prevent the fleet from directing more toward females in order to fill an overly optimistic female landing limit. If the sex ratio from the recent observed trips matches the realized sex ratio in 2011-2013, total removals under this option will be 243 mt lower than the ABC based on historical removals.

**Table 8- Option 2 for ABC with Female Landings.**

|                                  |      |
|----------------------------------|------|
| ABC Including Dead Discards      | 2991 |
| Male TAL                         | 1775 |
| Male Dead Discards               | 110  |
| Female TAL                       | 719  |
| Female Dead Discards             | 120  |
| Bycatch Dead Discards            | 24   |
| Total Removals                   | 2748 |
| Buffer or Excess compared to ABC | 243  |



**Table 9- Exploitation rates for specifications that include a 719 mt female TAL and use the sex ratio from recent observed trips with the 0.50 discard mortality rate from Table 1.**

| 07-08 Obs Trip Sex Ratio, 0.50 Disc Mort | Males | Females | Total  |
|--|-------|---------|--------|
| Total Allowable Landings                 | 1775  | 719     | 2494   |
| Discard Rate                             | 0.11  | 0.25    |        |
| Catch (mt, includes all discards)        | 1994  | 959     | 2953   |
| Discard (mt)                             | 219   | 240     | 459    |
| Discard mortality rate                   | 0.5   | 0.5     |        |
| Mortal discard directed fishery (mt)     | 110   | 120     | 229    |
| Mortal discard by-catch fisheries        |       |         | 24     |
| Landings + mortal discard (mt)           | 1885  | 839     | 2747   |
| Total biomass (mt)                       | 56443 | 74689   | 131132 |
| 90+ CW biomass (mt)                      | 38220 | 55279   | 93499  |
| F relative to total biomass              | 0.033 | 0.011   | 0.021  |
| F relative to 90+ biomass                | 0.049 | 0.015   | 0.029  |

### **ABC with Female Landings Option 3**

Option 3 for ABC including females retained in the normal course of fishing for large males uses the sex ratio from recent observed trips and a discard mortality rate of 0.25, one-half that used in Table 1 and reflecting an assumed continuing improvement in discarding practices. ABC is from ABC Option 1, which uses the historical removals calculated using the sex ratio and discard mortality rate from Table 1. The regulations would state that the fishery would close when the allowable landings of male crabs had been reached, regardless of any remaining allowable landings of females. Under these assumptions, the total removals of female crab would be 303 mt less than the ABC based on historical removals. The total removals of male crab would be 55 mt less than historical removals and total removals for both sexes would be 358 mt less than historical removals.

**Table 10- Option 3 for ABC with female allowable landings (metric tons).**

|                                  |      |
|----------------------------------|------|
| ABC Including Dead Discards      | 2991 |
| Male TAL                         | 1775 |
| Male Dead Discards               | 55   |
| Female TAL                       | 719  |
| Female Dead Discards             | 60   |
| Bycatch Dead Discards            | 24   |
| Total Removals                   | 2633 |
| Buffer or Excess compared to ABC | 358  |

**Table 11- Exploitation rates for specifications that include a 719 mt female TAL and use the sex ratio from recent observed trips with a 0.25 discard mortality rate.**

| 07-08 Obs Trip Sex Ratio, 0.25 Disc Mort | Males | Females | Total  |
|--|-------|---------|--------|
| Total Allowable Landings                 | 1775  | 719     | 2494   |
| Discard Rate                             | 0.11  | 0.25    |        |
| Catch (mt, includes all discards)        | 1994  | 959     | 2953   |
| Discard (mt)                             | 219   | 240     | 459    |
| Discard mortality rate                   | 0.25  | 0.25    |        |
| Mortal discard directed fishery (mt)     | 55    | 60      | 115    |
| Mortal discard by-catch fisheries        |       |         | 24     |
| Landings + mortal discard (mt)           | 1830  | 779     | 2633   |
| Total biomass (mt)                       | 56443 | 74689   | 131132 |
| 90+ CW biomass (mt)                      | 38220 | 55279   | 93499  |
| F relative to total biomass              | 0.032 | 0.010   | 0.020  |
| F relative to 90+ biomass                | 0.048 | 0.014   | 0.028  |

#### **ABC with Female Landings Option 4**

Table 12 and Table 13 provide the corresponding values associated with zero female total allowable landings if the sex ratio going forward matches that recorded on recent observed trips and the discard mortality rate is 0.25.

**Table 12- Total removals with zero female TAL using sex ratio from recent observed trips and a discard mortality rate of 0.25.**

|                                  |      |
|----------------------------------|------|
| ABC Including Dead Discards      | 2991 |
| Male TAL                         | 1775 |
| Male Dead Discards               | 55   |
| Female TAL                       | 0    |
| Female Dead Discards             | 240  |
| Bycatch Dead Discards            | 24   |
| Total Removals                   | 2094 |
| Buffer or Excess compared to ABC | 897  |

**Table 13- Exploitation rates with zero female TAL using sex ratio from recent observed trips and a discard mortality rate of 0.25.**

| 07-08 Obs Trip Sex Ratio, 0.25 Disc Mort | Males | Females | Total  |
|--|-------|---------|--------|
| Total Allowable Landings                 | 1775  | 0       | 1775   |
| Discard Rate                             | 0.11  | 0.25    |        |
| Catch (mt, includes all discards)        | 1994  | 959     | 2953   |
| Discard (mt)                             | 219   | 959     | 1178   |
| Discard mortality rate                   | 0.25  | 0.25    |        |
| Mortal discard directed fishery (mt)     | 55    | 240     | 294    |
| Mortal discard by-catch fisheries        |       |         | 24     |
| Landings + mortal discard (mt)           | 1830  | 240     | 2093   |
| Total biomass (mt)                       | 56443 | 74689   | 131132 |
| 90+ CW biomass (mt)                      | 38220 | 55279   | 93499  |
| F relative to total biomass              | 0.032 | 0.003   | 0.016  |
| F relative to 90+ biomass                | 0.048 | 0.004   | 0.022  |



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