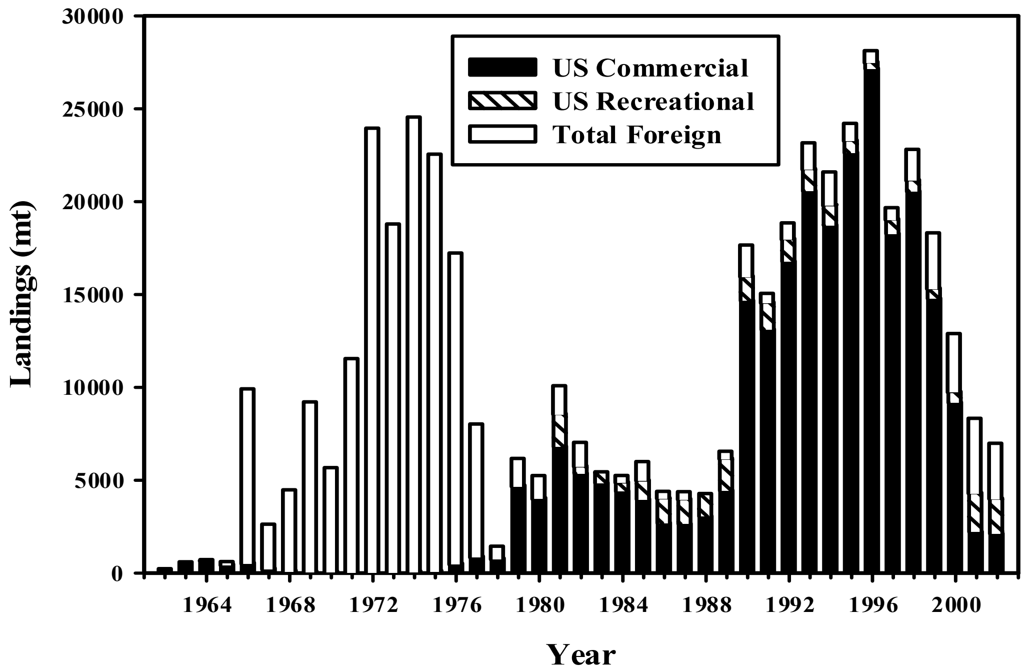


Figure B4.1. Commercial landings (metric tons) and recreational catch of spiny

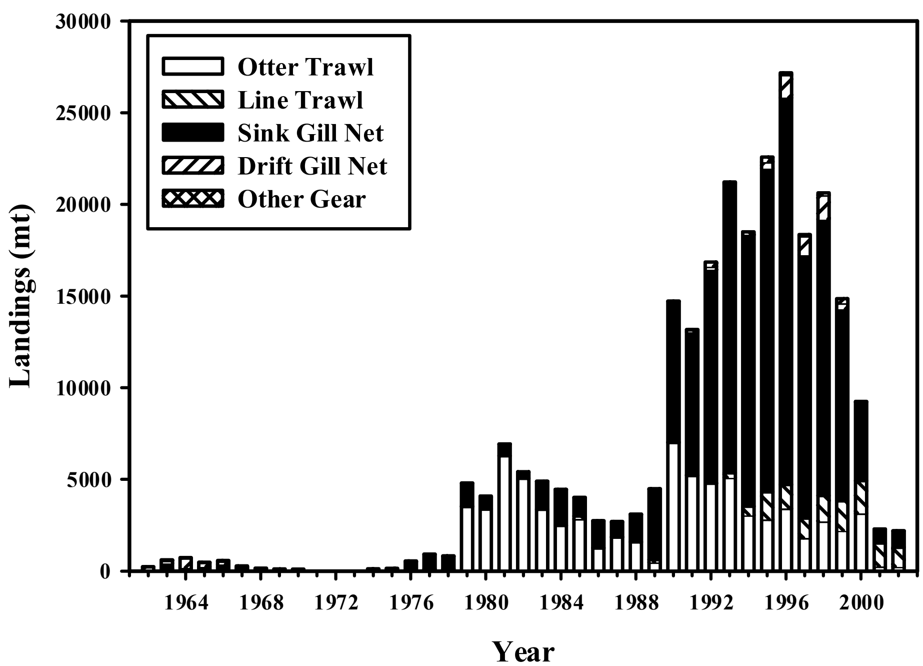
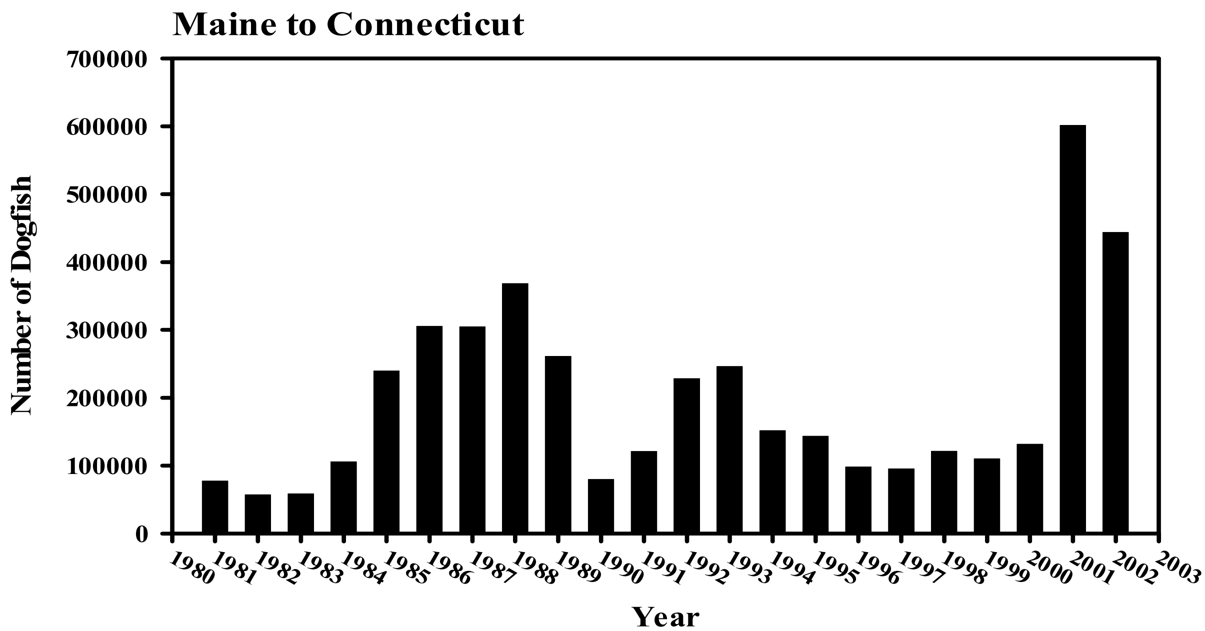
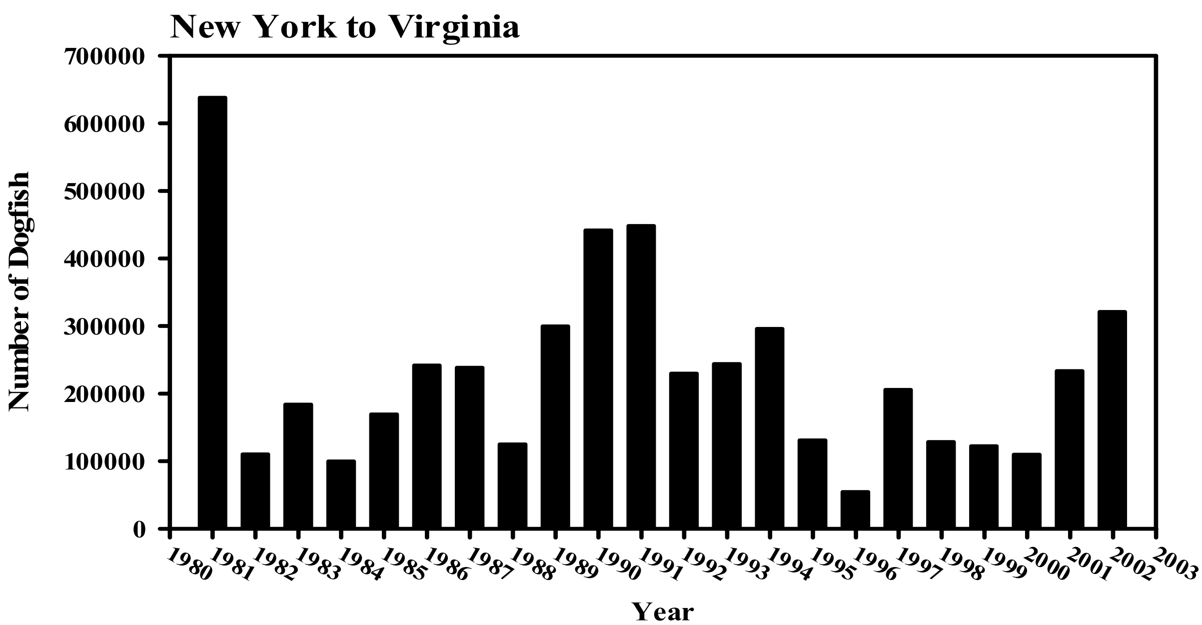


Figure B4.2. U. S. Landings of spiny dogfish from NAFO subareas 2-6 by gear type, 1962-2002.





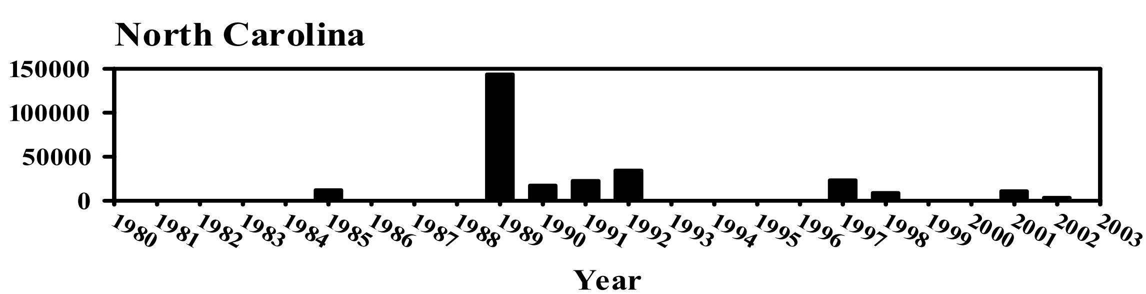
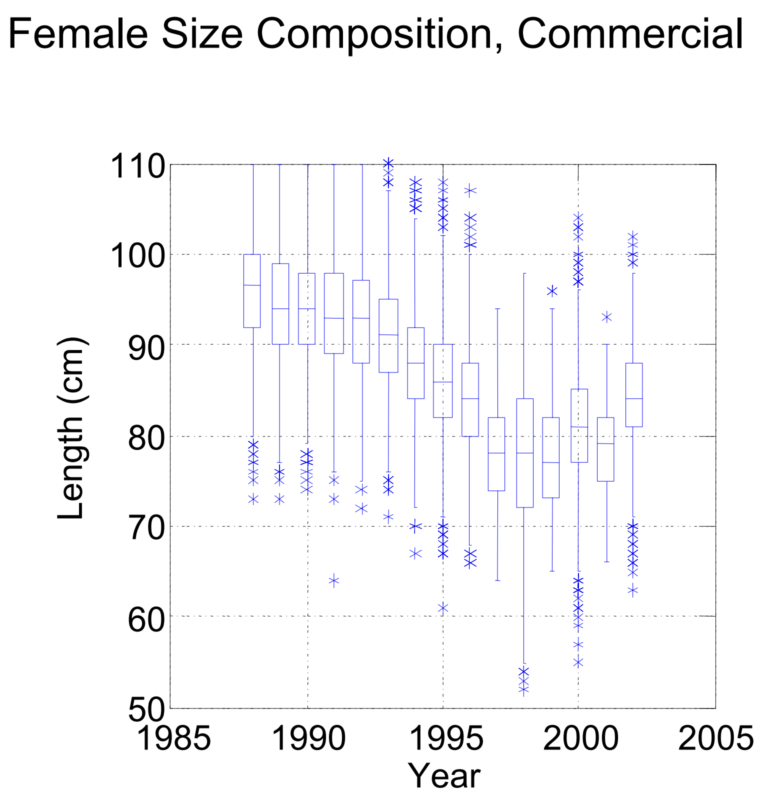


Table B4.3. Estimated total recreational catch of spiny dogfish (numbers of fish) by geographical area, 1981-2002.



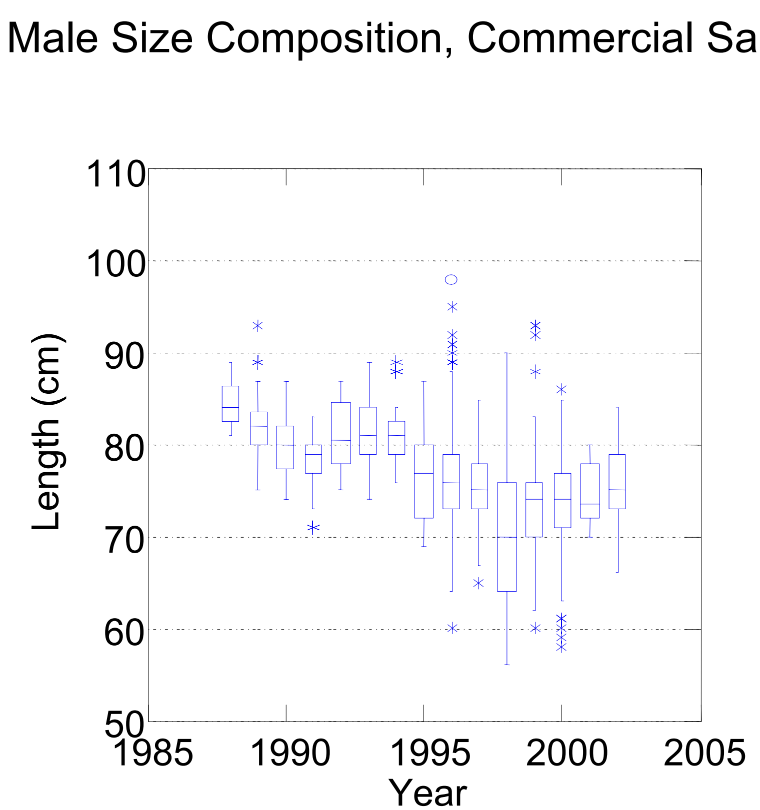
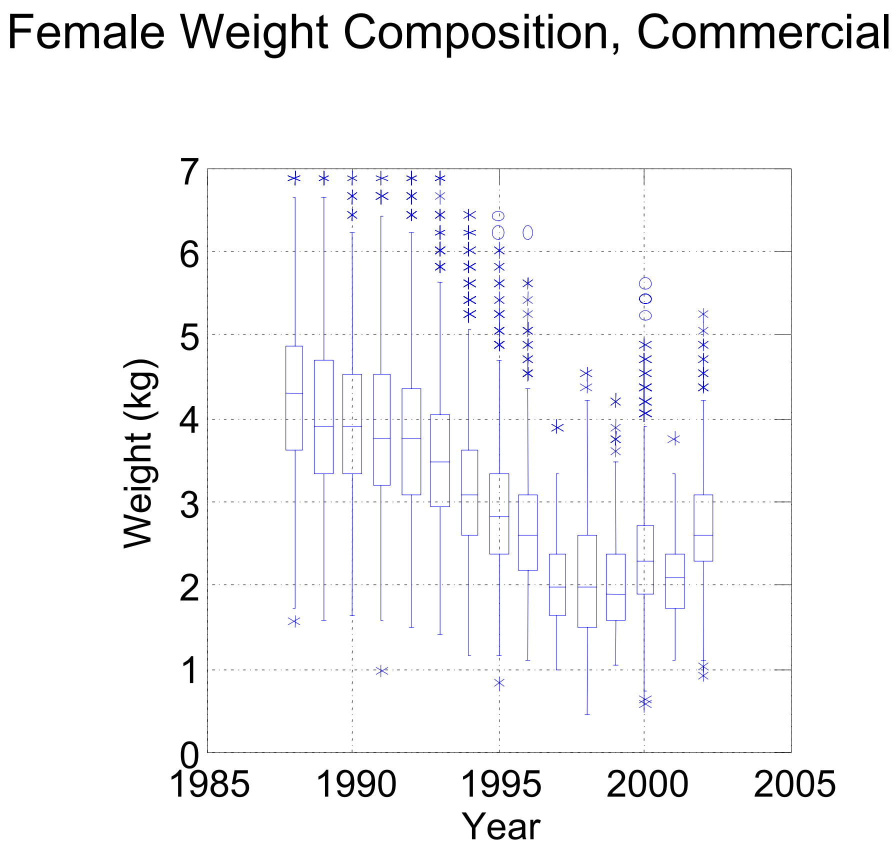


Fig. B4.4 Box plots of length (cm) frequency of female and male dogfish in commercial fishery samples.



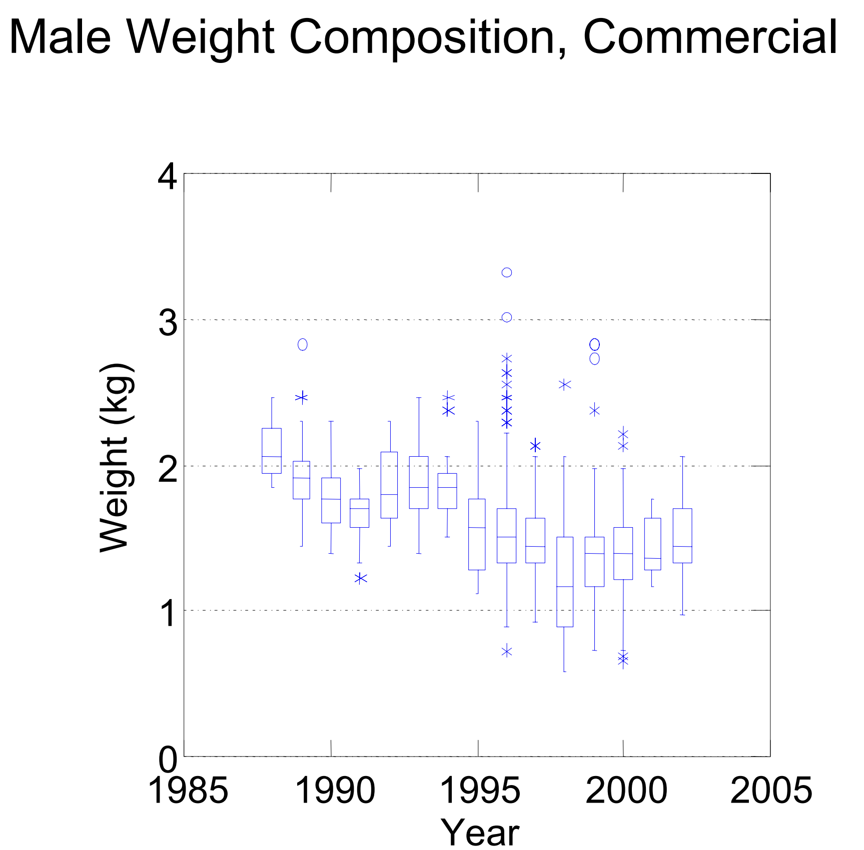
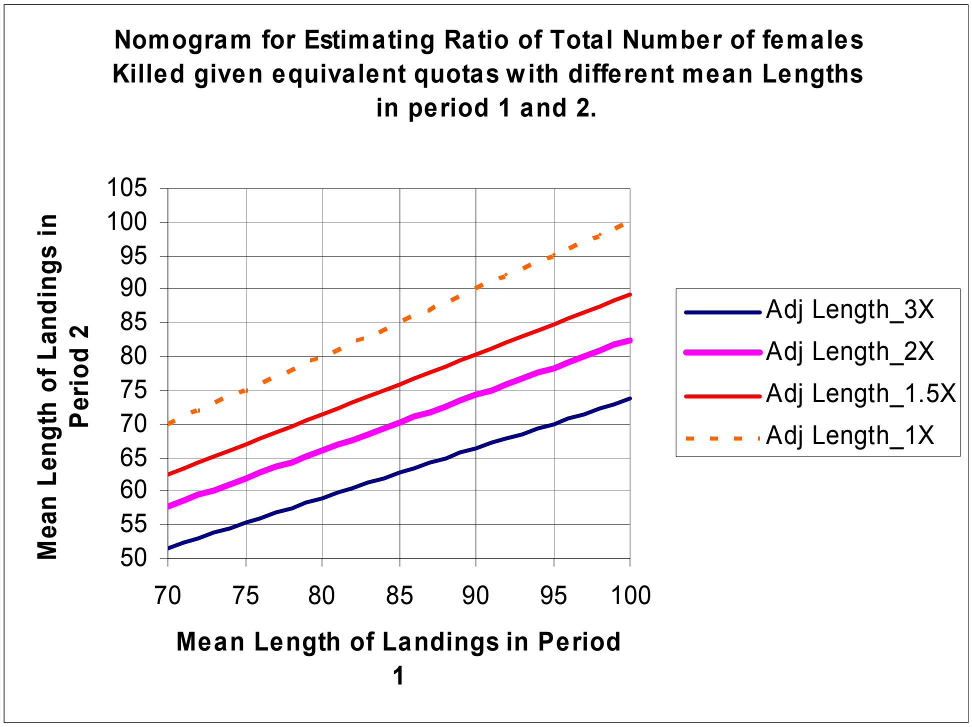


Fig. B4.5 Box plots of average weight (kg) of female and male dogfish in commercial fishery samples.



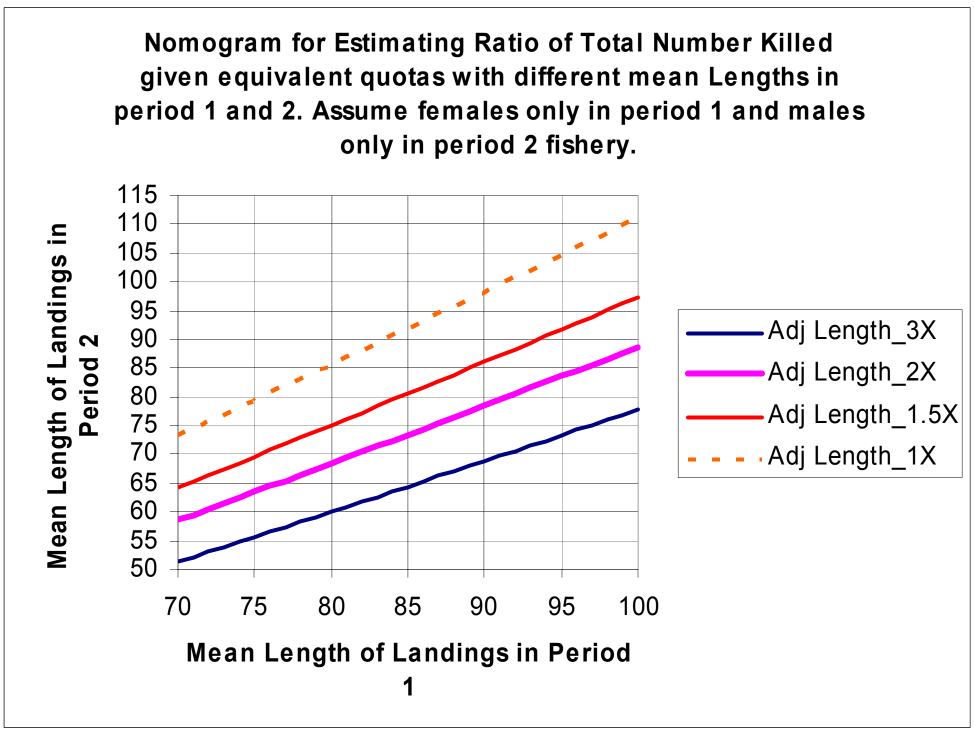
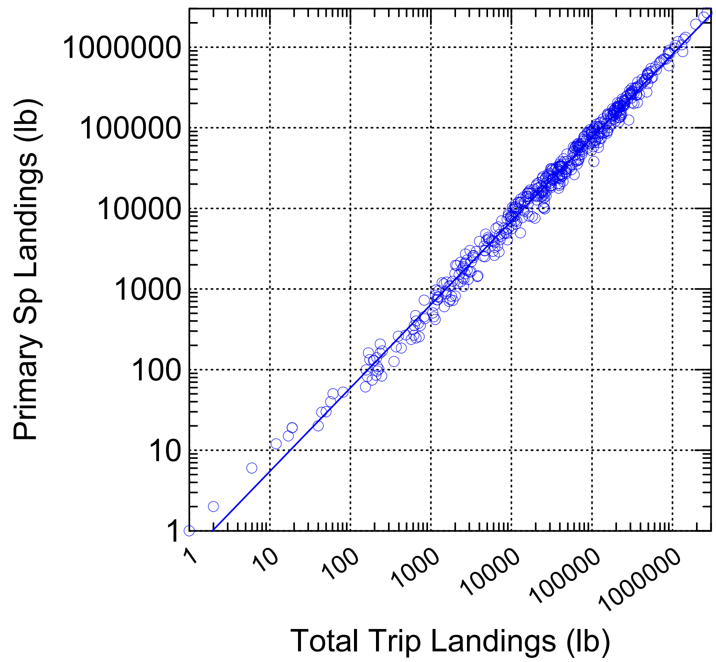


Fig. B4.6 Nomograms illustrating the increase in numbers of dogfish killed with alternative average sizes of dogfish in two landings periods.

All Gears and Species: Primary Sp.Group vs Tot Landings (lb)



All Gears and Species: Secondary Sp.Group vs Tot Landings (lb)

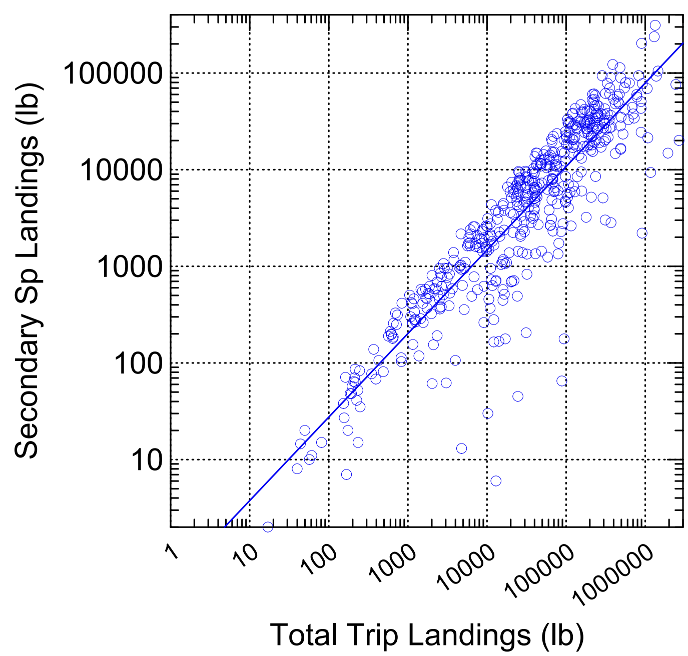
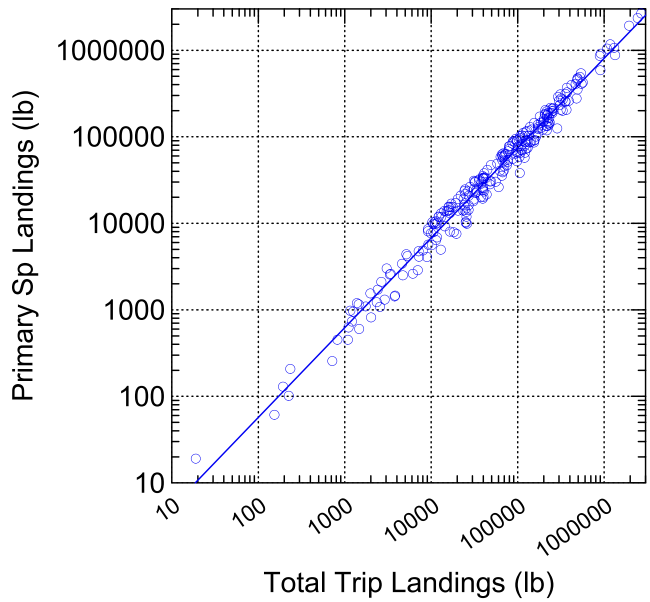


Fig B4.7. Relationship between total landings of all species and the landings of the primary species group (top) and secondary species group (bottom) on commercial vessel trips. At sea observers were onboard. All gears combined.

Trawls, All Species: Primary Sp.Group vs Tot Landings (lb)



Trawls, All Species: Secondary Sp.Group vs Tot Landings (lb)

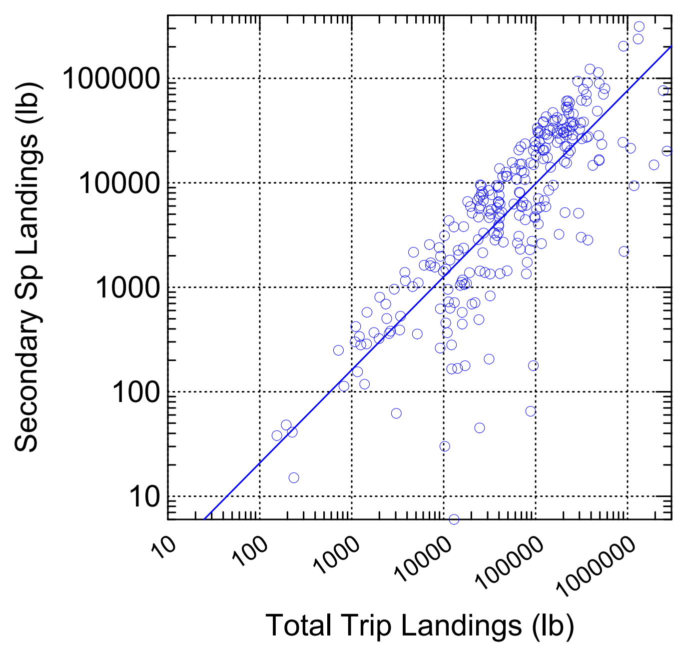
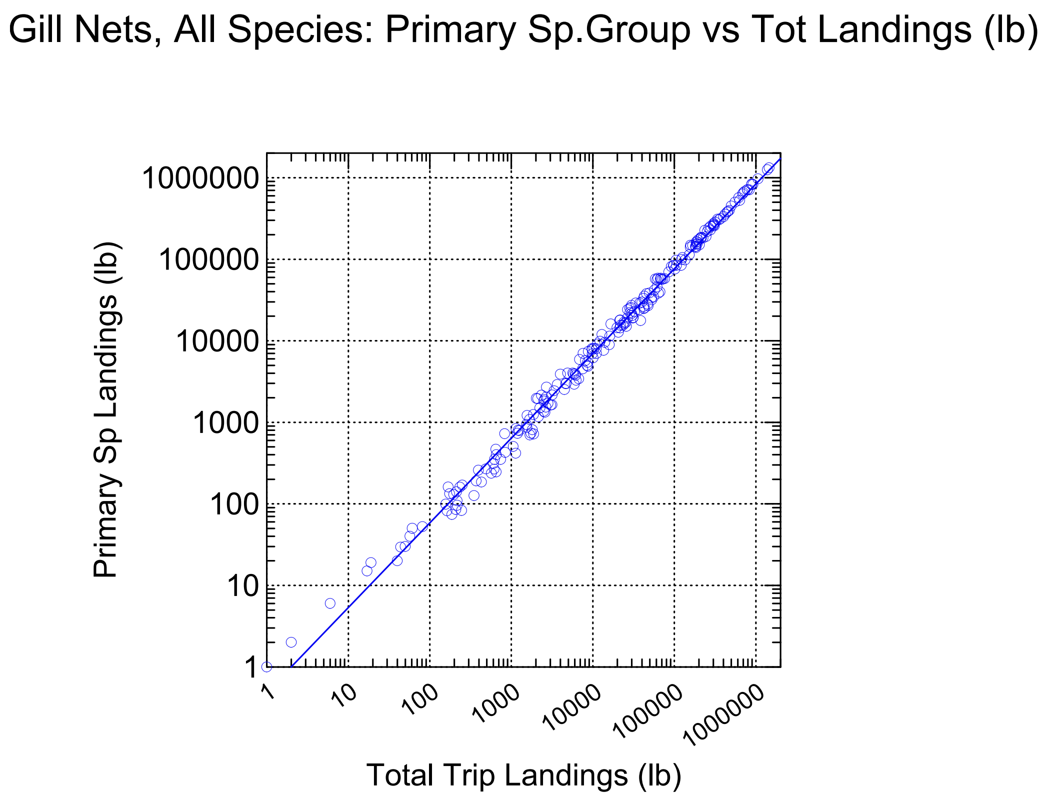


Fig B4.8. Relationship between total landings of all species and the landings of the primary species group (top) and secondary species group (bottom) on commercial vessel trips using trawls. At sea observers were onboard



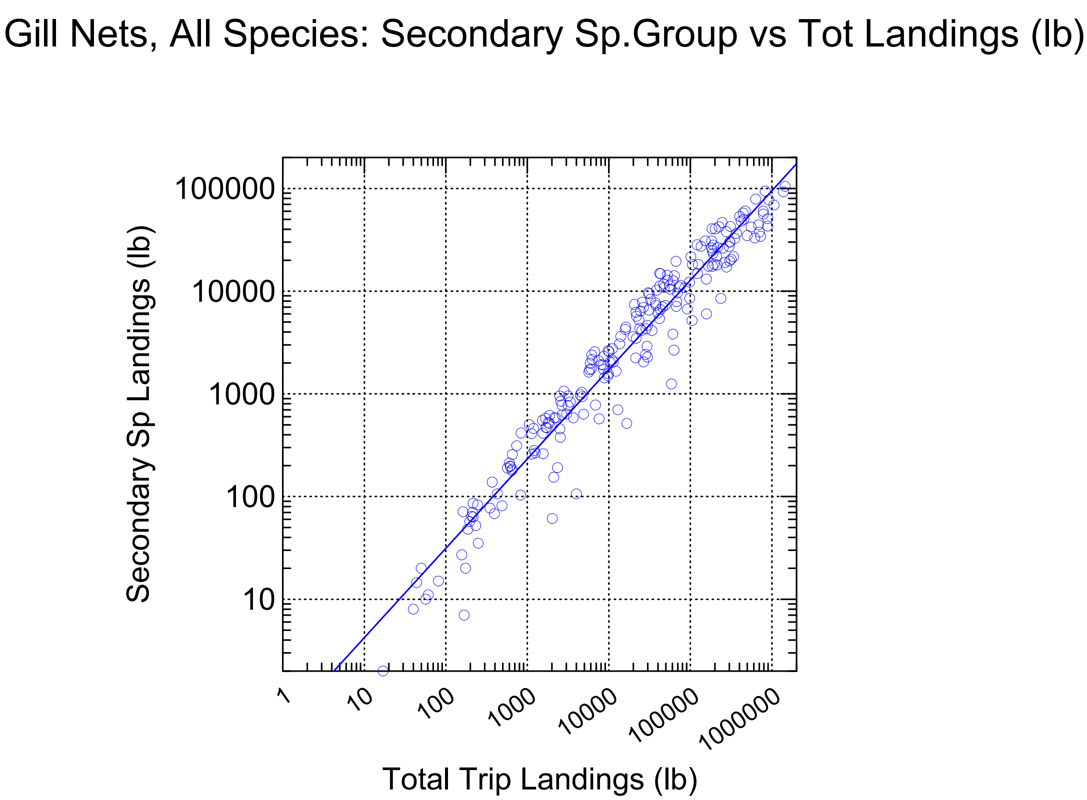


Fig B4.9. Relationship between total landings of all species and the landings of the primary species group (top) and secondary species group (bottom) on commercial vessel trips using gill nets. At sea observers were onboard

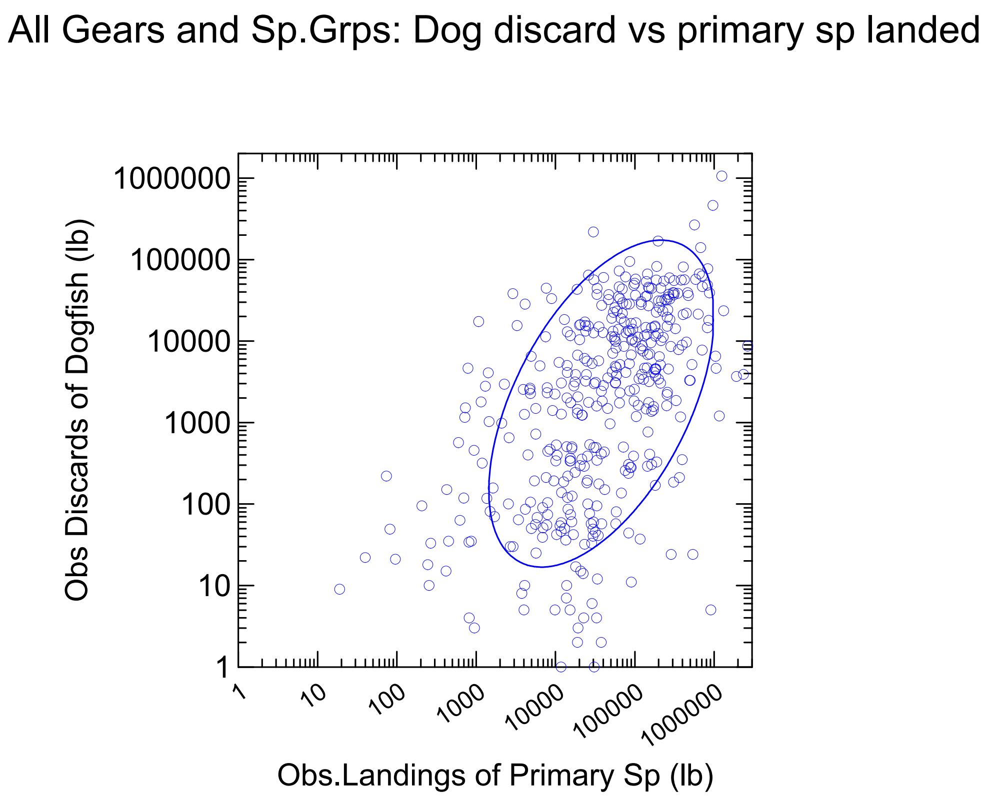
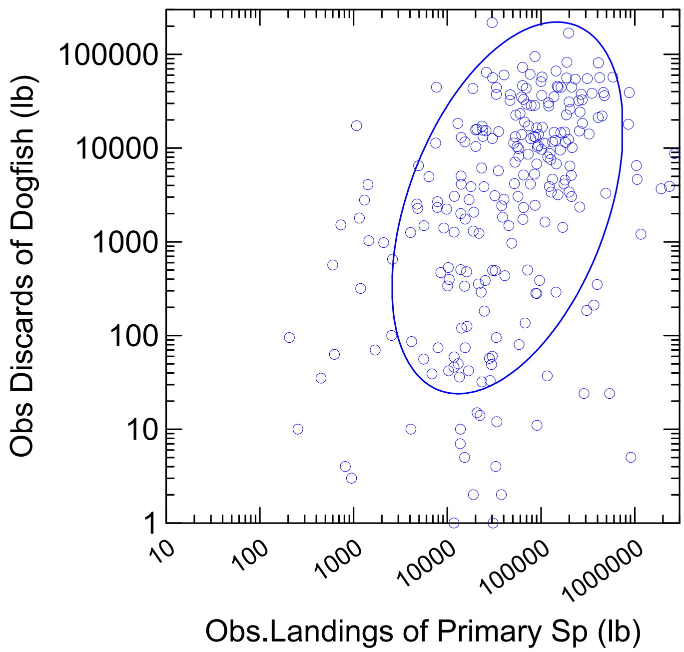


Fig. B4.10 Relationship between total dogfish discards and total landings of primary species group on commercial vessels with at sea observers on board. Each point represents an individual trip, 1989-2002. All gears and species groups combined. Confidence ellipse represents 0.68 probability level.

Trawl Gear and Sp.Grps: Dog discard vs primary sp landed



Gill Net Gear and Sp.Grps: Dog discard vs primary sp landed

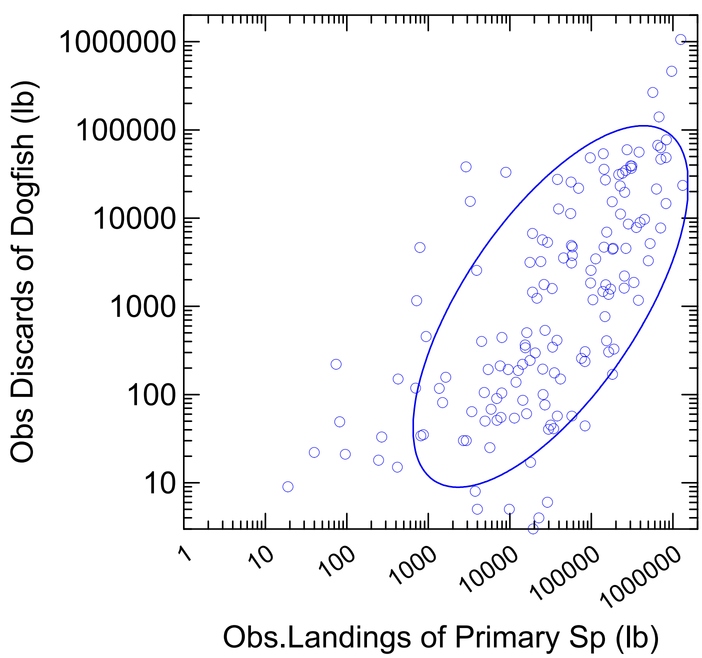
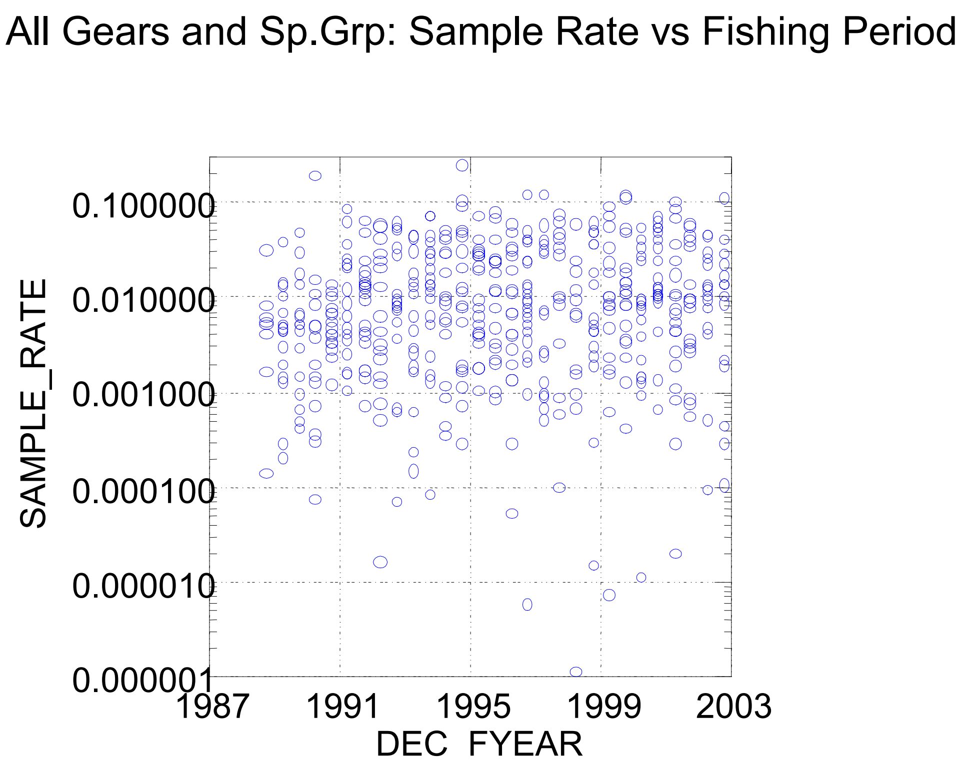


Fig. B4.11 Relationship between total dogfish discards and total landings of primary species group on commercial vessels with at sea observers on board. Each point represents an individual trip, 1989-2002. All species groups combined. Trawl gear (top panel); gill net gear (bottom panel) . Confidence ellipse represents 0.68 probability level.



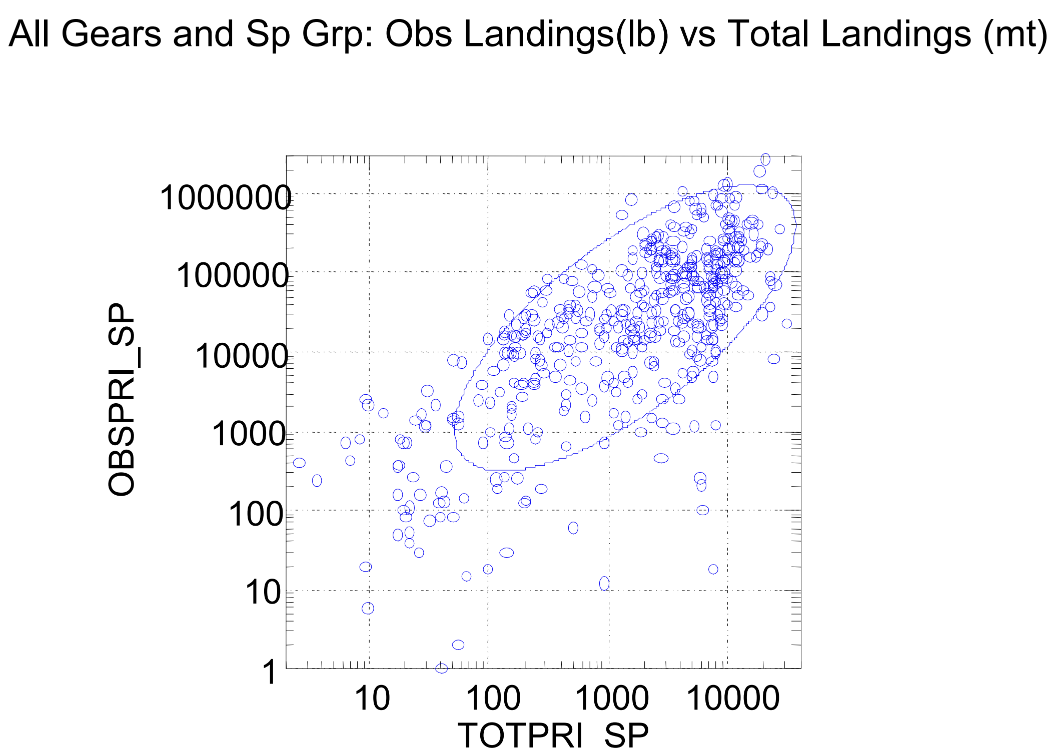
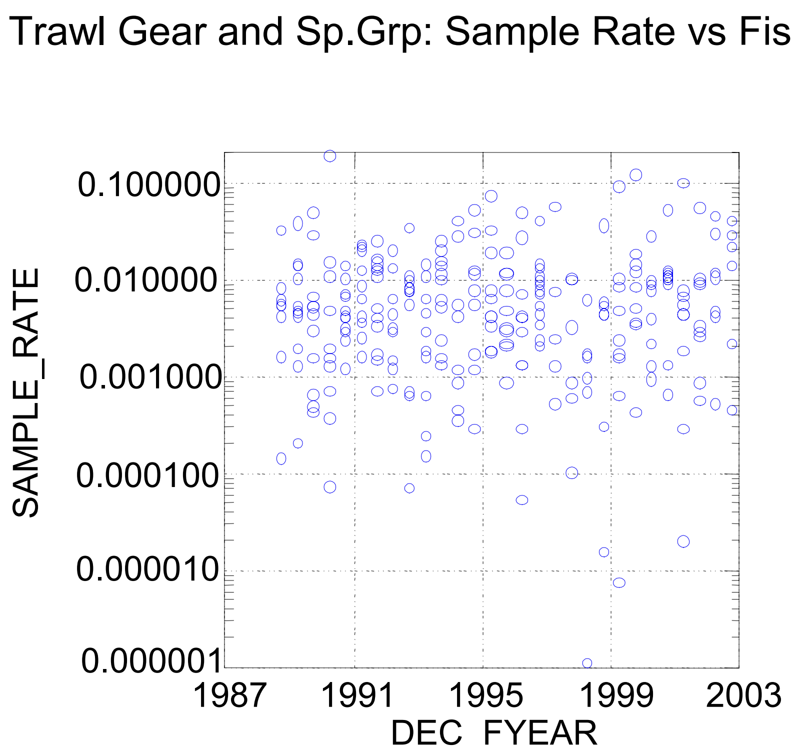


Fig. B4.12 Estimated sampling rate by month (denoted as decimal year) for each species group (top). Bottom panel illustrates relationship between total observed landings of primary species groups and gear groups and total landings those groups in commercial dealer database. Landings on X axis are in mt. Observed landings on Y axis are in pounds. Confidence ellipse represents 0.68 probability level.



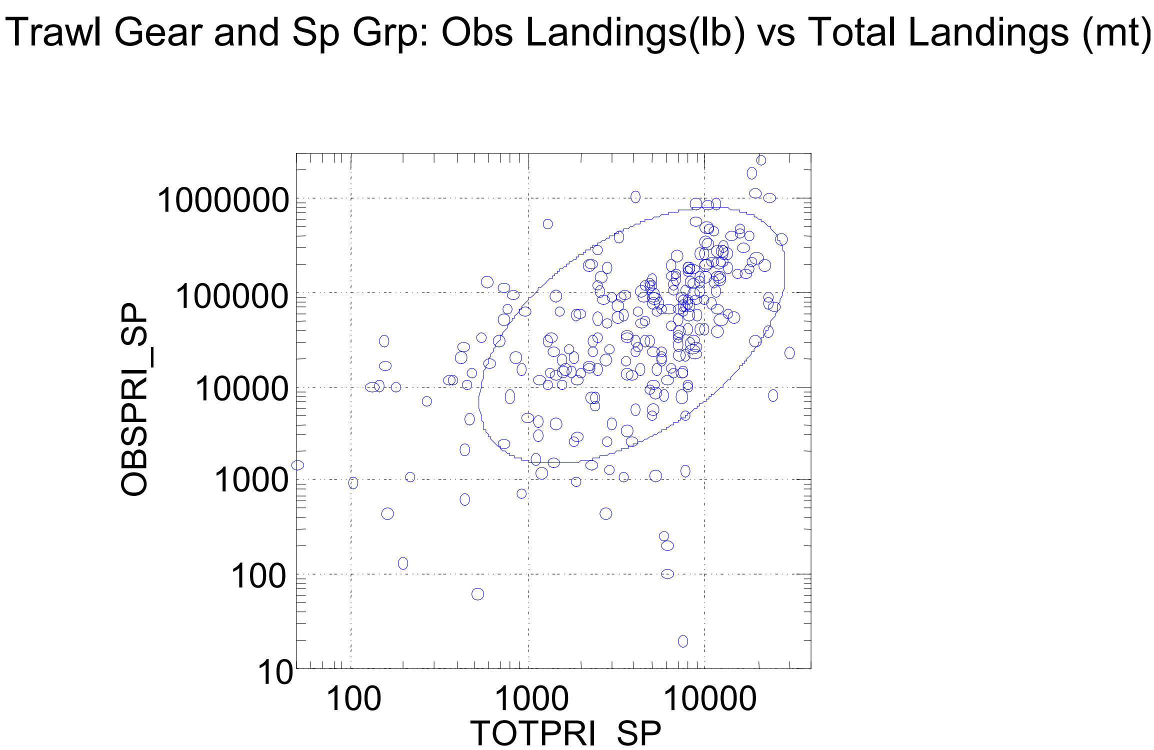
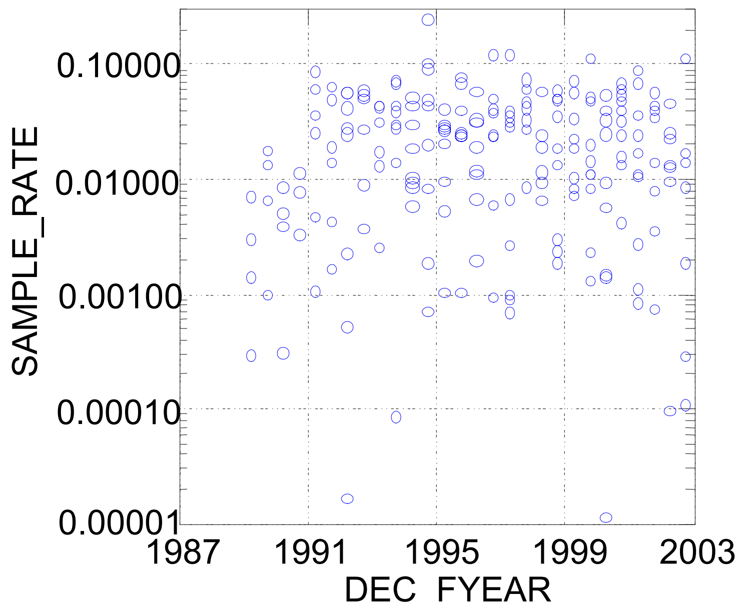


Fig. B4.13 Estimated sampling rate by month (denoted as decimal year) for each species group (top). Bottom panel illustrates relationship between total observed landings of primary species groups and total landings those groups in commercial dealer database. Landings on X axis are in mt. Observed landings on Y axis are in pounds. Only trawl gear. Confidence ellipse represents 0.68 probability level.

Gill Net Gear and Sp.Grp: Sample Rate vs Fishing Period



Gill Net Gear and Sp Grp: Obs Landings(lb) vs Total Landings (mt)

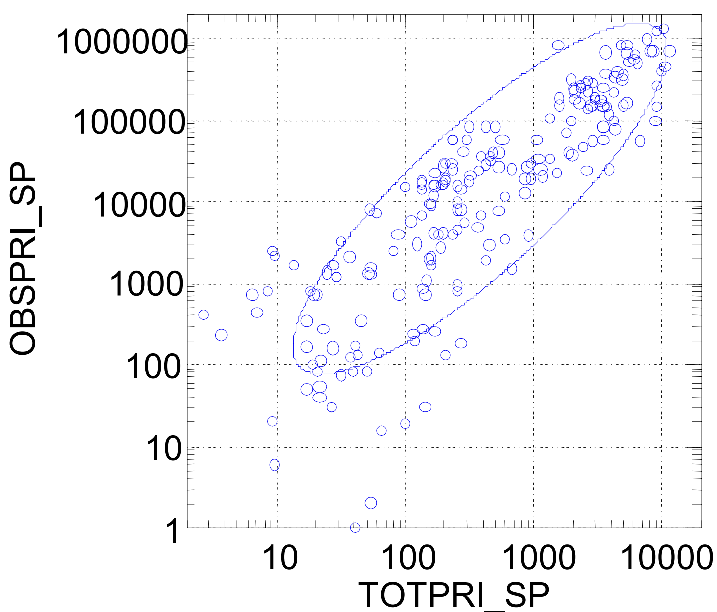
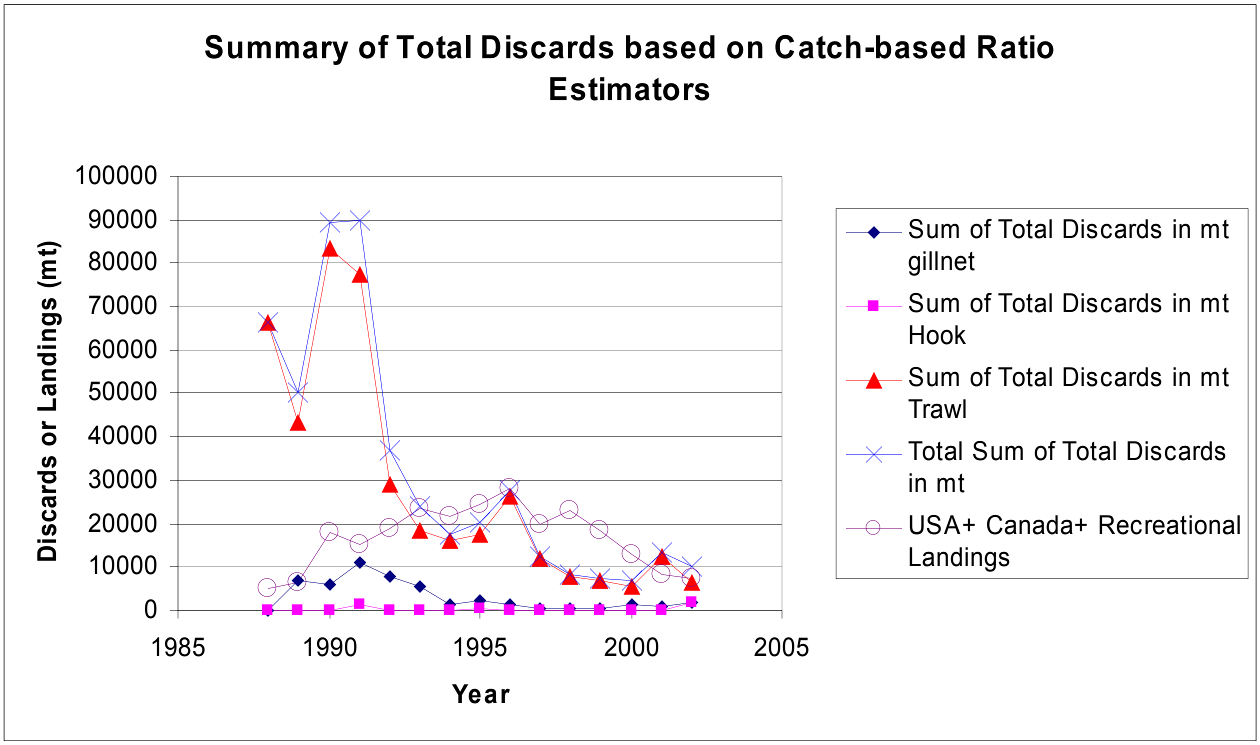


Fig. B4.14 Estimated sampling rate by month (denoted as decimal year) for each species group (top). Bottom panel illustrates relationship between total observed landings of primary species groups and total landings those groups in commercial dealer database. Landings on X axis are in mt. Observed landings on Y axis are in pounds. Only gill net gear. Confidence ellipse represents 0.68 probability level.



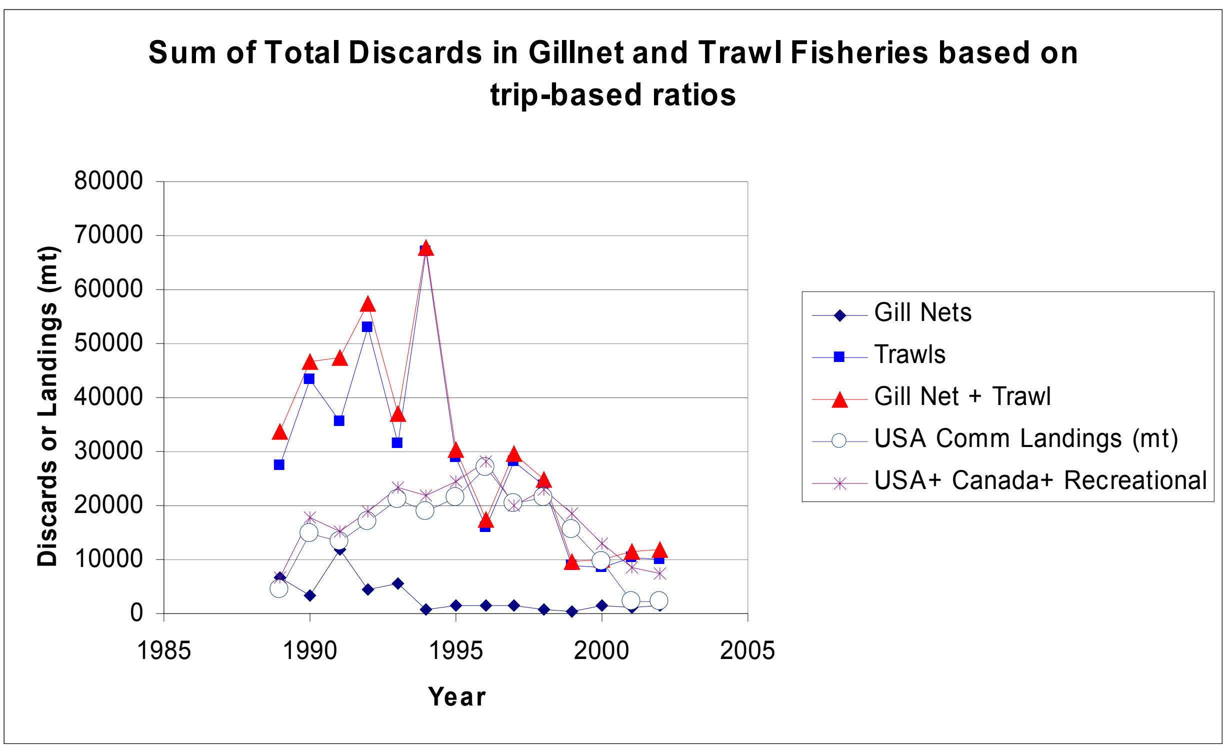
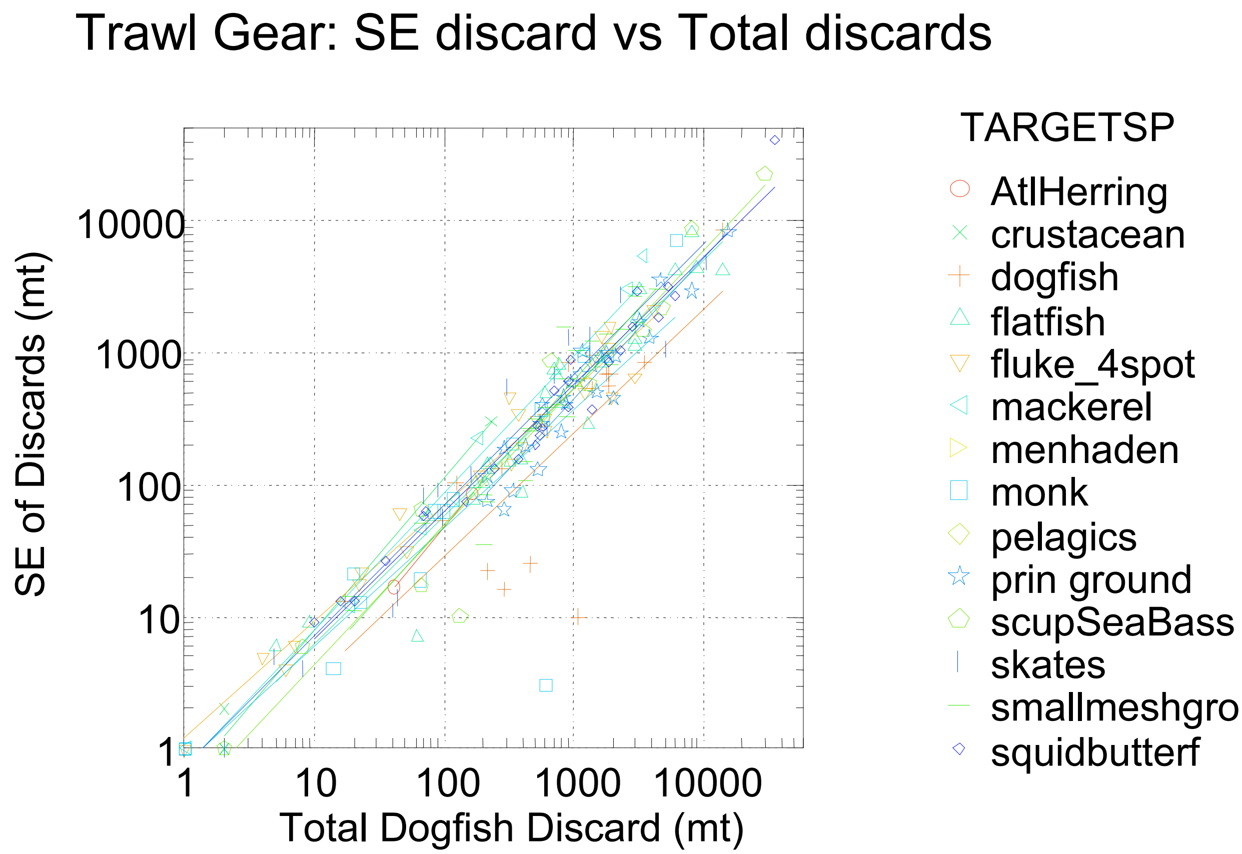


Fig. B4.15 Summary of total discard estimates based on catch ratio method (top) and comparisons with total landings in US, Canada and recreational fisheries, 1988-2002 fishing years. Bottom panel represents comparable estimates based on trip ratio estimator.



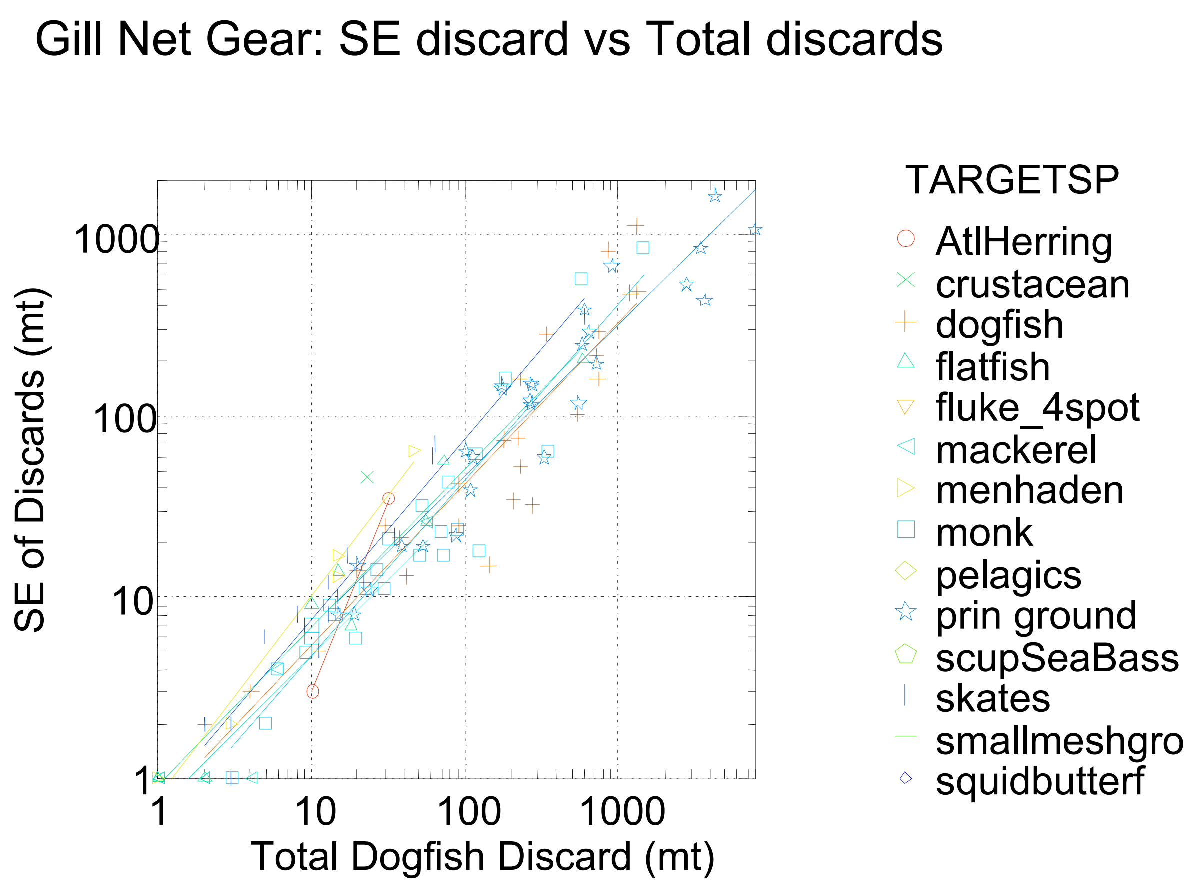


Fig. B4.16 Relationship between standard error of discard estimate and total discards by species group for trawl (top) and gill net (bottom) fisheries. All years combined.

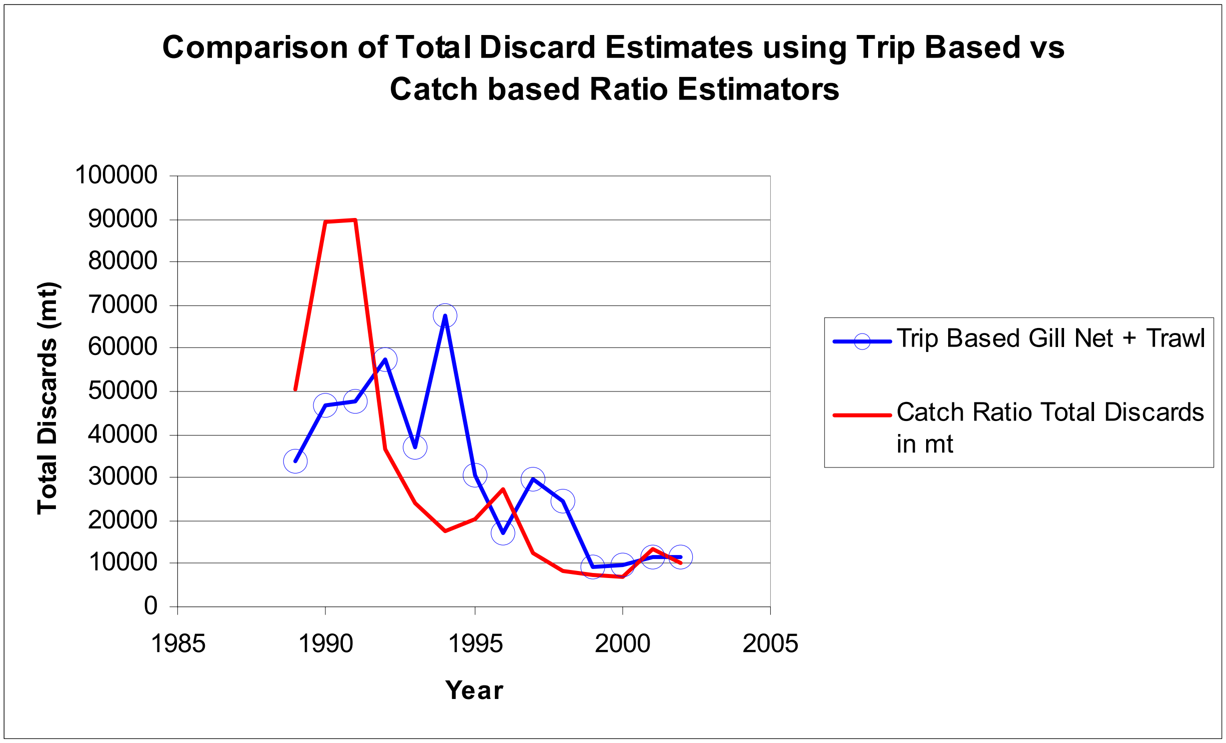


Fig. B4.17 Comparison of total discard estimates using catch ratio method with discard estimates using the trip-ratio method. Trip-based ratio estimator includes only gill net and trawl gear.

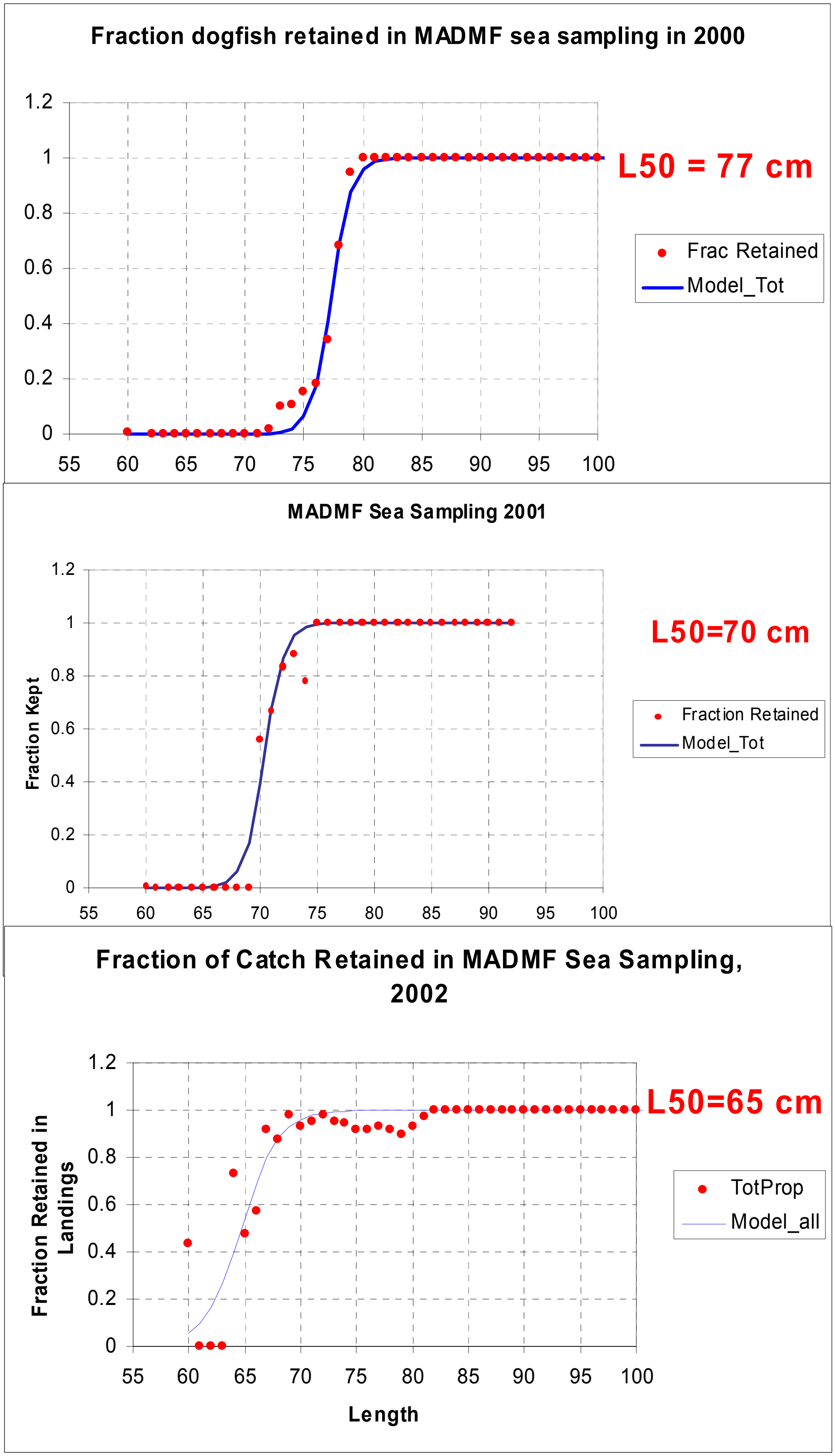


Fig. B4.18. Results of MADMF sea sampling data, 2000-02. Functions represent fits of logistic model to fraction retained by size class.

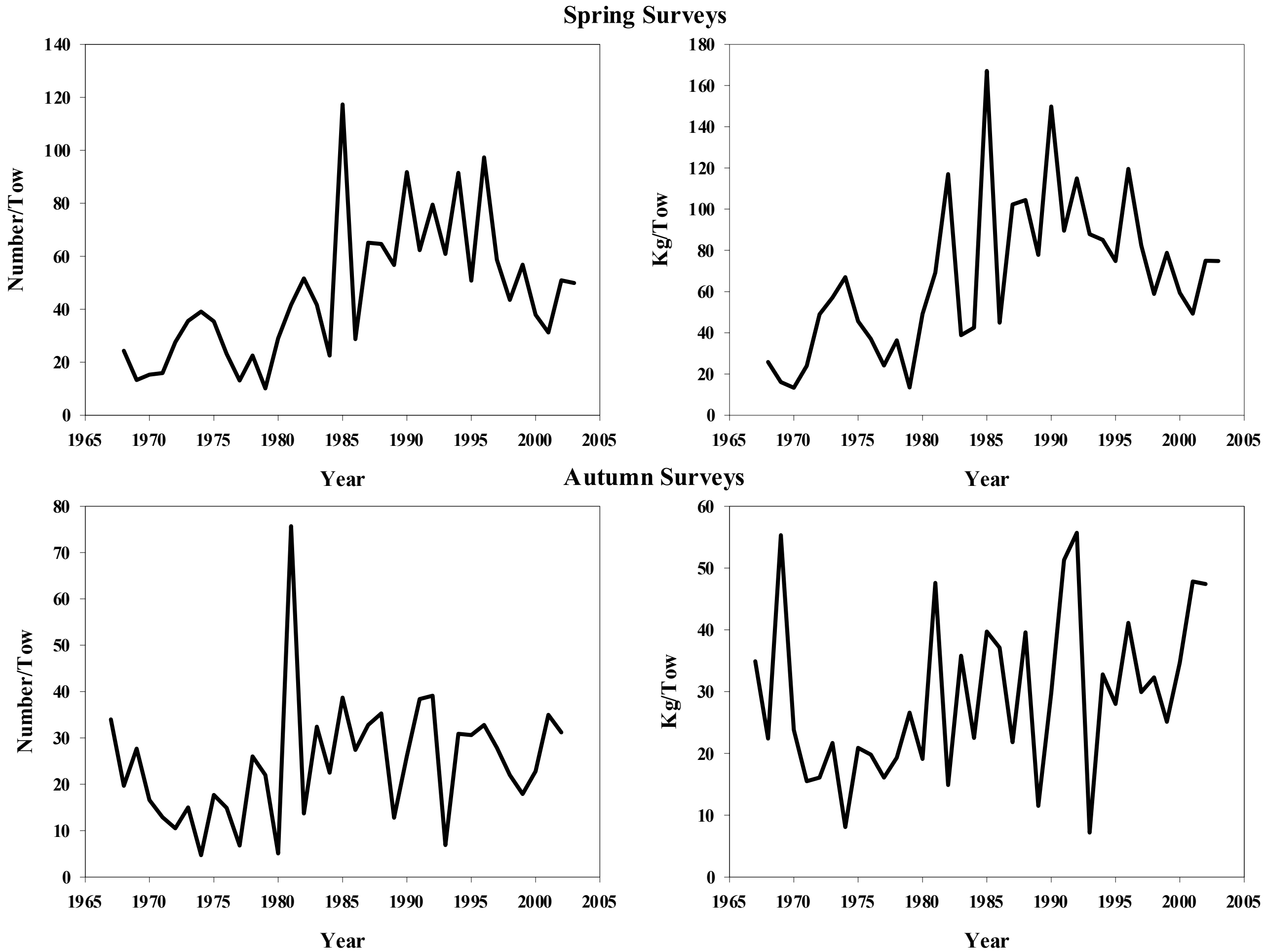


Figure B5.1. Abundance (stratified mean catch per tow in numbers) and biomass (stratified mean catch per tow in kilograms) indices of spiny dogfish from the NEFSC spring survey, 1968-2003, and autumn survey, 1967-2002 (Offshore strata 1-30, 33-40, 61-76.

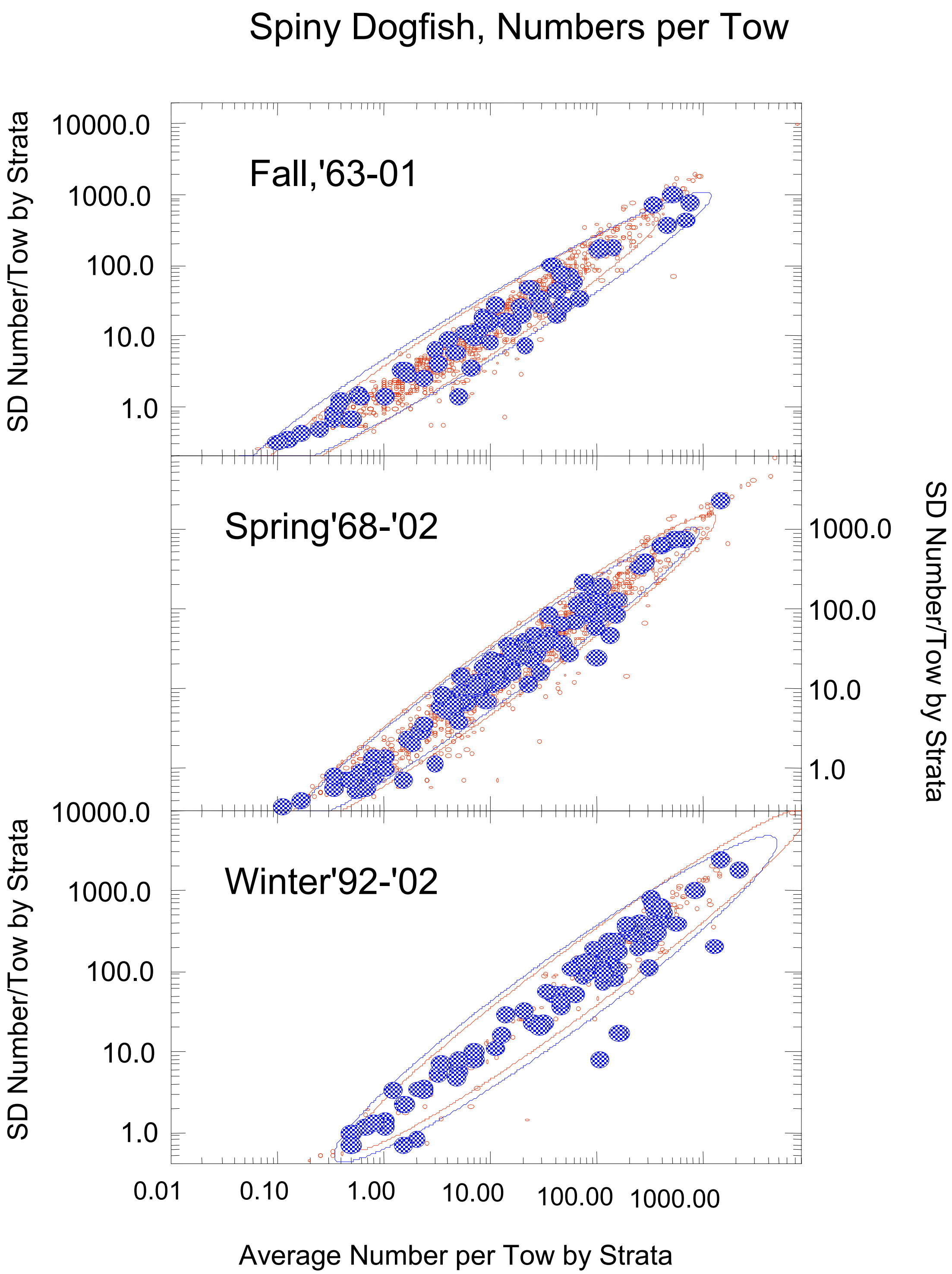


Figure B5.2. Standard deviation of catch in numbers vs. mean catch (#/tow) for Spiny Dogfish in NEFSC fall, spring and winter trawl surveys. Each dot represents a stratum. Small open dots represent data from 1999 and earlier, large solid circles represent data from 2000-02. Confidence ellipses (95%) are drawn for pre and post warp offset treatment period.

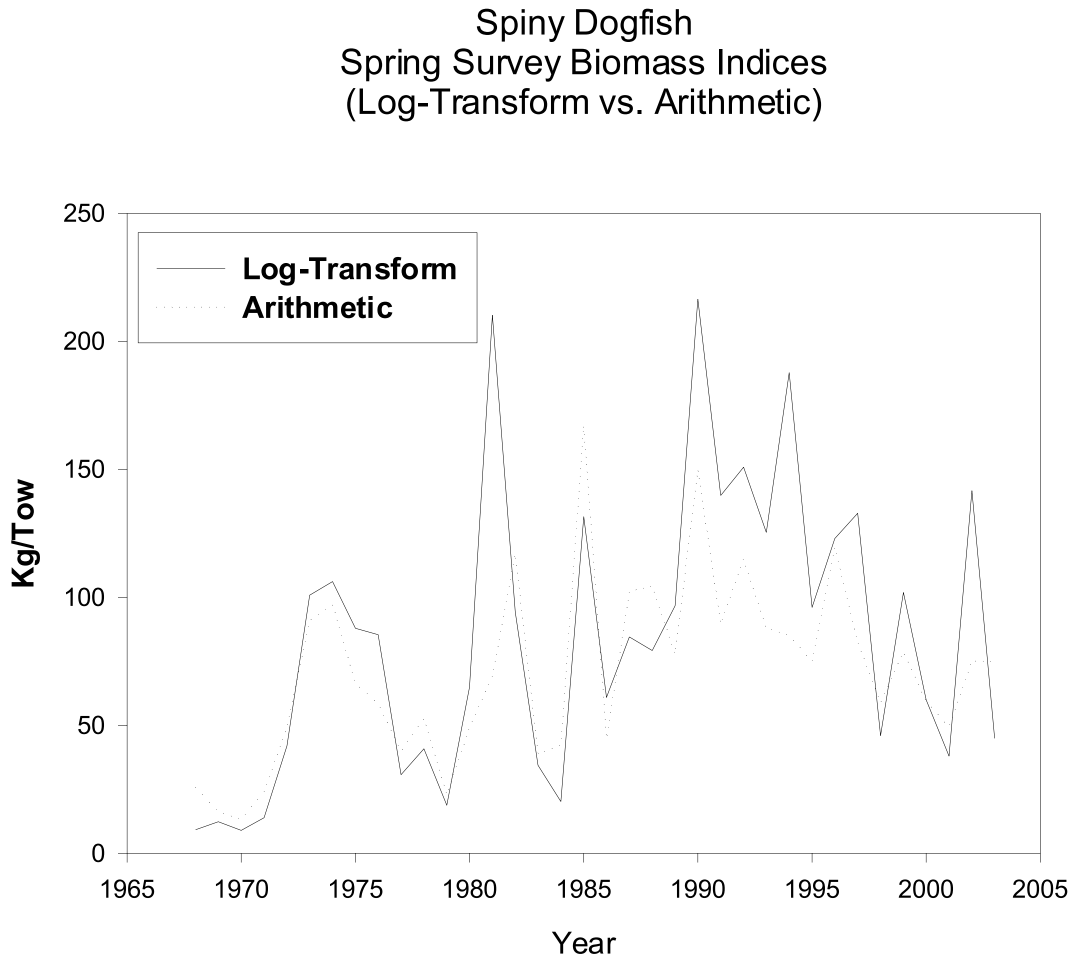


Figure B5.3. Biomass (stratified mean catch per tow in kilograms) indices of spiny dogfish comparing arithmetic and log-transformed means from the NEFSC spring survey, 1968-2003 (Offshore strata 1-30, 33-40, 61-76.

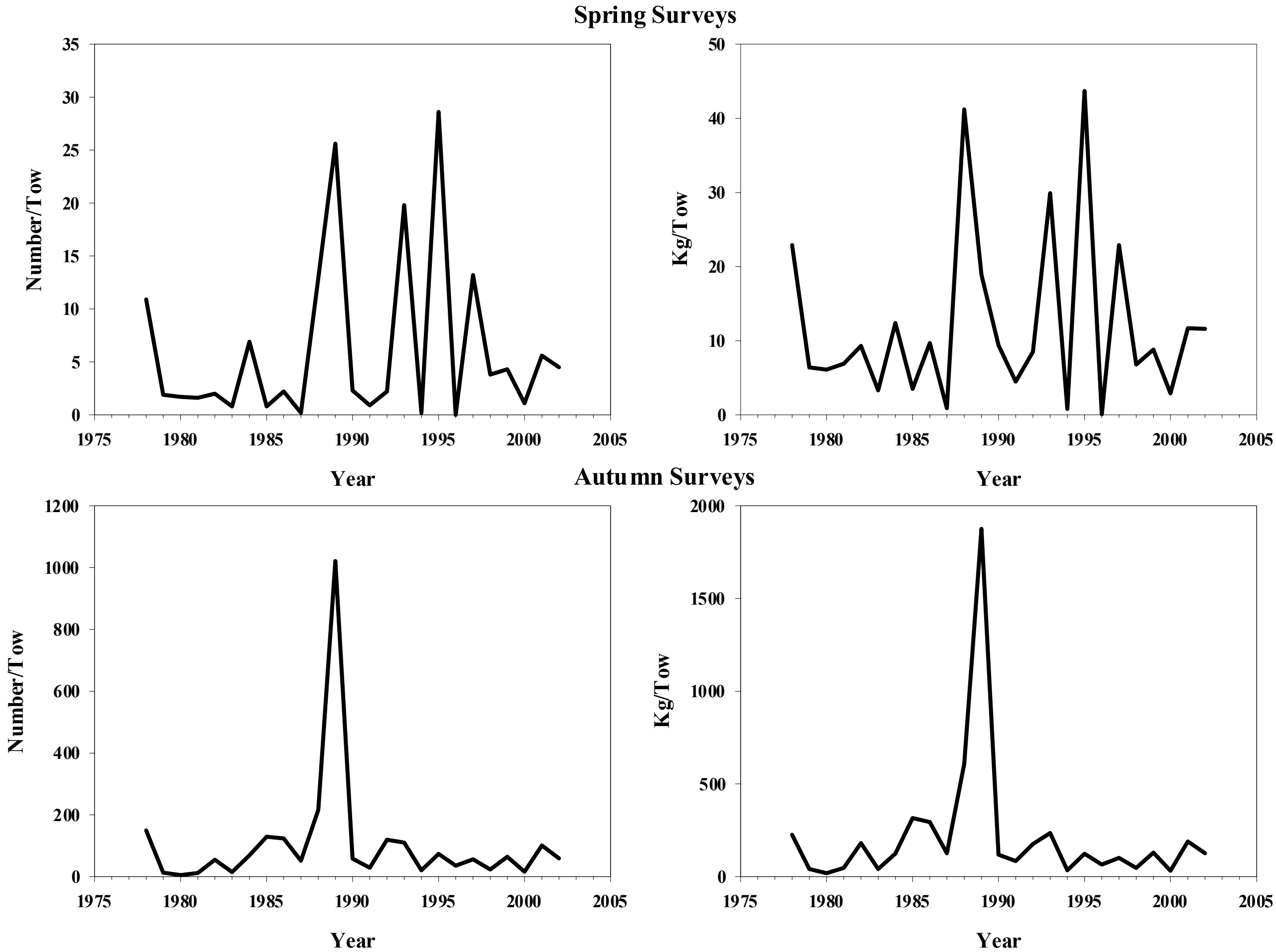
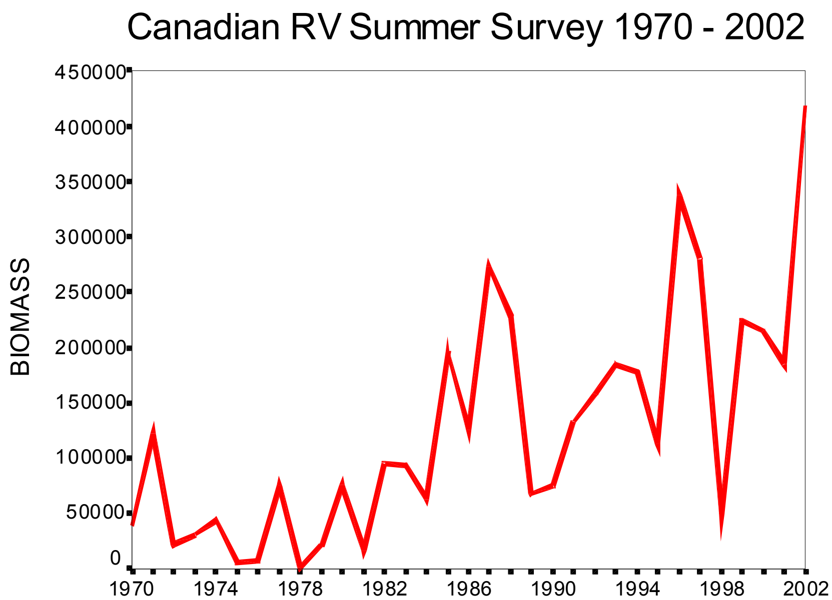
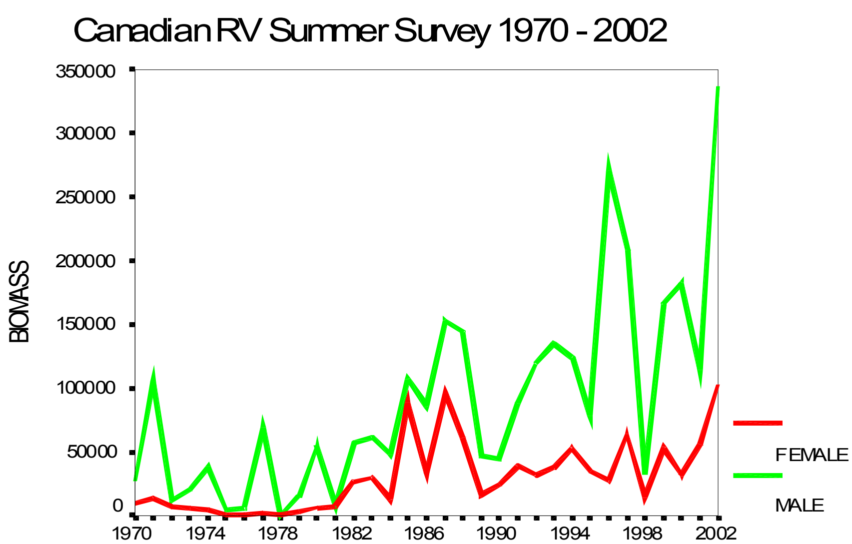


Figure B5.4 Abundance (mean catch per tow in numbers) and biomass (mean catch per tow in kilograms) indices of spiny dogfish from the Massachusetts spring and autumn surveys, 1978-2002.





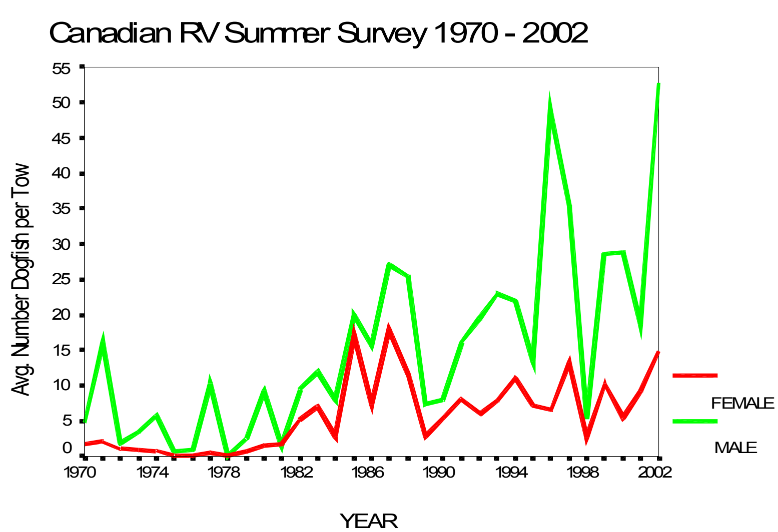


Fig. B5.5 Summary of abundance trends for spiny dogfish captured in Canadian R/V trawl surveys. Data provided courtesy of Steve Campana, DFO, Halifax.

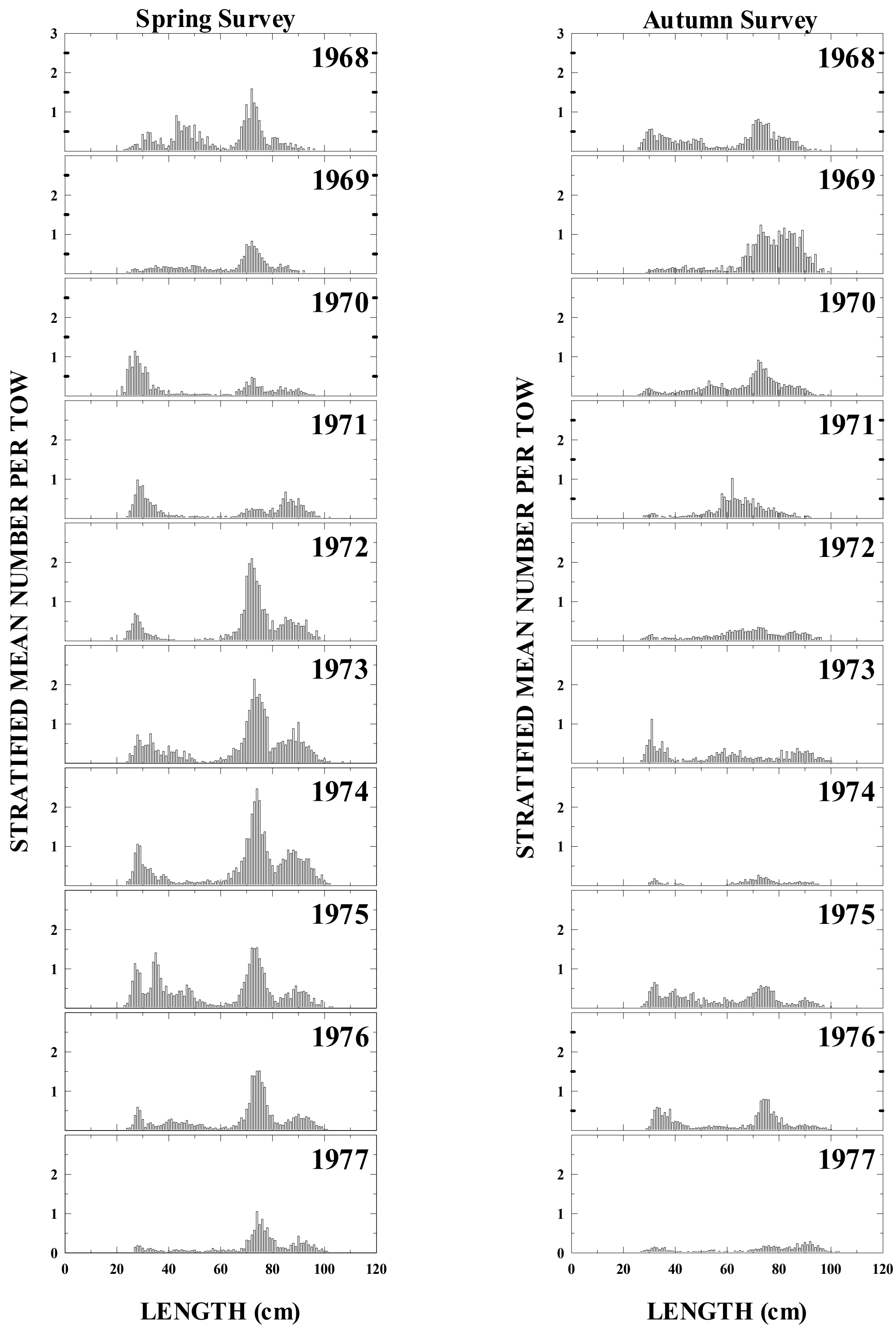


Figure B5.6.a. Length composition of spiny dogfish from the NEFSC spring and autumn bottom trawl survey, 1968-1977 (Offshore strata 1-30, 33-40, 61-76).

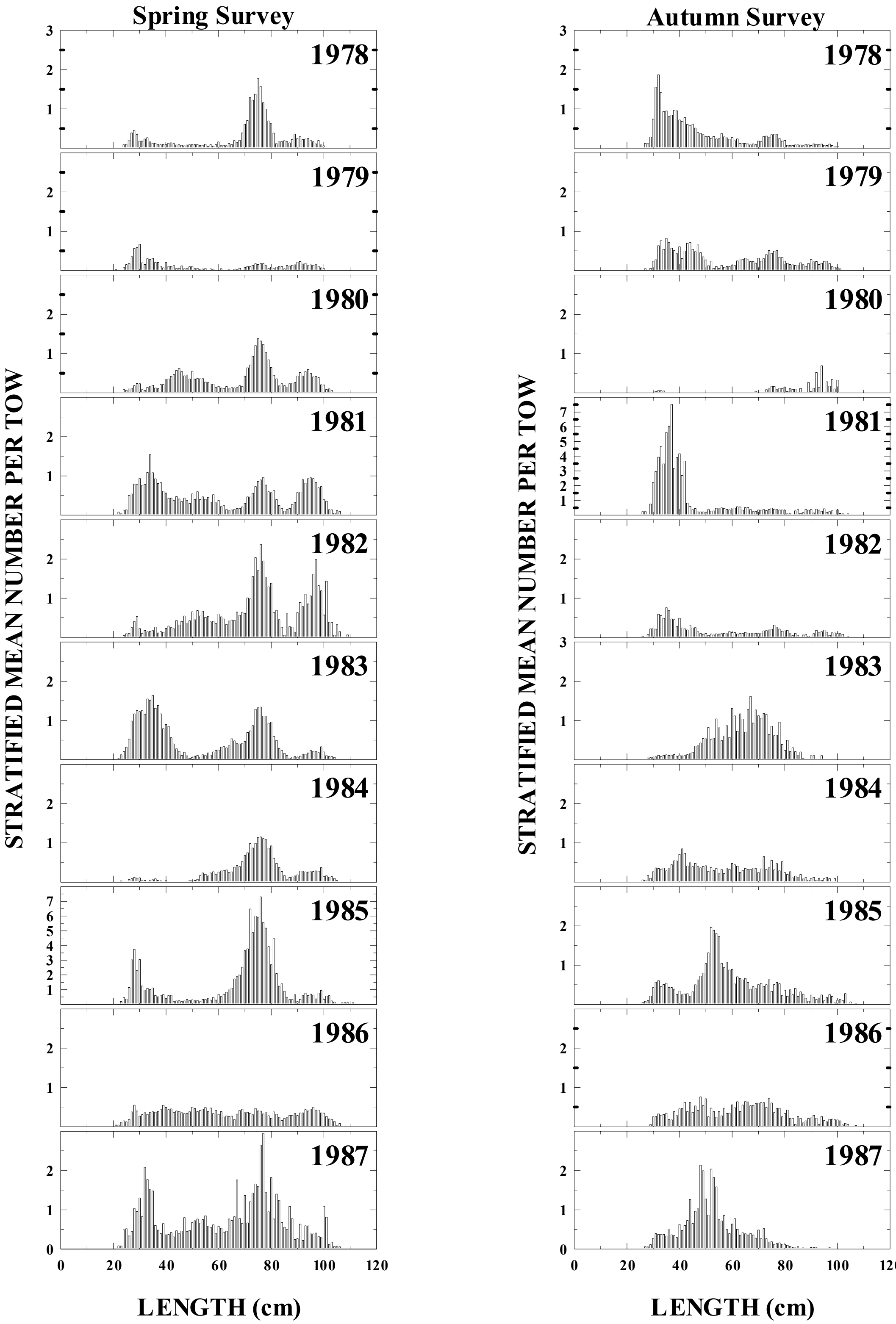


Figure B5.6 b. Length composition of spiny dogfish from the NEFSC spring and autumn bottom trawl survey, 1978-1987 (Offshore strata 1-30, 33-40, 61-76). Note the scales for spring 1985 and autumn 1981 are higher.

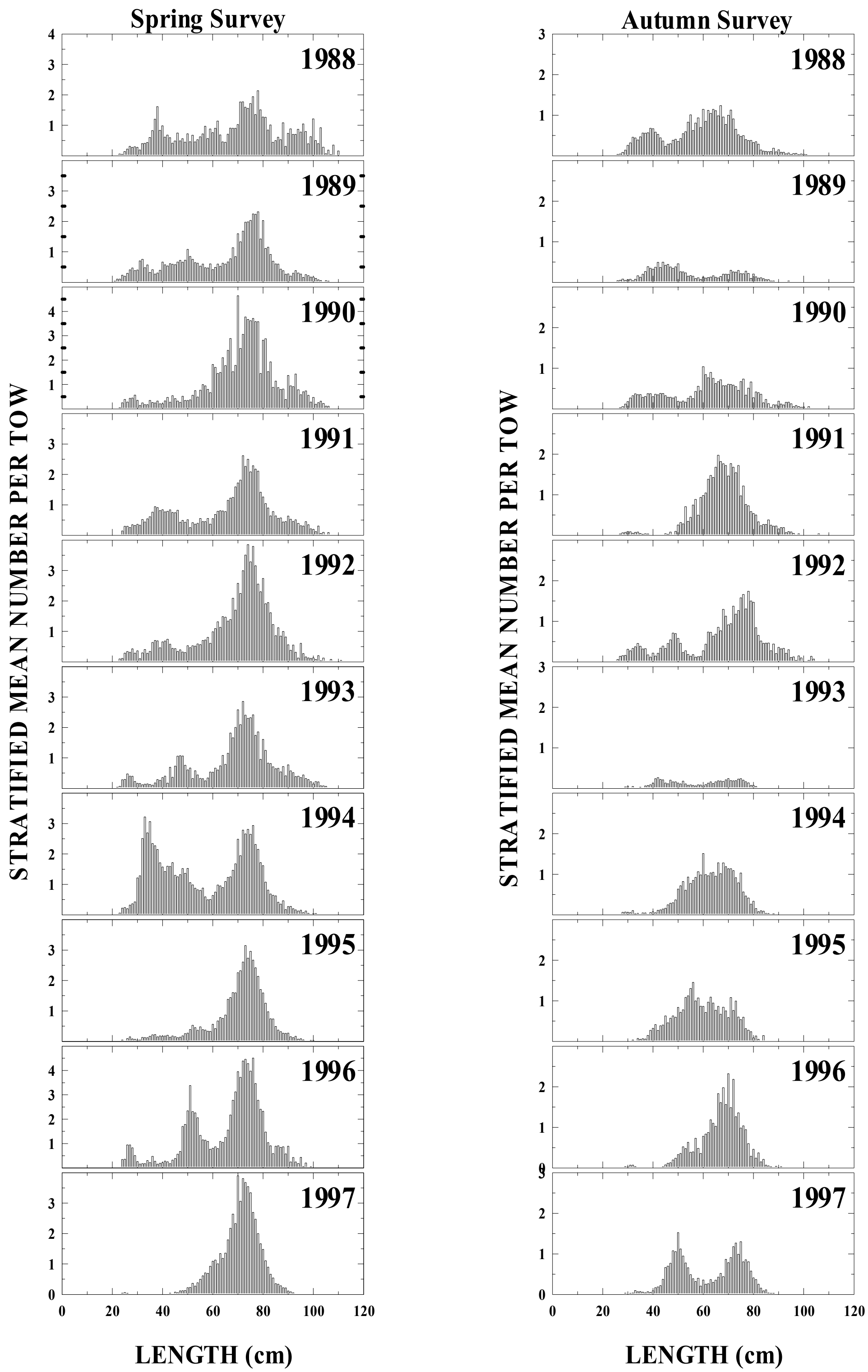


Figure B5.6 c. Length composition of spiny dogfish from the NEFSC spring and autumn bottom trawl survey, 1988-1997 (Offshore strata 1-30, 33-40, 61-76). Note the scales for spring and autumn differ and spring 1990 and 1996 are also different..

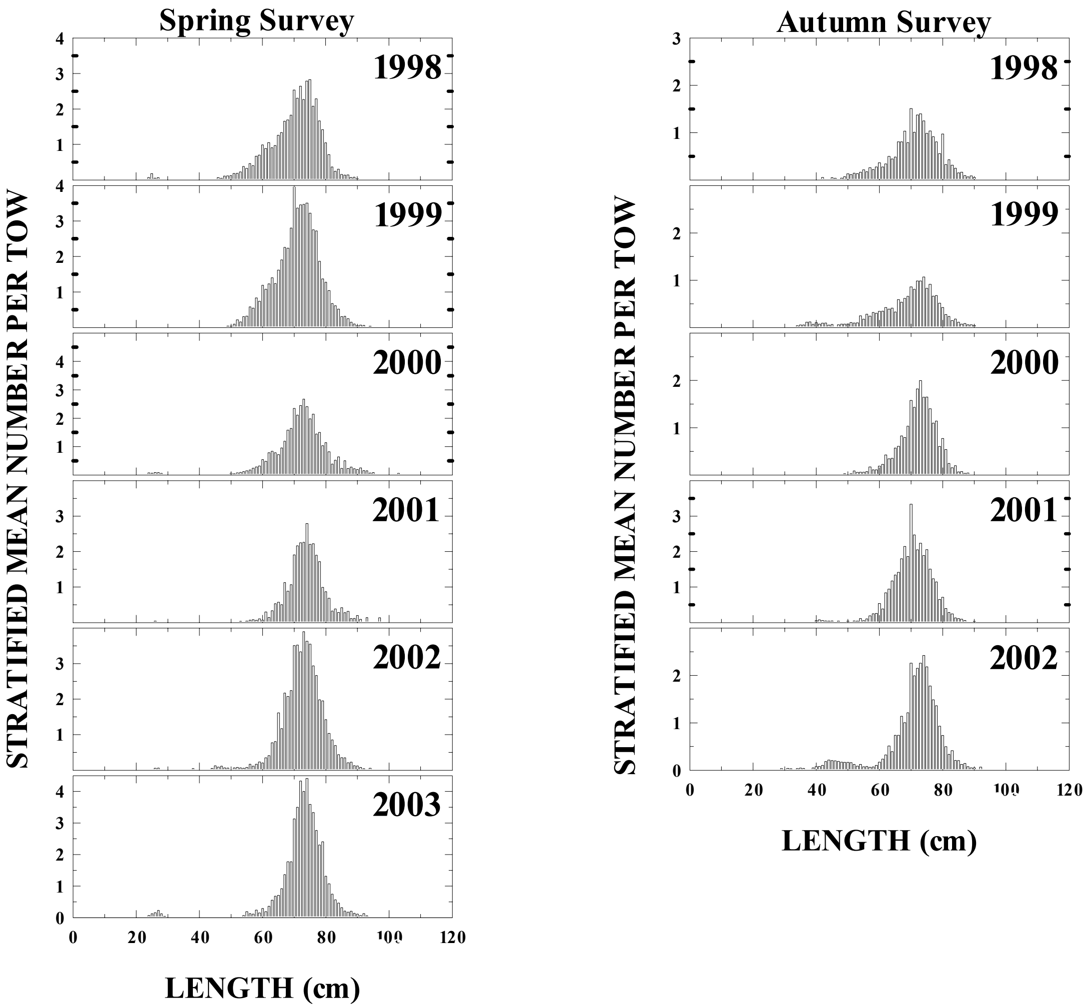


Figure B5.6d. Length composition of spiny dogfish from the NEFSC spring and autumn bottom trawl survey, 1998-2003 (Offshore strata 1-30, 33-40, 61-76). Note the scales for spring and autumn differ and spring 2002 and autumn 2001 are also different.

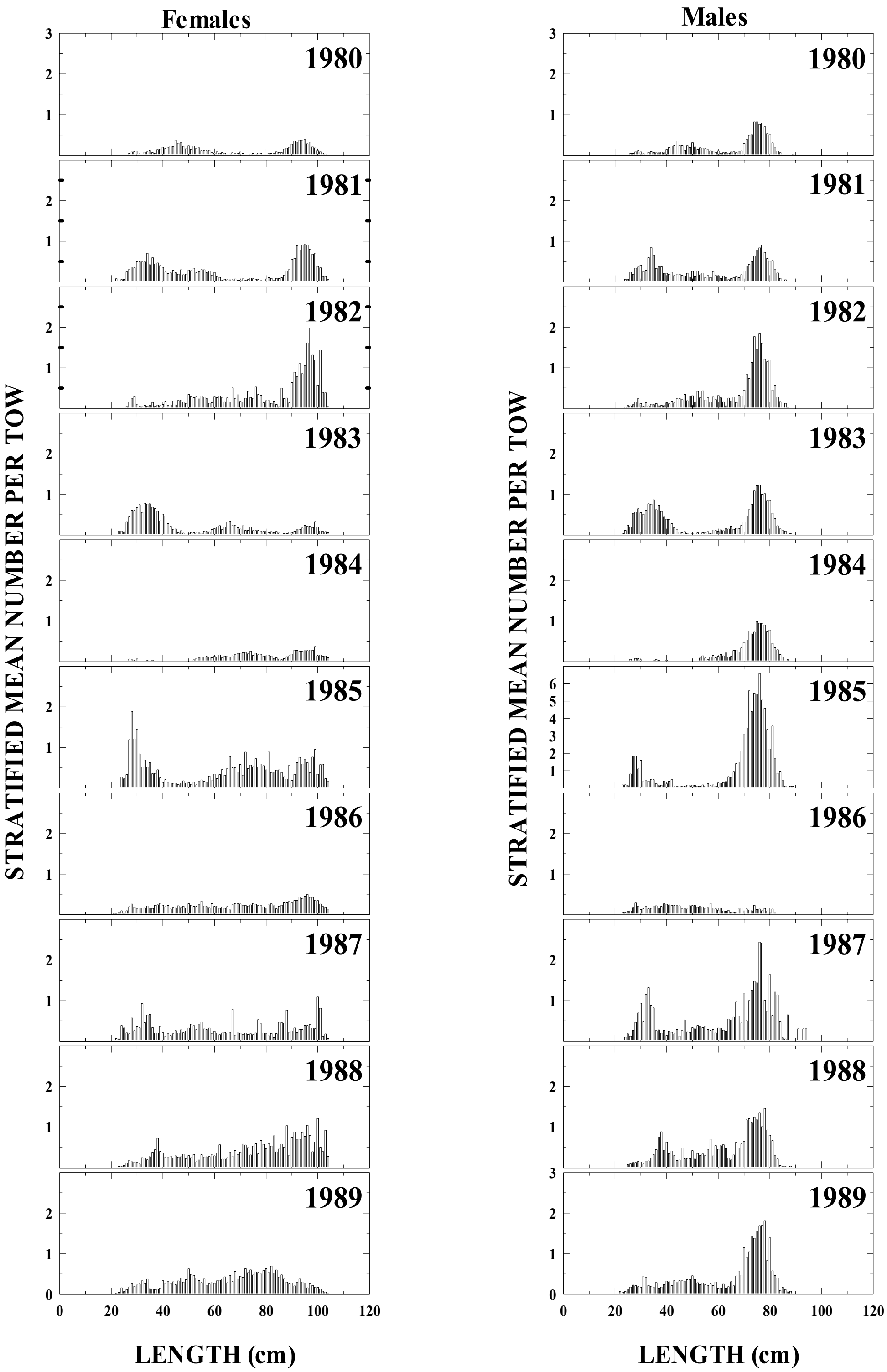


Figure B5.7 a. Length composition of male and female spiny dogfish from the NEFSC spring bottom trawl surveys, 1980-1989 (Offshore strata 1-30, 33-40, 61-76). Note the scale for males in 1985 is larger.

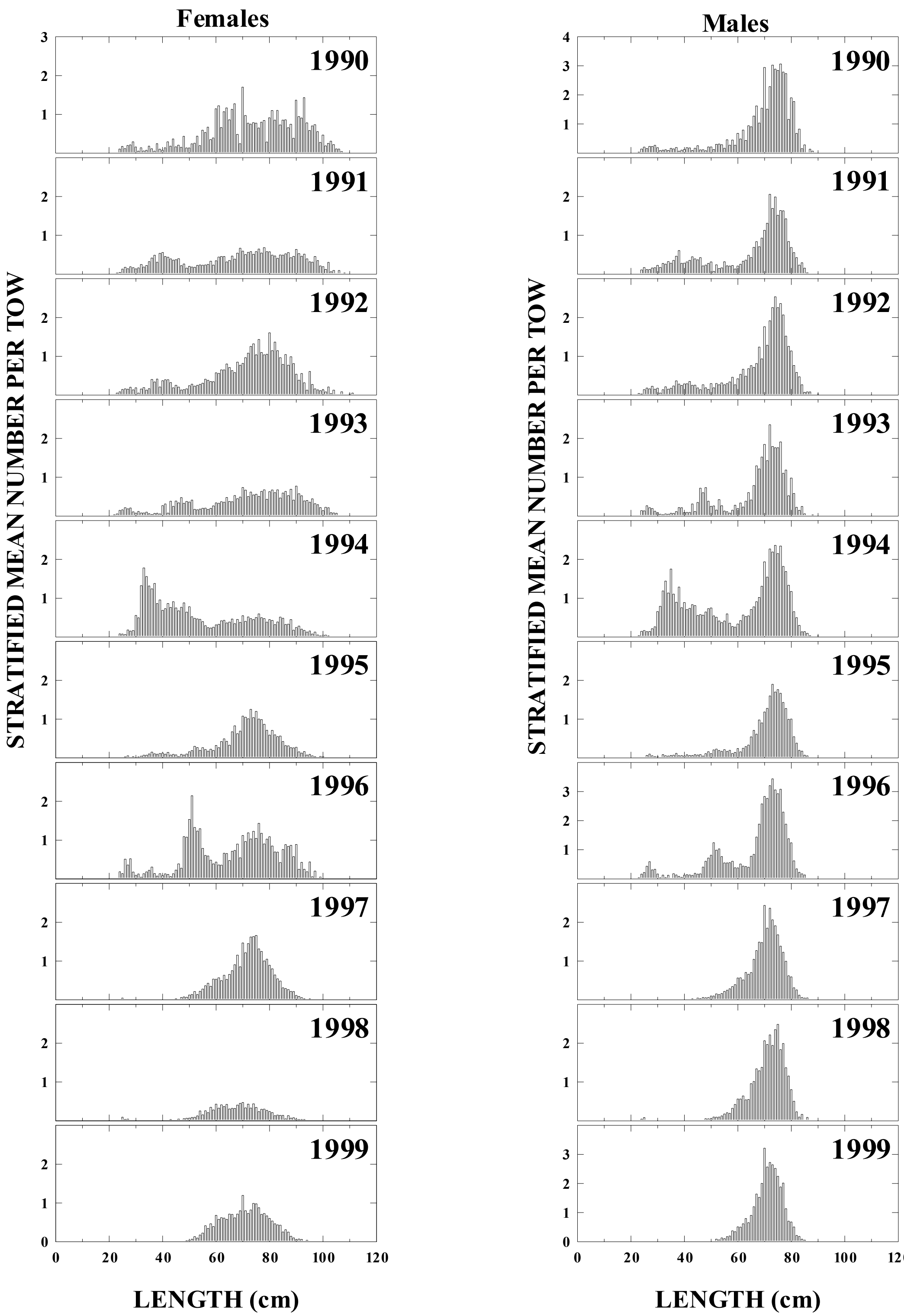


Figure B5.7 b. Length composition of male and female spiny dogfish from the NEFSC spring bottom trawl surveys, 1989-1999 (Offshore strata 1-30, 33-40, 61-76). Note the scales for males in 1990, 1996, and 1999 are larger.

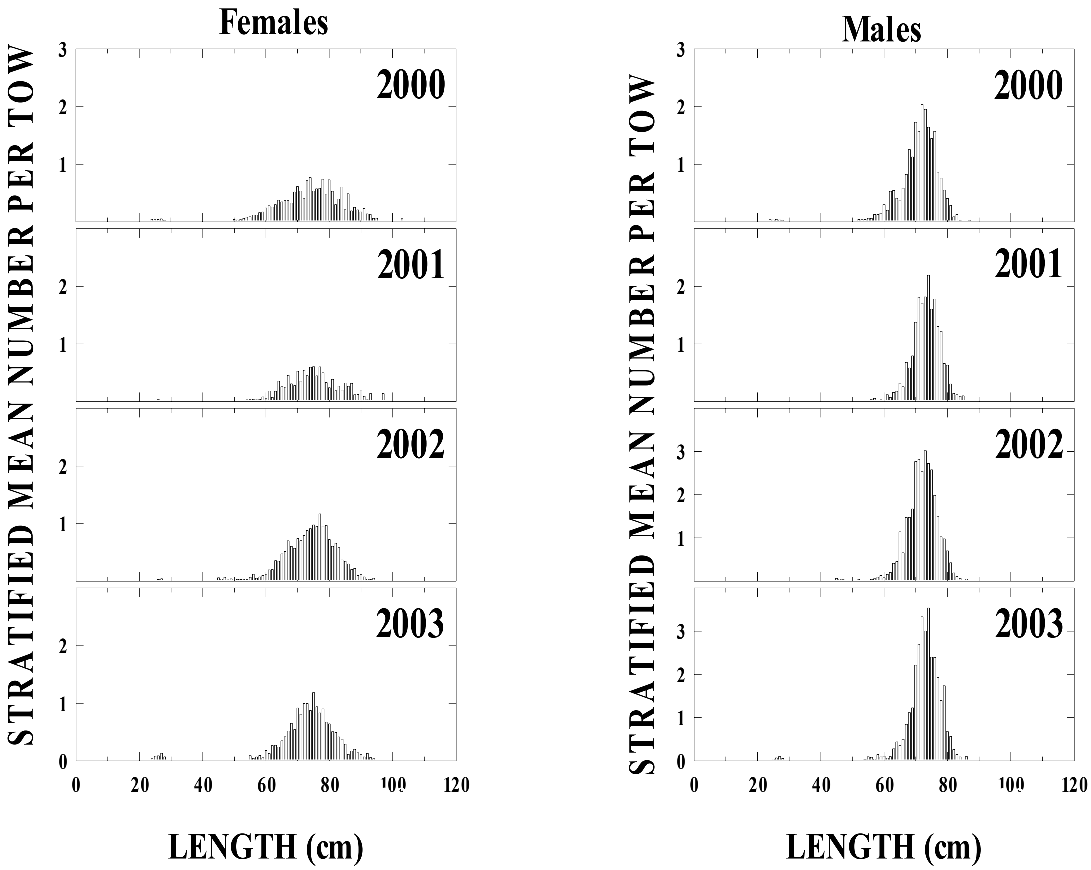


Figure B5.7 c. Length composition of male and female spiny dogfish from the NEFSC spring bottom trawl surveys, 2000-2003 (Offshore strata 1-30, 33-40, 61-76). Note the scale for males in 2002 is different.

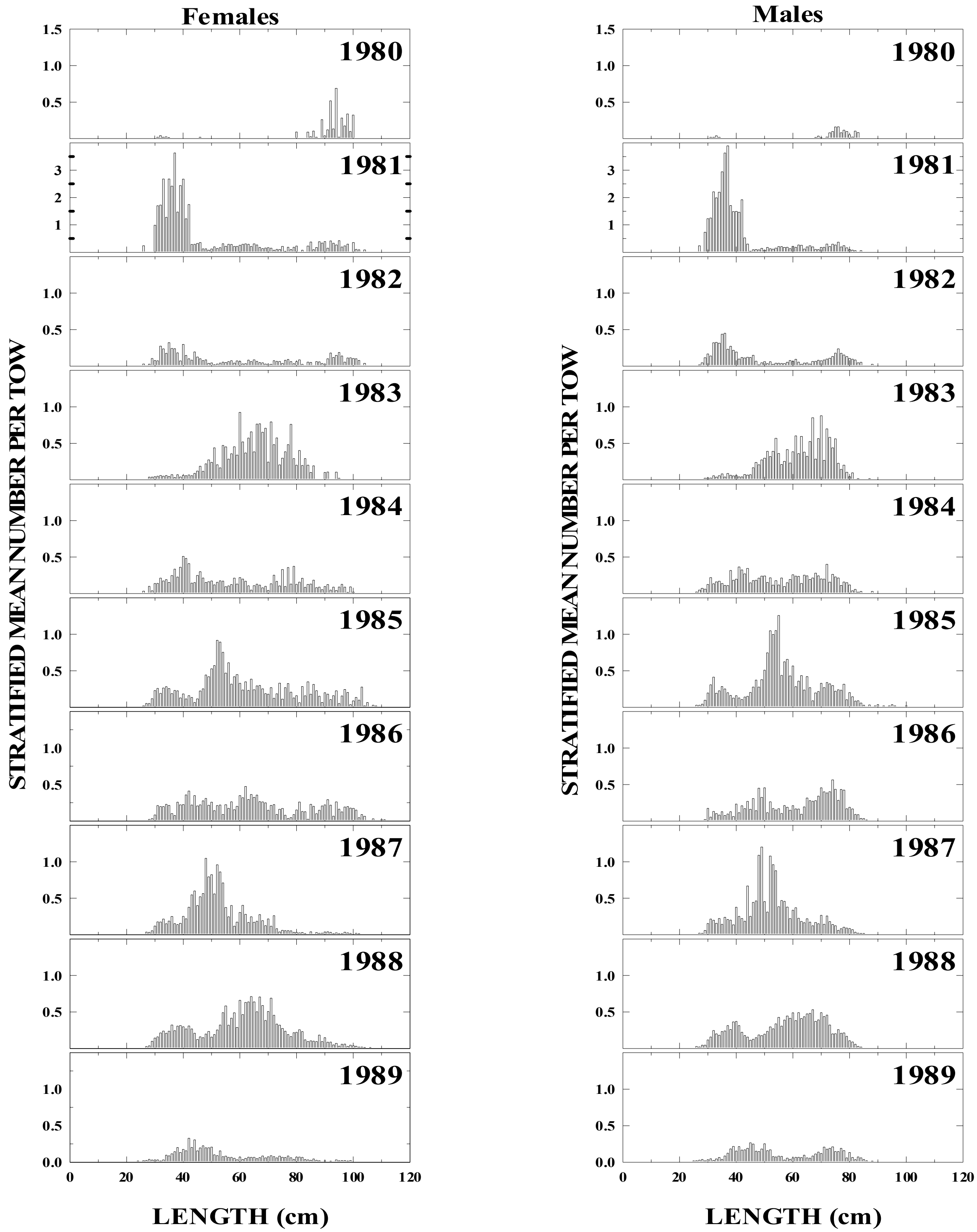


Figure B5.8 a. Length composition of male and female spiny dogfish from the NEFSC autumn bottom trawl surveys, 1980-1989 (Offshore strata 1-30, 33-40, 61-76). Note the scale for males in 1981 is larger.

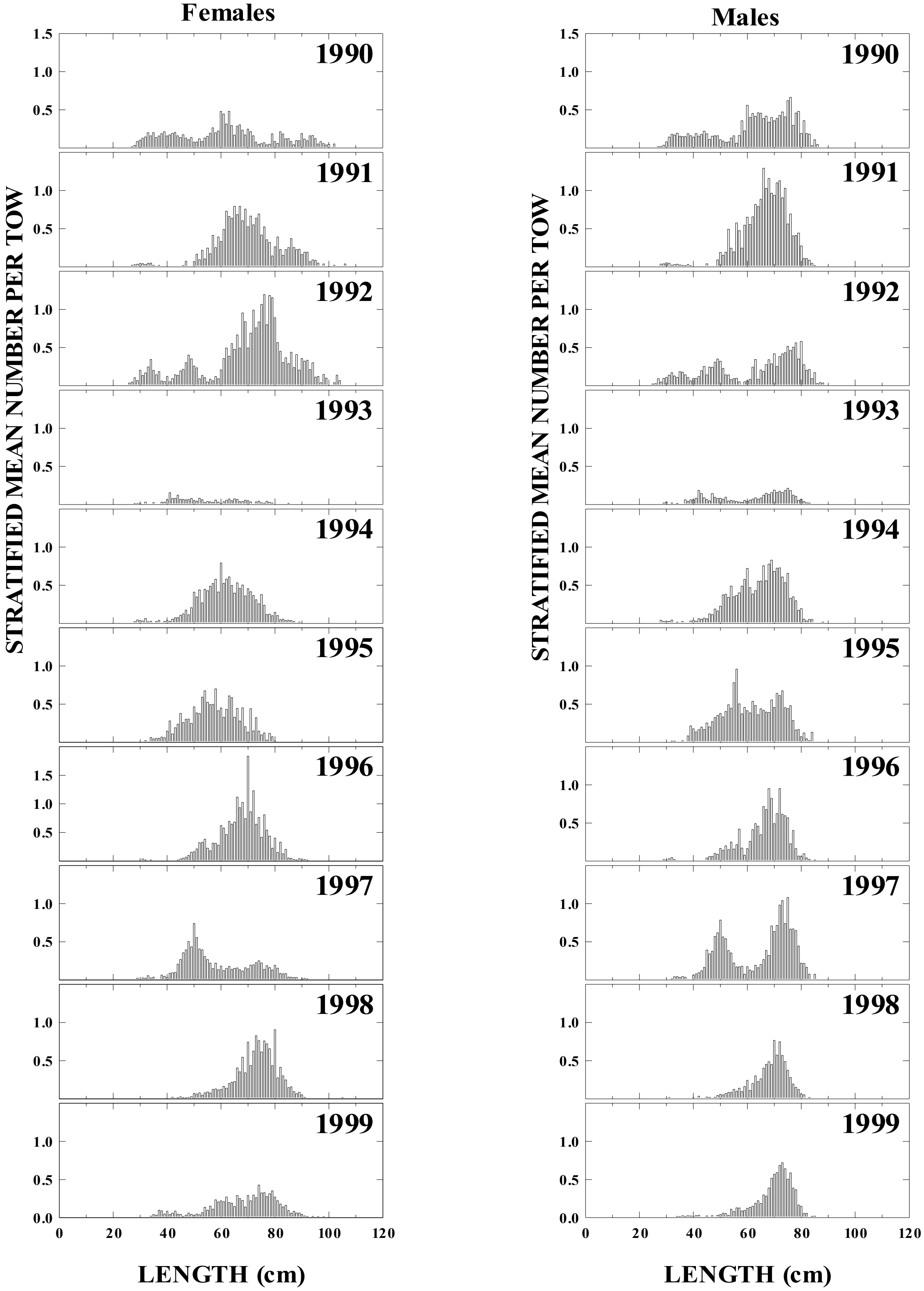


Figure B5.8 b. Length composition of male and female spiny dogfish from the NEFSC autumn bottom trawl surveys, 1990-1999 (Offshore strata 1-30, 33-40, 61-76). Note the scale for females in 1996 is larger.

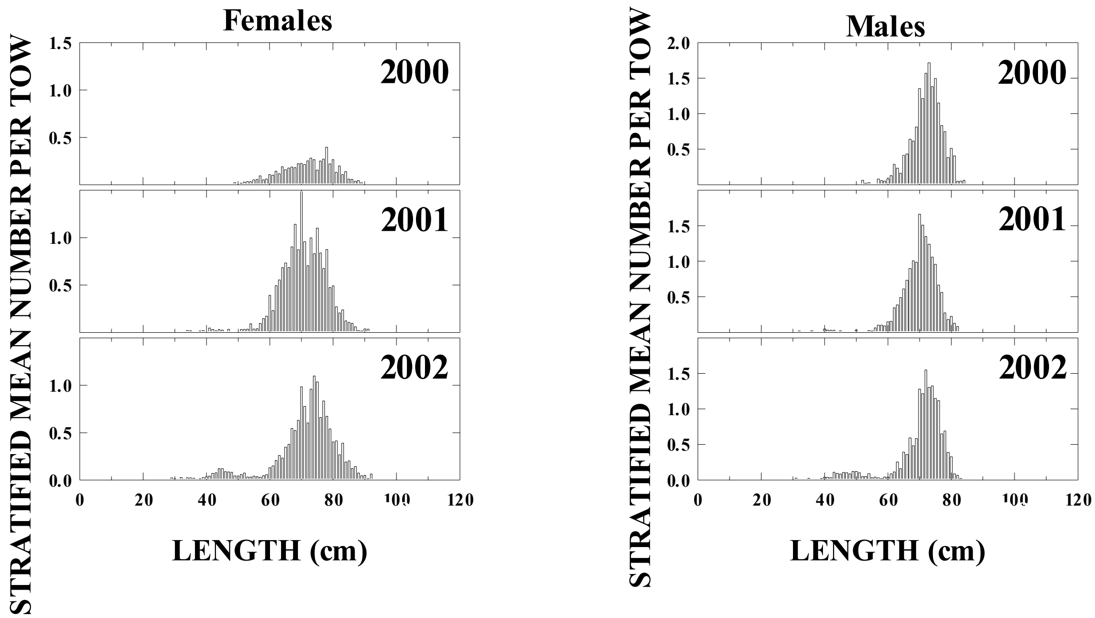


Figure B5.8c. Length composition of male and female spiny dogfish from the NEFSC autumn bottom trawl surveys, 2000-2002 (Offshore strata 1-30, 33-40, 61-76). Note the scale for males is different from previous figures.

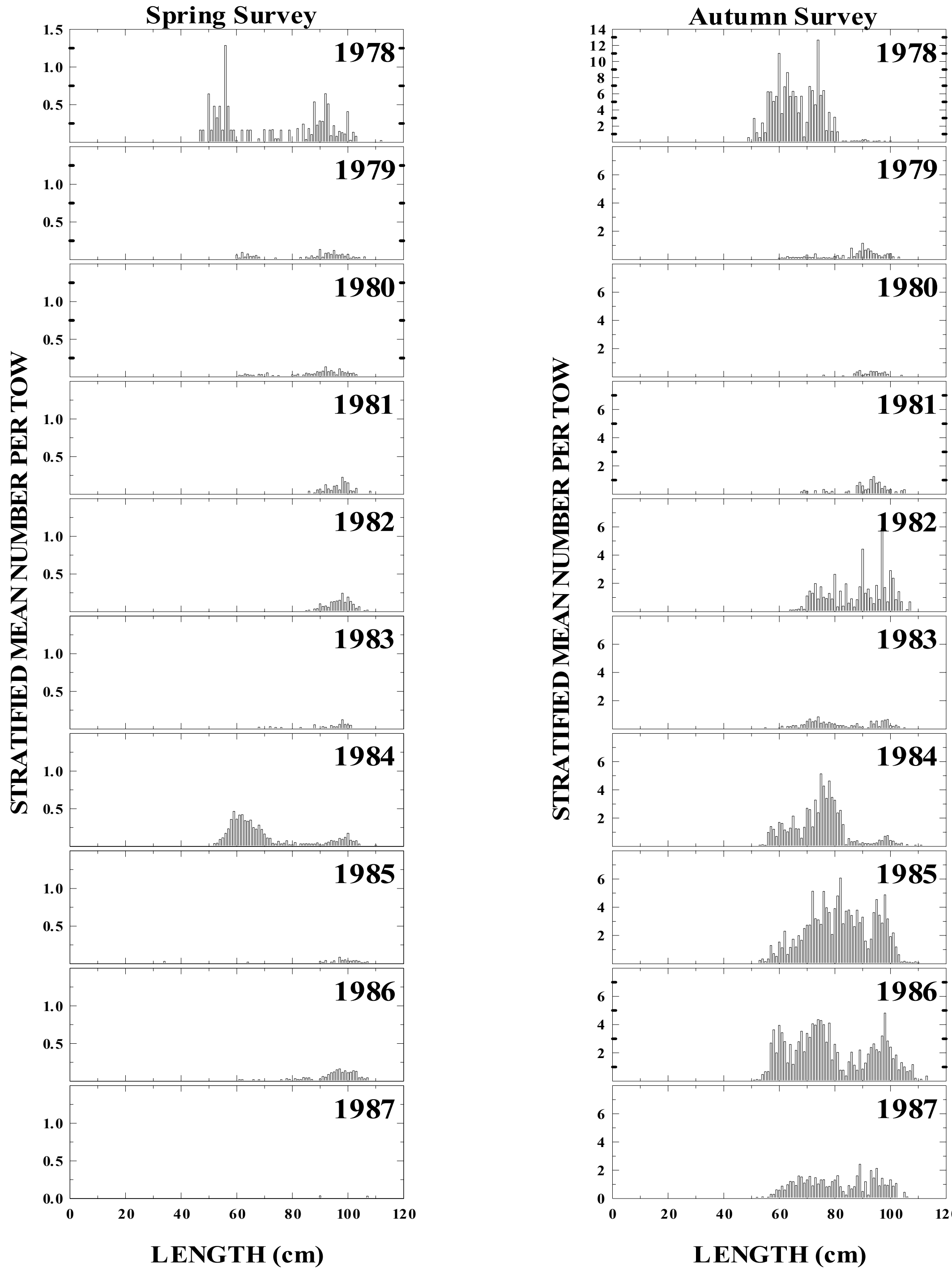


Figure B5.9 a. Length composition of spiny dogfish from the Massachusetts spring and autumn bottom trawl surveys, 1978-1987. Note the scales for spring and autumn differ and autumn 1978 is higher.

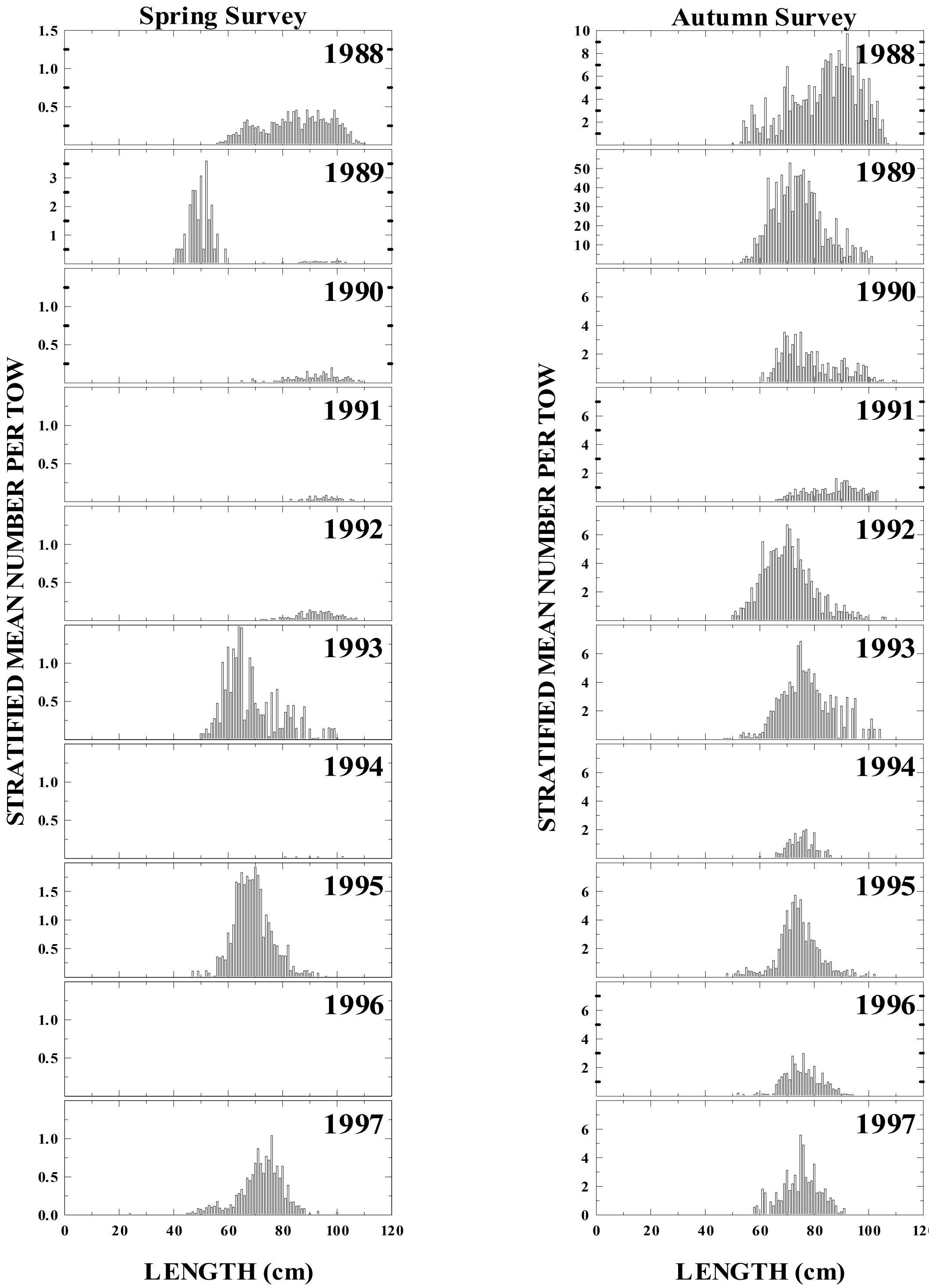


Figure B5.9 b. Length composition of spiny dogfish from the Massachusetts spring and autumn bottom trawl surveys, 1988-1997. Note the scales for spring and autumn differ and spring (1989,1995) autumn (1988,1989) are also different.

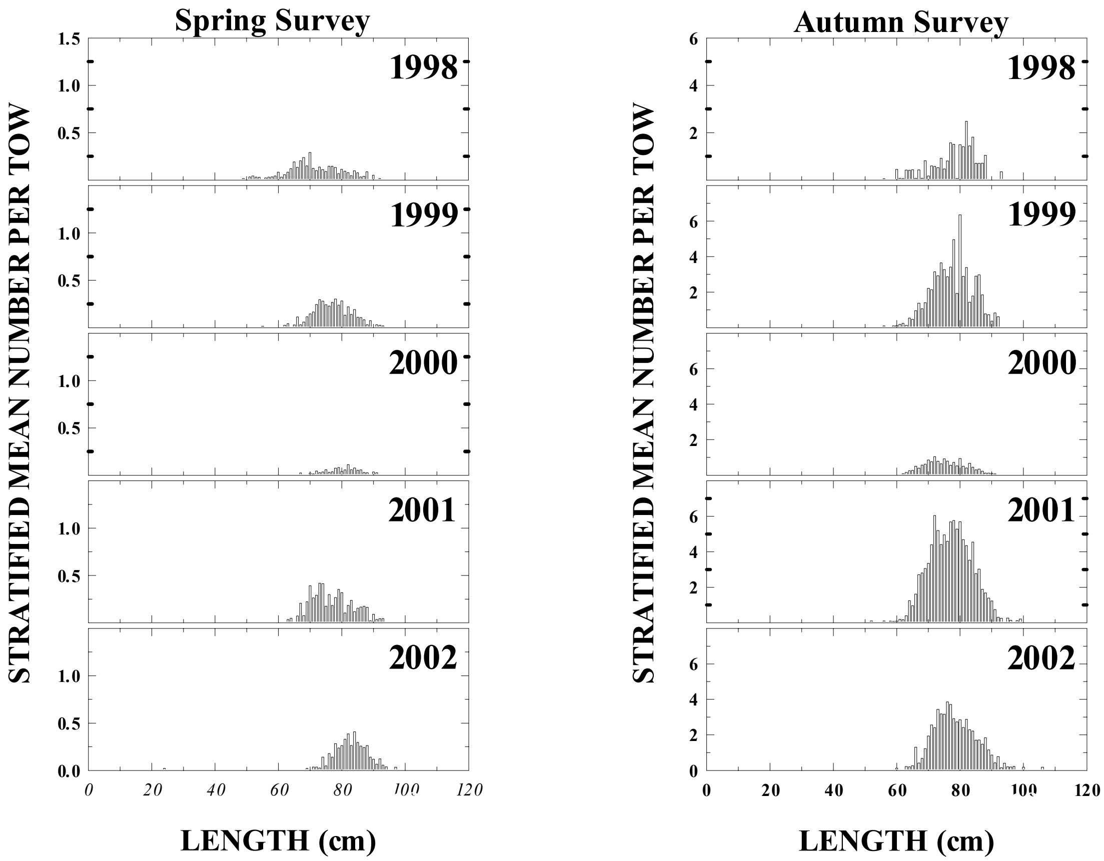


Figure B5.9c. Length composition of spiny dogfish from the Massachusetts spring and autumn bottom trawl surveys, 1998-2002.

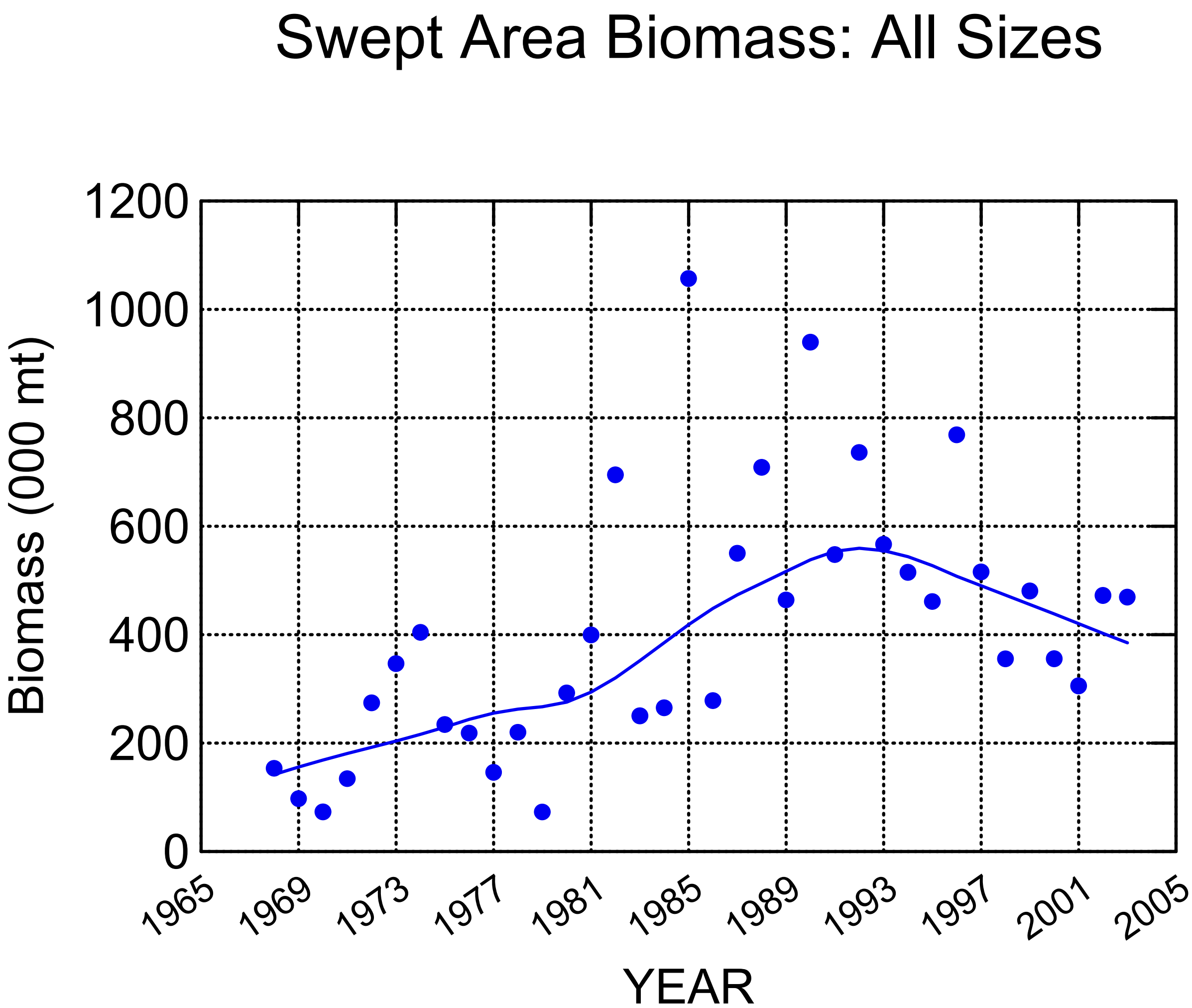
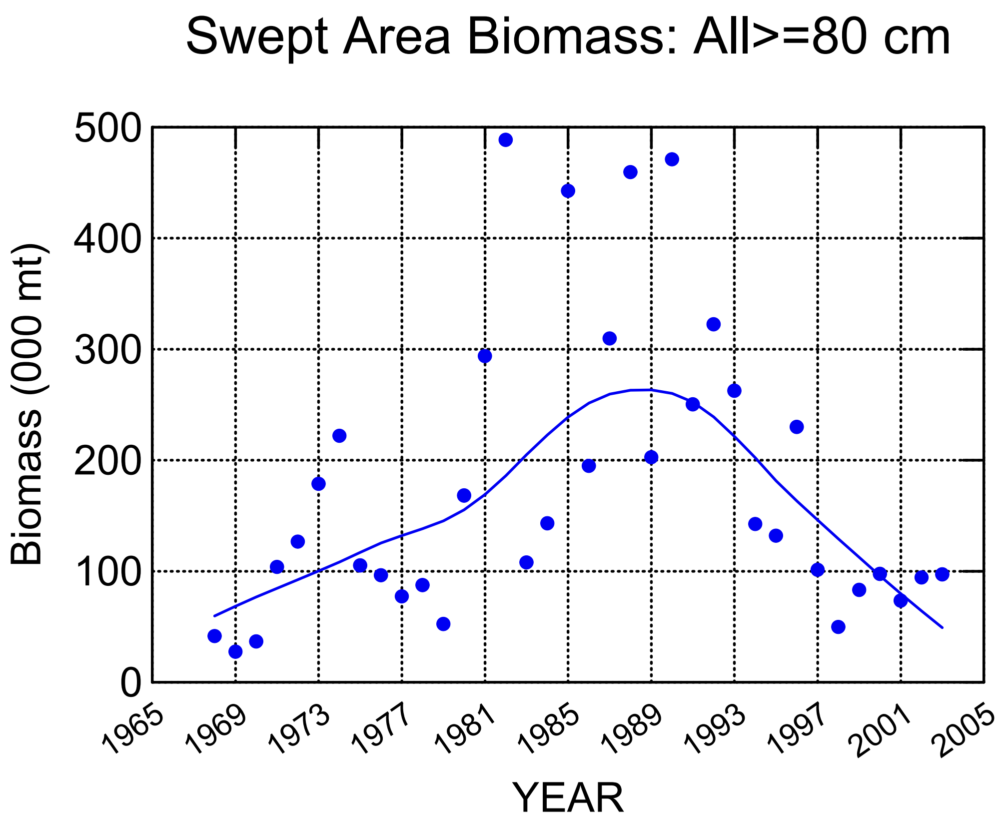


Fig. 6.1 Swept area estimate of total dogfish biomass (000 mt) in spring R/V trawl survey, 1968-2003. Line represents Lowess smooth with tension factor = 0.5.



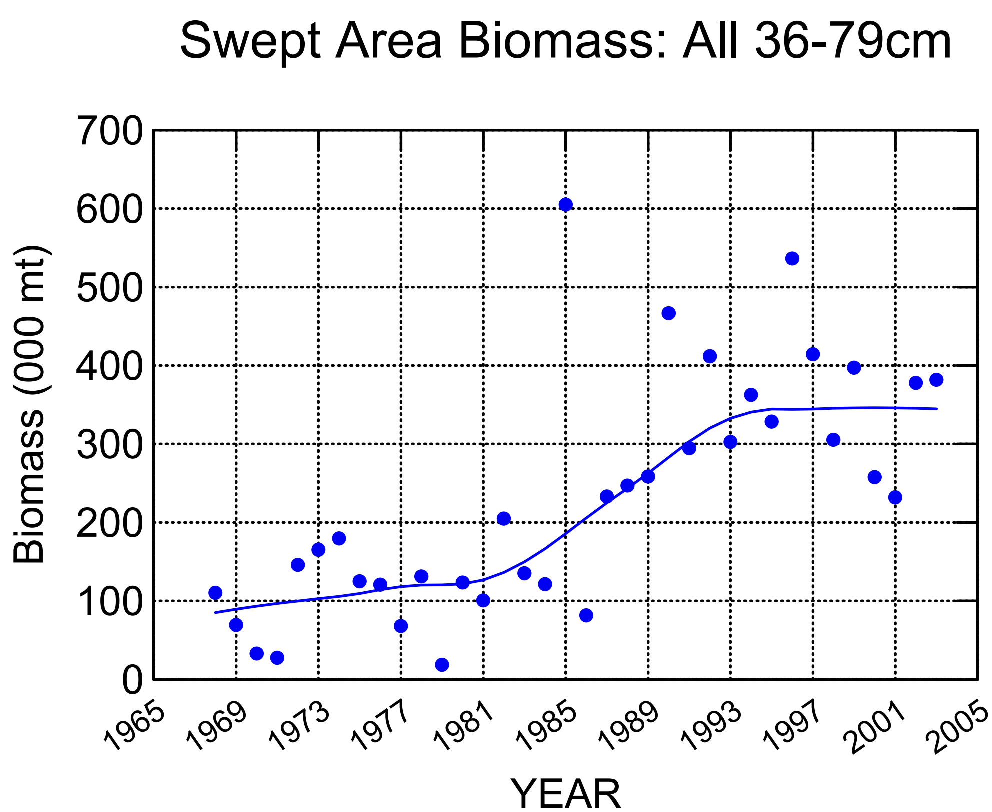


Fig. 6.2 Swept area estimate of dogfish biomass (000 mt) in spring R/V trawl survey, 1968-2003 for dogfish greater than 80 cm (top) and 36-79 cm (bottom). Both sexes combined. Line represents Lowess smooth with tension factor = 0.5.

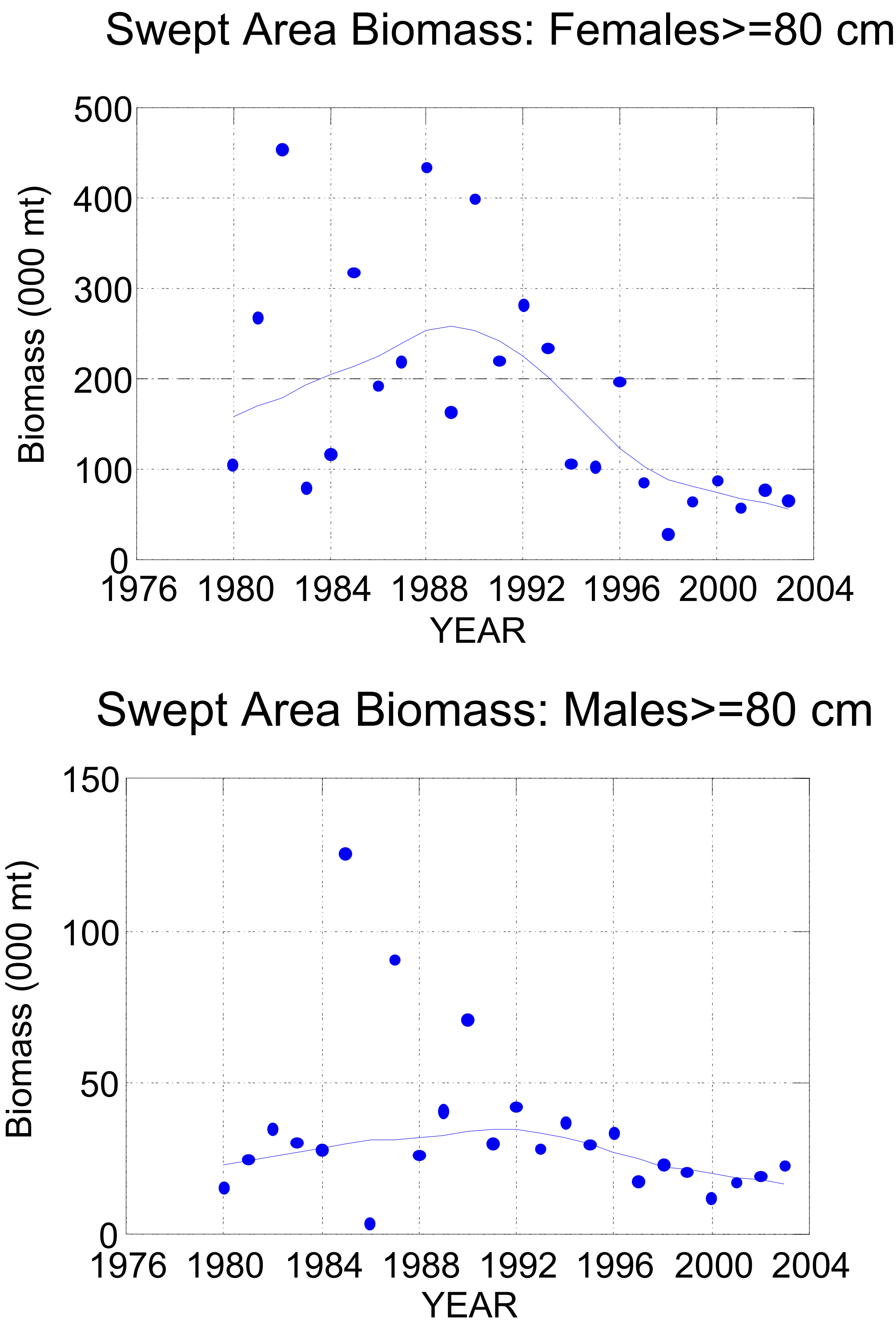
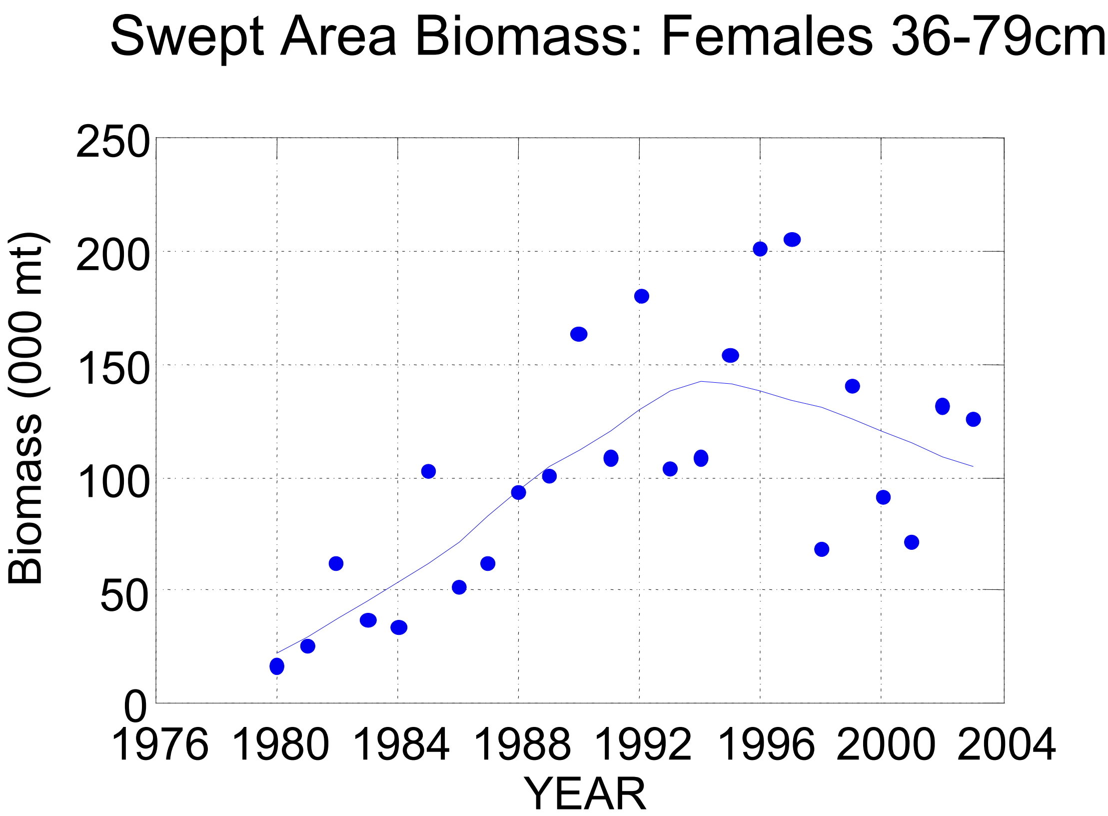


Fig. B6.3 Swept area estimate of dogfish biomass (000 mt) by sex in spring R/V trawl survey, 1980-2003 for dogfish greater than 80 cm, Females (top) and males (bottom). Line represents Lowess smooth with tension factor = 0.5.



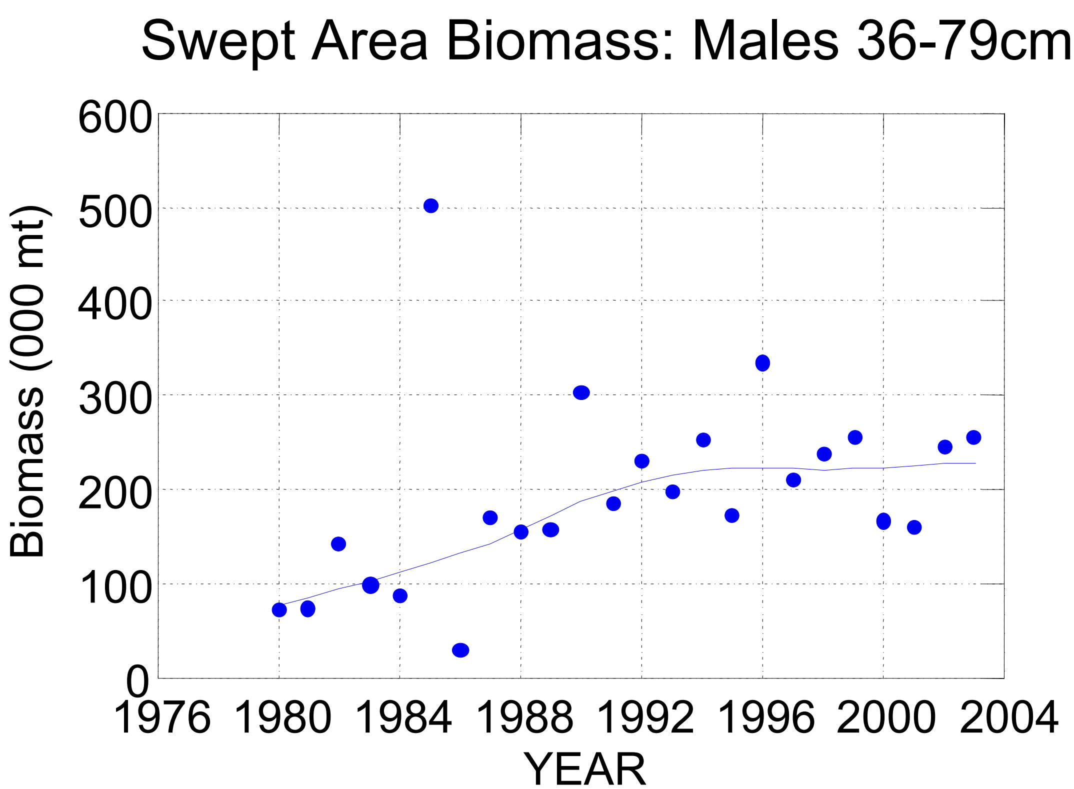


Fig. B6.4 Swept area estimate of dogfish biomass (000 mt) by sex in spring R/V trawl survey, 1980-2003 for dogfish between 36-79 cm, Females (top) and males (bottom). Line represents Lowess smooth with tension factor = 0.5.

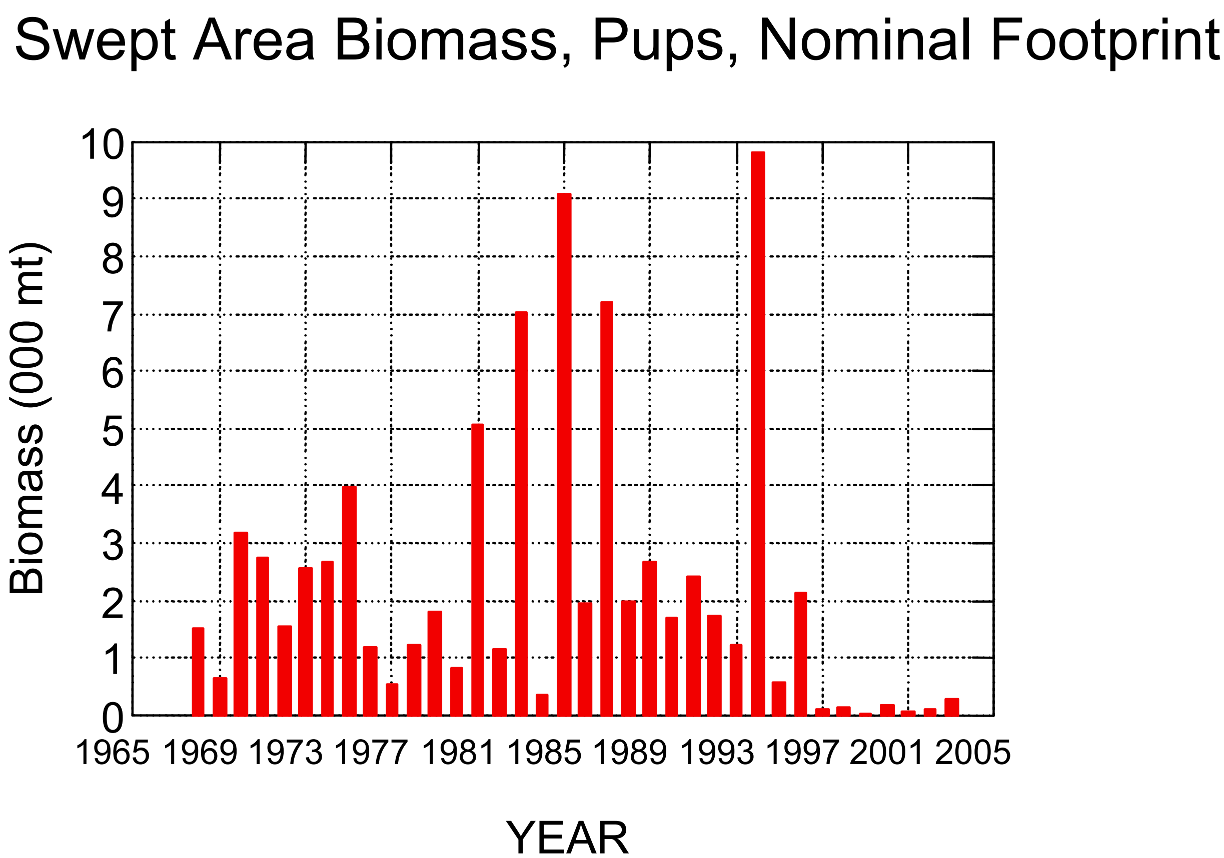


Fig. B6.5 Swept area estimate of dogfish biomass (000 mt) recruits in spring R/V trawl survey, 1968-2003. Recruits defined as individuals less than 36 cm.

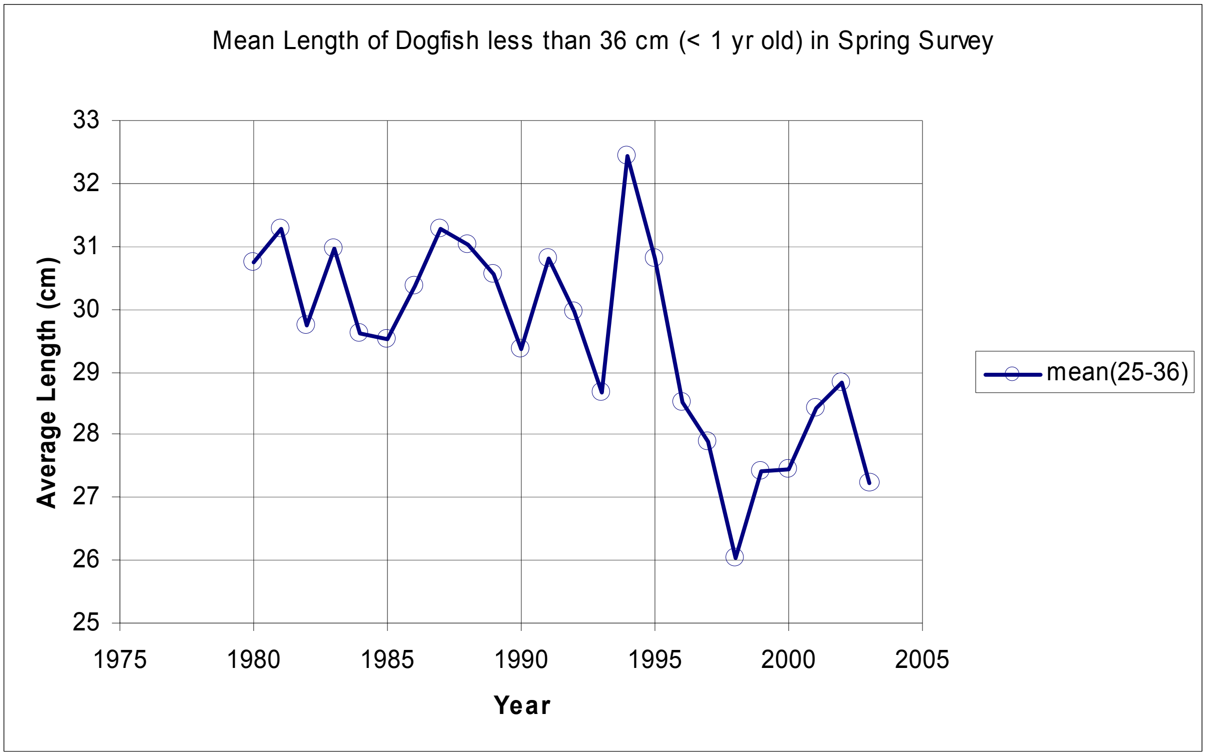
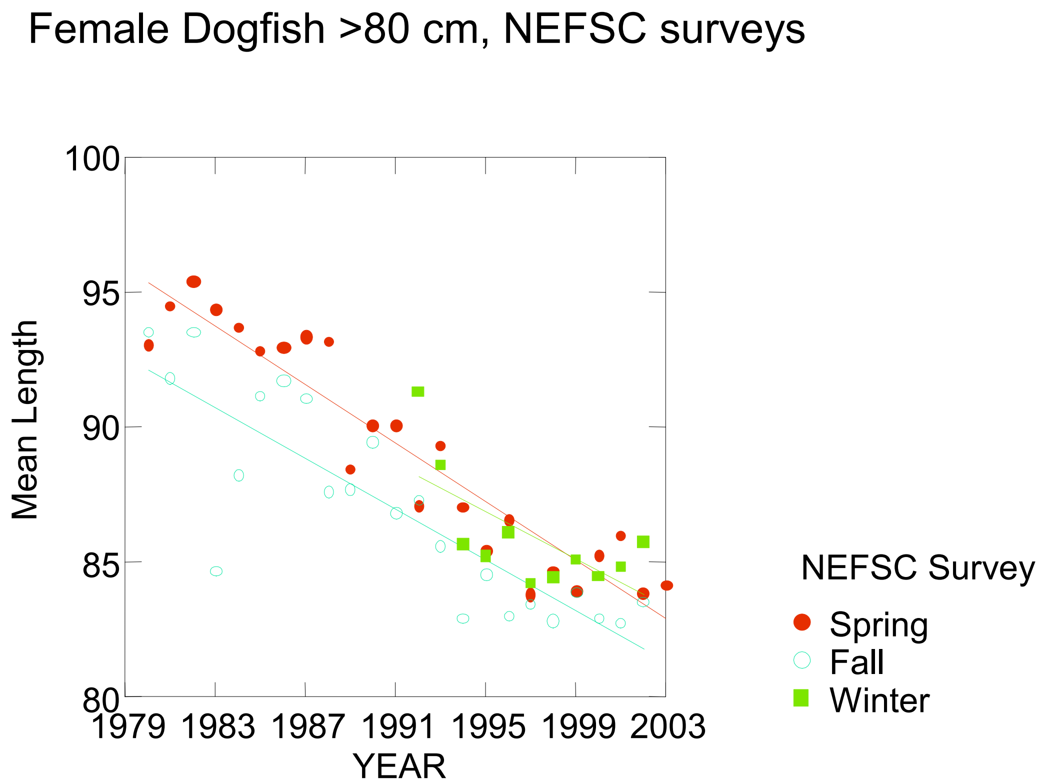


Fig. B6.6 Trend in average size of dogfish recruits, 1980-2003. Recruits defined as individuals less than 36 cm.



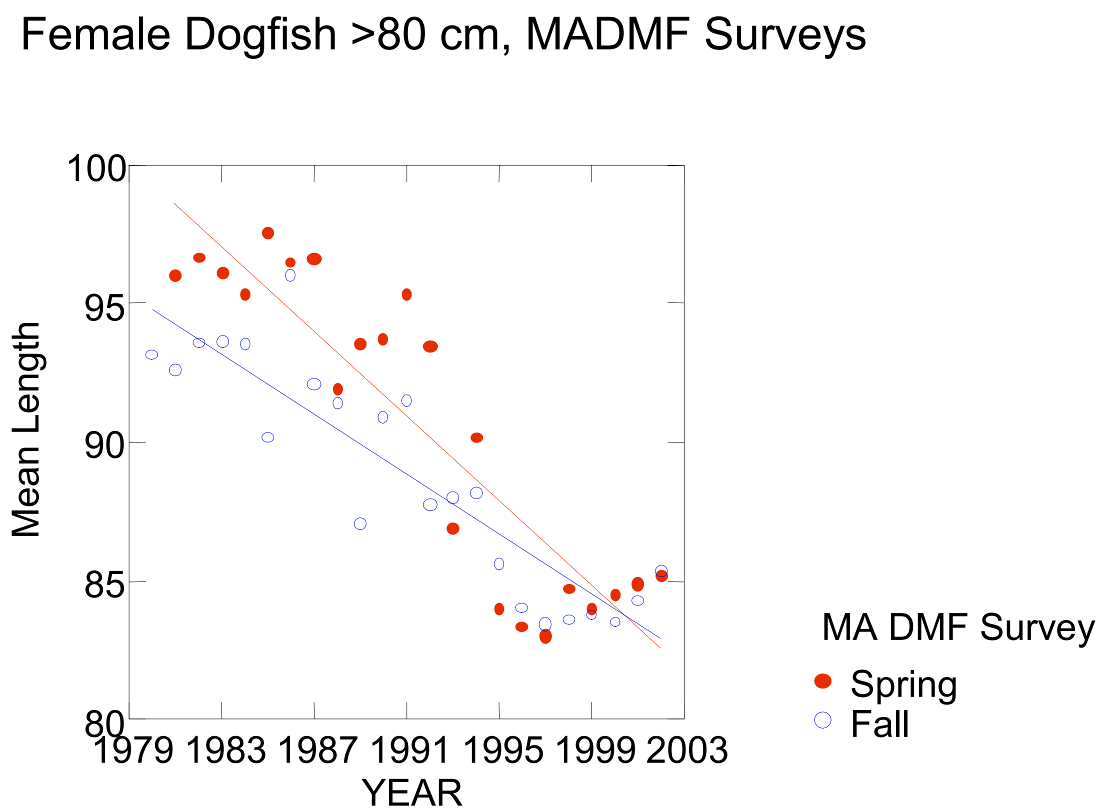


Fig. B6.7 Average size of mature female dogfish (>80cm) in NMFS R/V surveys, 1980-2003, (top) and MADMF R/V surveys (bottom), 1980-2002.

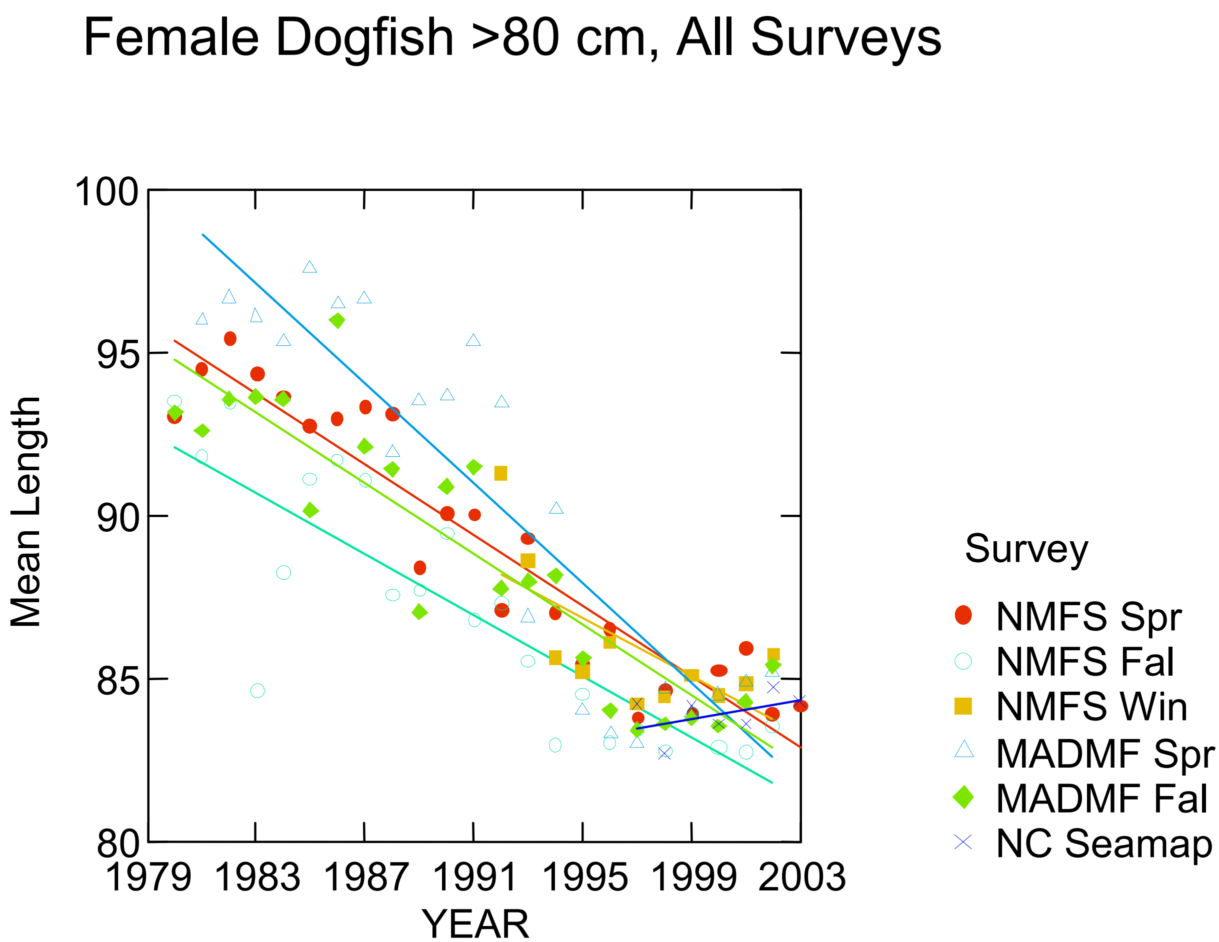
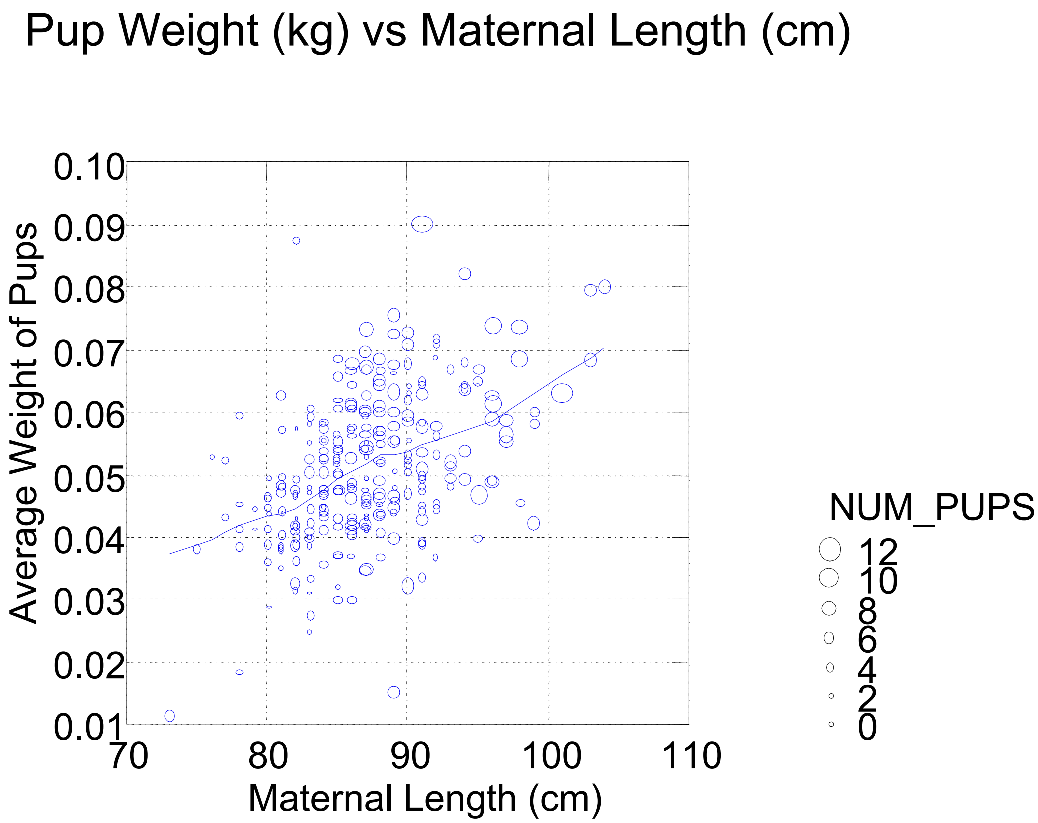


Fig. B6.8 Average size of mature female dogfish (>80cm) in all surveys: NMFS R/V surveys, 1980-2003, and MADMF R/V surveys, 1980-2002, and NC SeaMap survey.



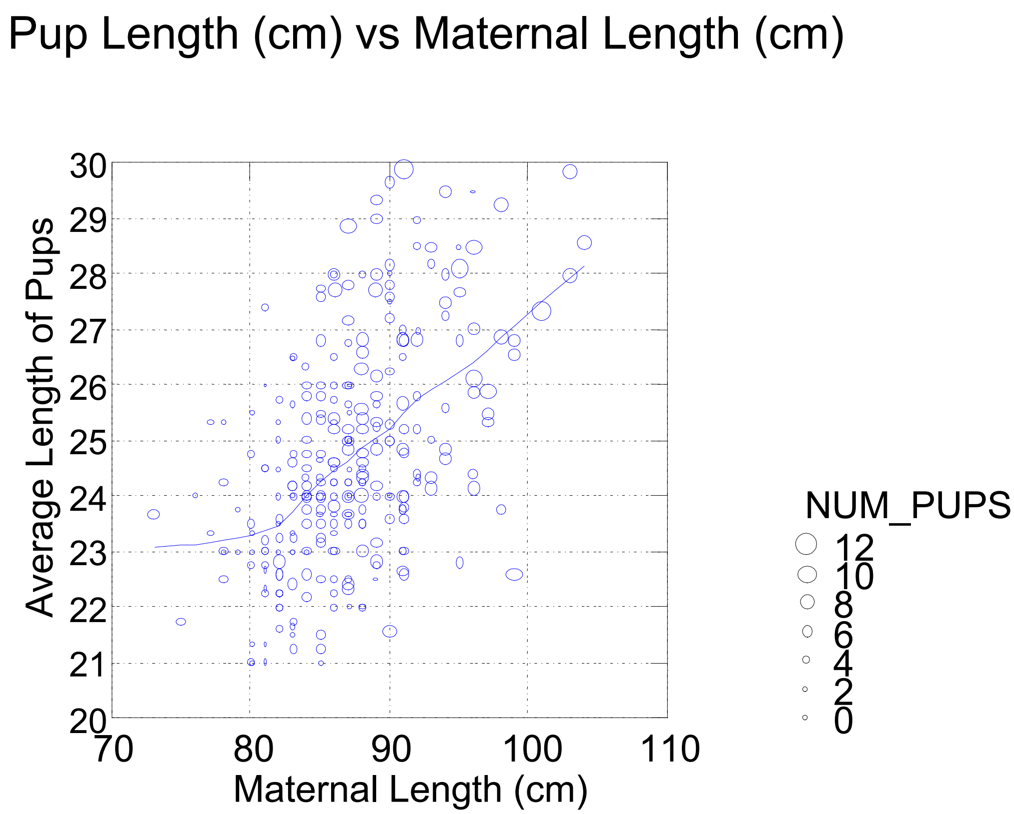


Fig. B6.9 Relationship between average weight (kg) of near-term pups (top) and average length (cm) of pups (bottom) with maternal length (cm). Circle size is proportional to number of pups in brood. Line represents Lowess smooth with tension =0.5.

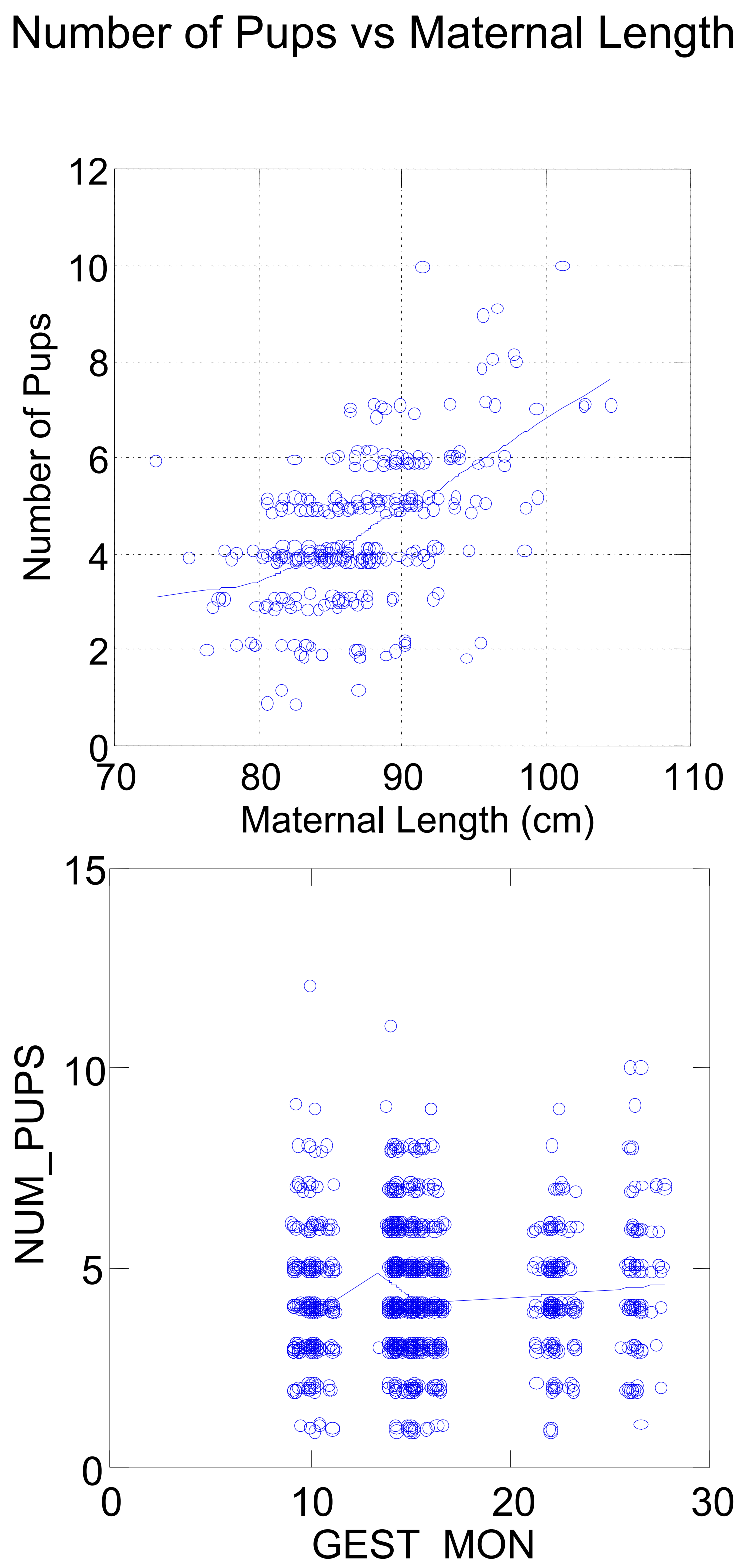


Fig. B6.10 Relationship between number of near-term pups per brood (top) and maternal length (cm). Bottom panel shows relationship between gestational month and number of pups present in brood. Lines represents Lowess smooth with tension =0.5.

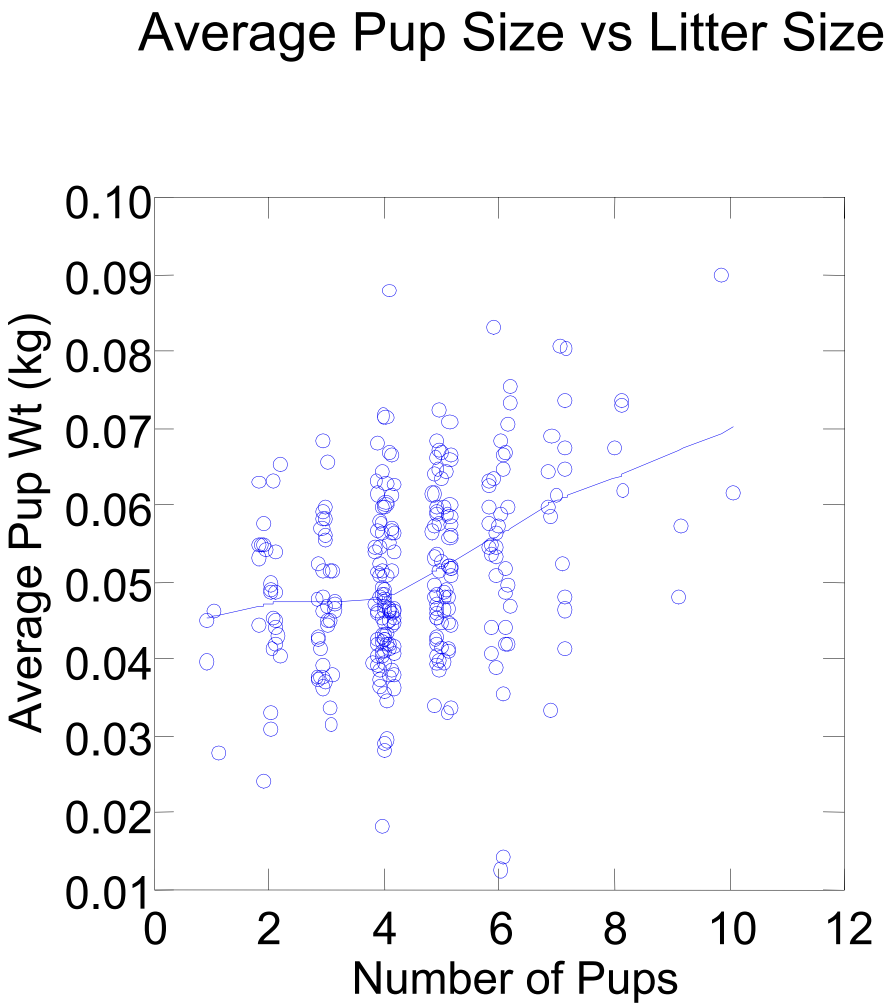


Fig. B6.11 Relationship between average size of near term free embryos and number of pups present in brood, based on 1998-2002 samples. Data points are jittered to show number of points within integer number of pups within brood. Line represent Lowess smooth with tension =0.5.

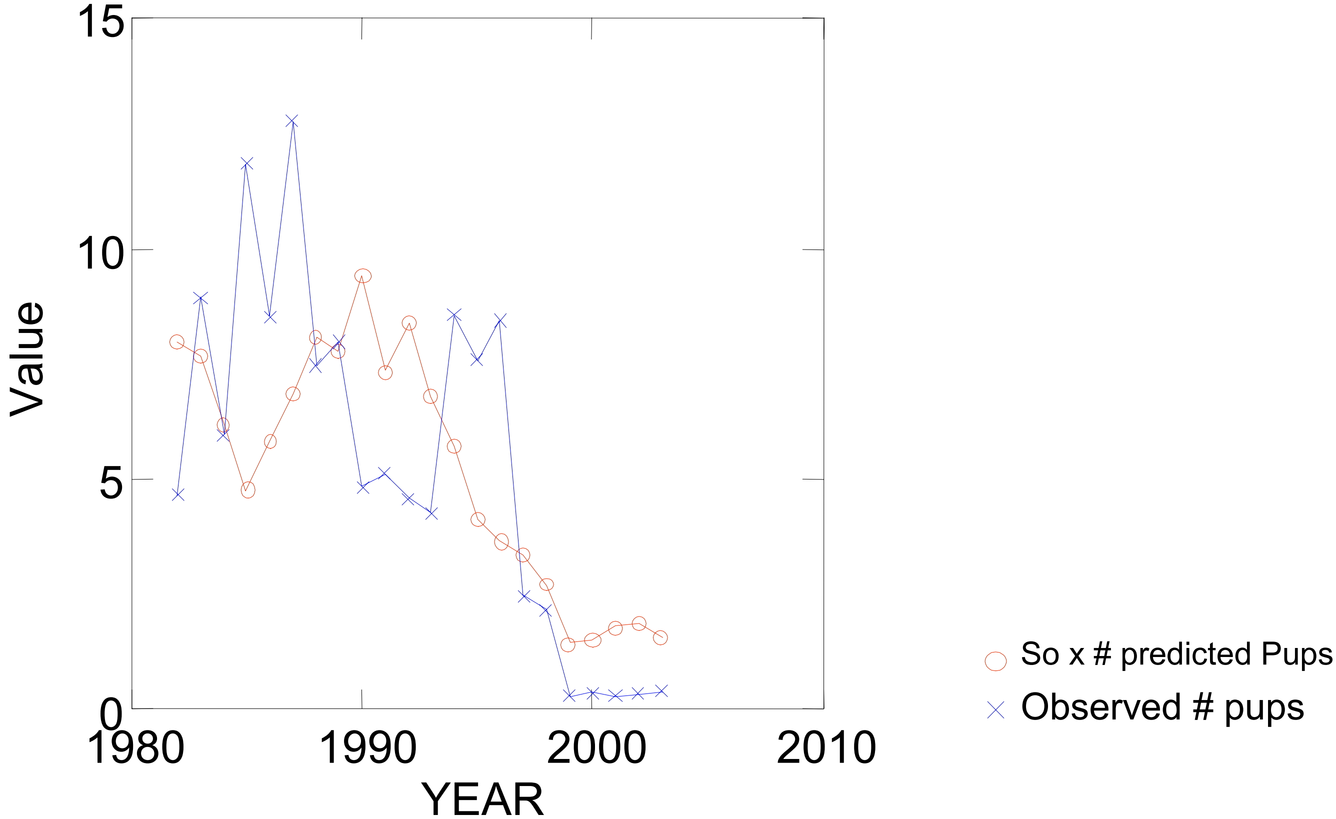


Fig. B6.12 Comparison of observed and predicted number of pups based on a 3 yr moving average. Predicted pups estimated as sum product of abundance and number per tow, multiplied by first year survival rate estimated from life history model. Observed number of pups is total number per tow in the <36 cm range. No adjustments for scale have been made.

Num Spawners/Tow (lf) and Maternal Size (rt) vs year

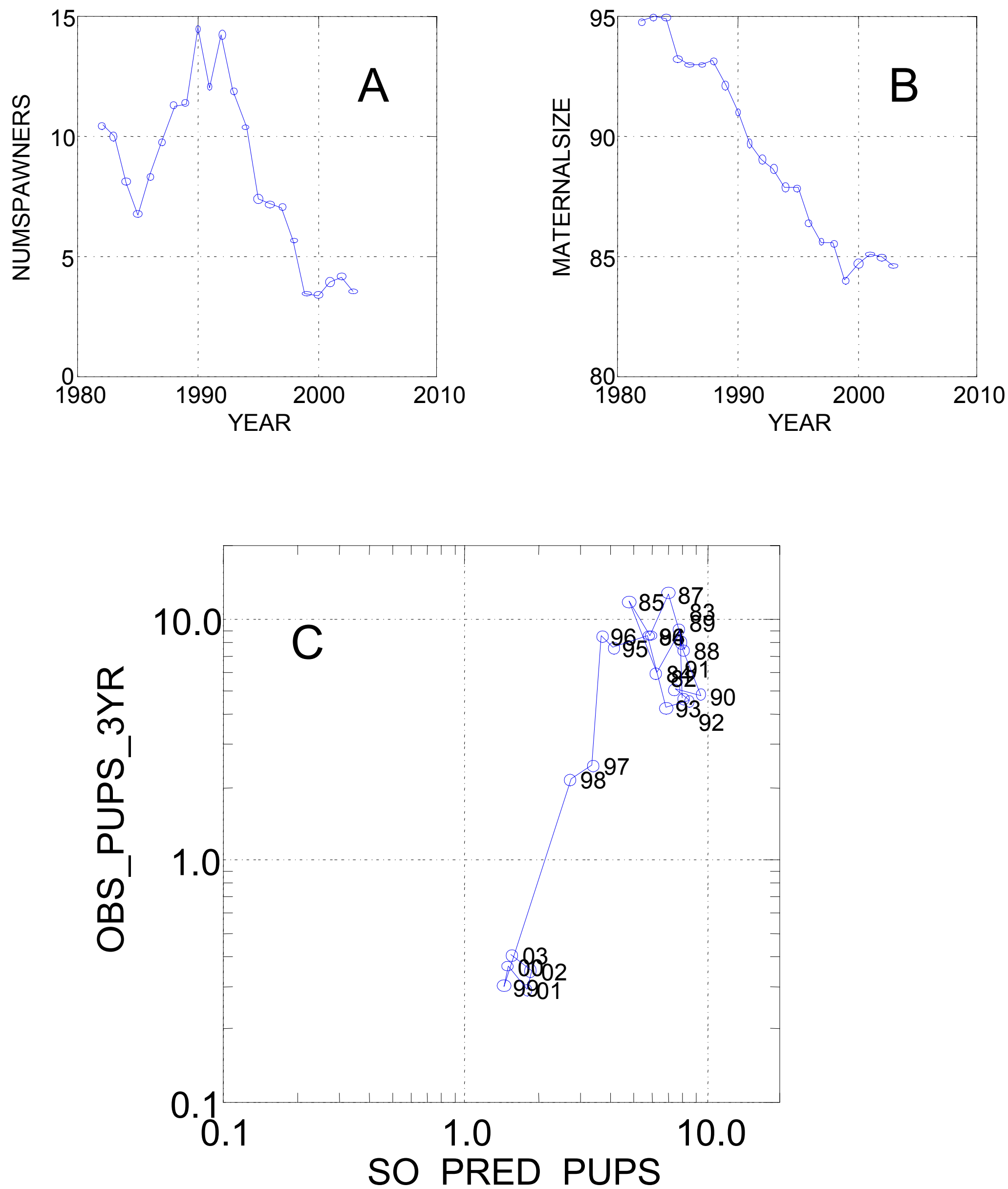


Fig. B6.13. Summary of trends in total number of mature female dogfish (#/tow) (A), average maternal size (cm) (B) and relationship between observed and predicted numbers of pups C.

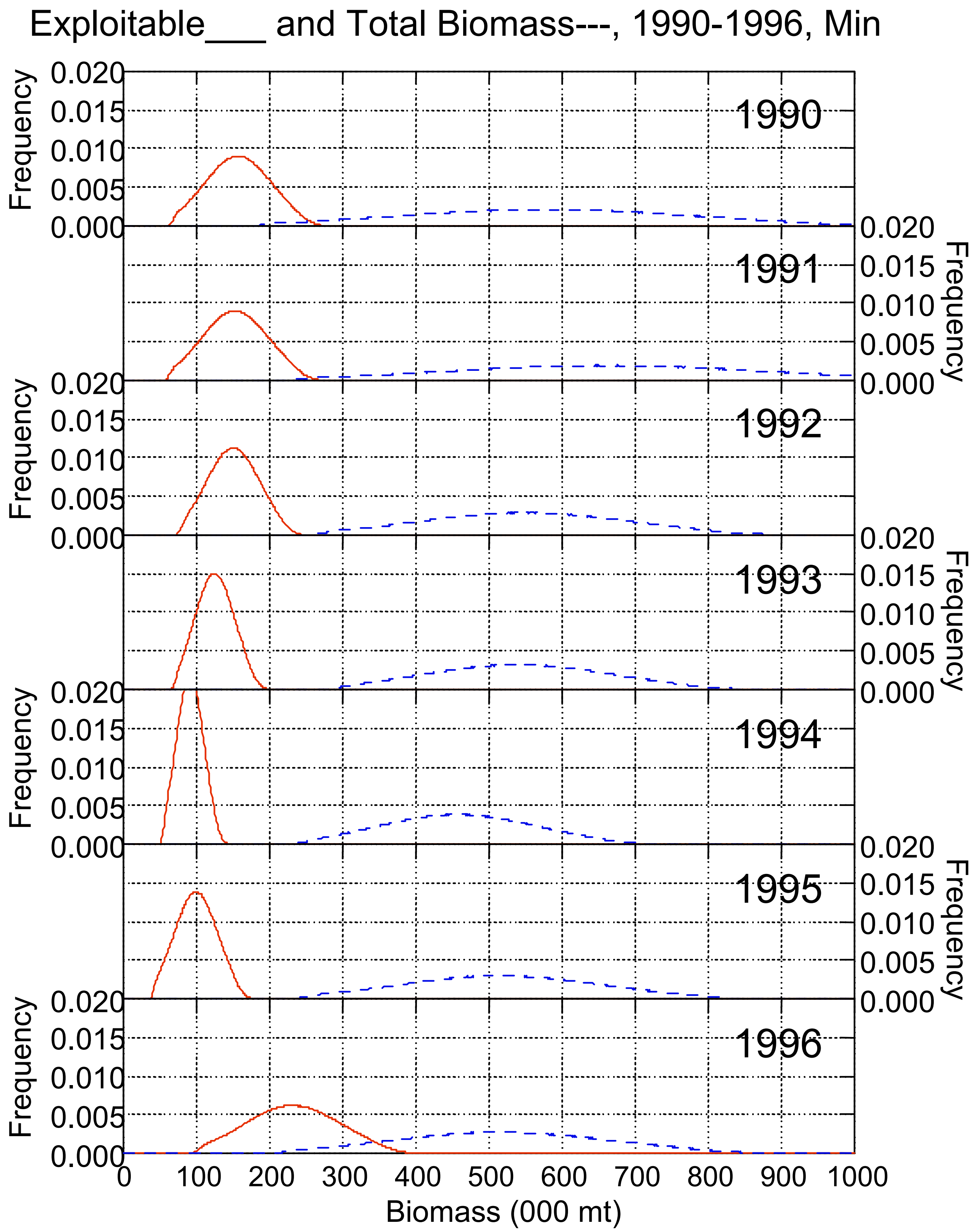


Fig. B7.3 a. Sampling distribution of exploitable(solid line) and total biomass (dashed line) of spiny dogfish, 1990-1996, under the assumption of the minimum trawl footprint.

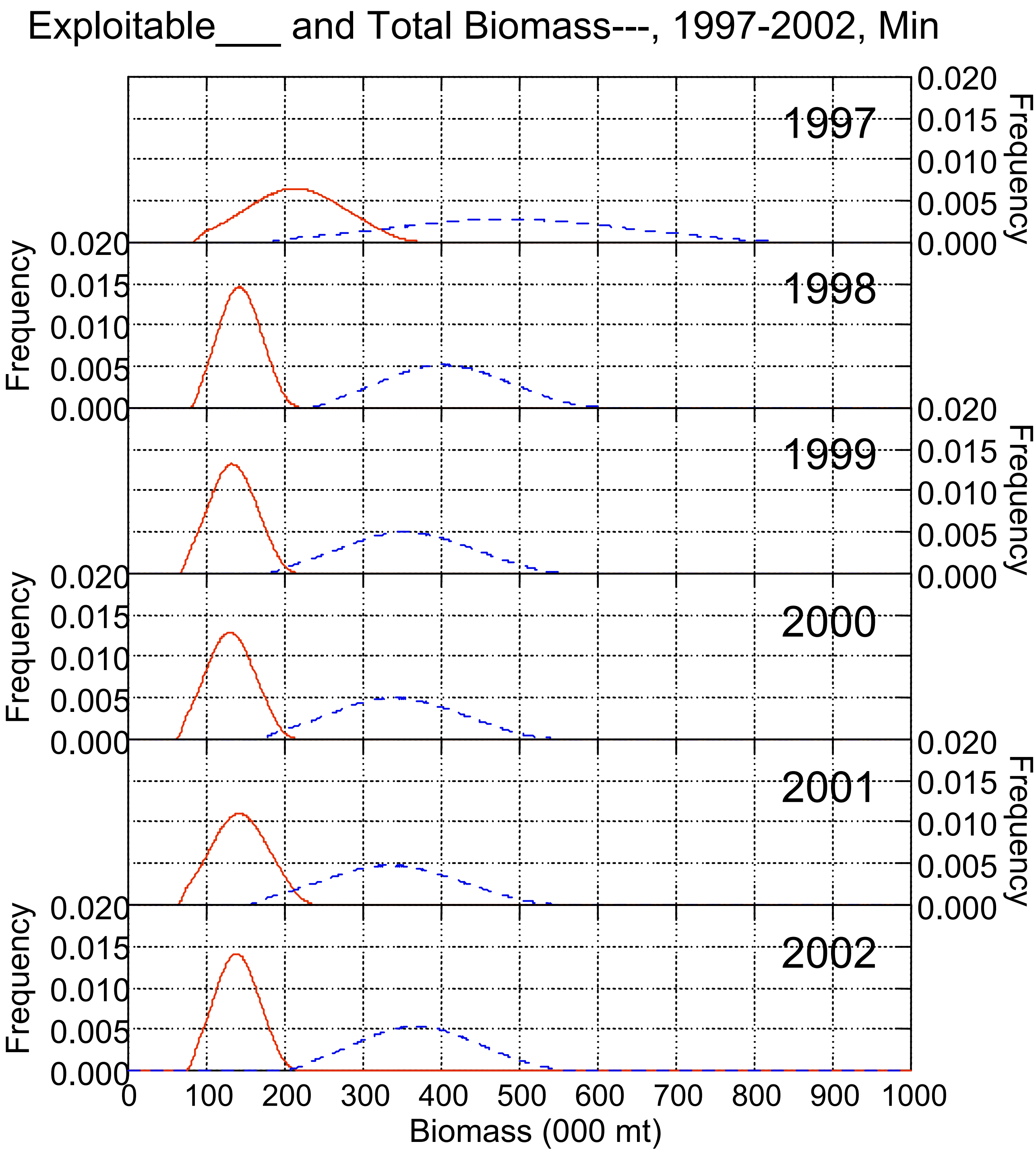


Fig. B7.3 b. Sampling distribution of exploitable(solid line) and total biomass (dashed line) of spiny dogfish, 1997-2002, under the assumption of the maximum trawl footprint.

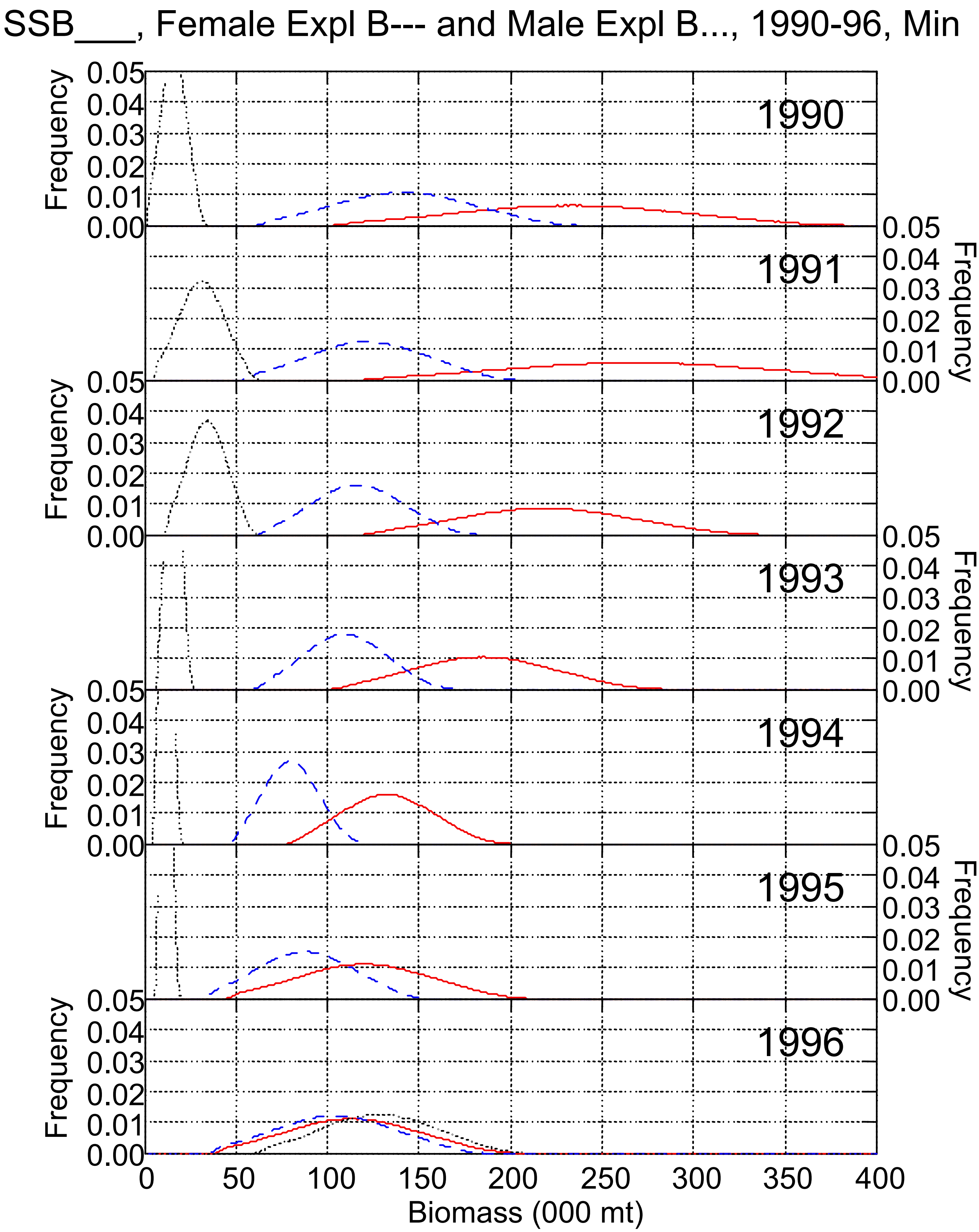


Fig. B7.4 a. Sampling distribution of spawning stock biomass (solid line), female exploitable biomass (dashed) and male exploitable biomass (dashed line) of spiny dogfish, 1990-1996, under the assumption of the minimum trawl footprint.

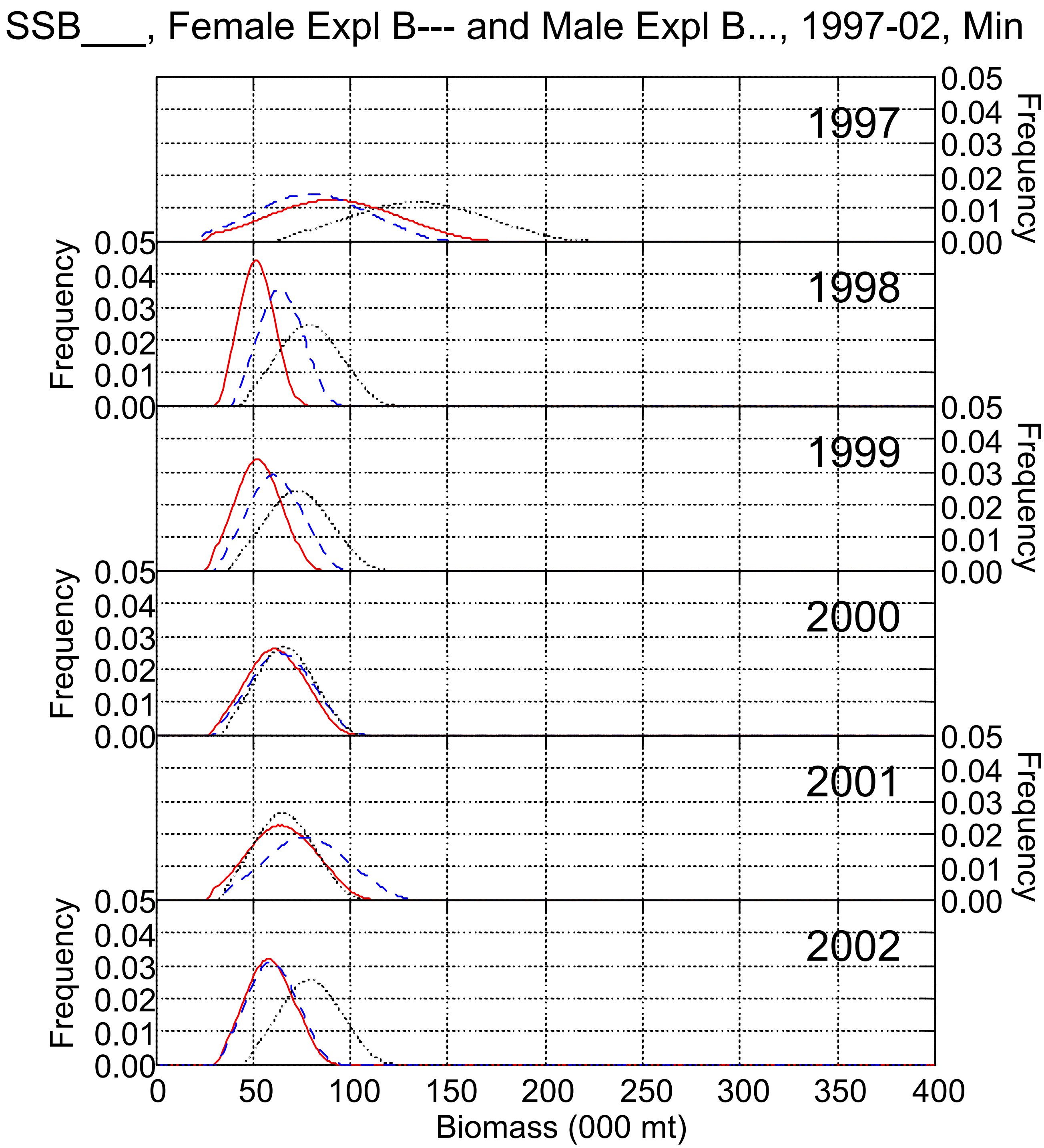


Fig. B7.4 b. Sampling distribution of spawning stock biomass (solid line), female exploitable biomass (dashed) and male exploitable biomass (dashed line) of spiny dogfish, 1997-2002, under the assumption of the minimum trawl footprint.

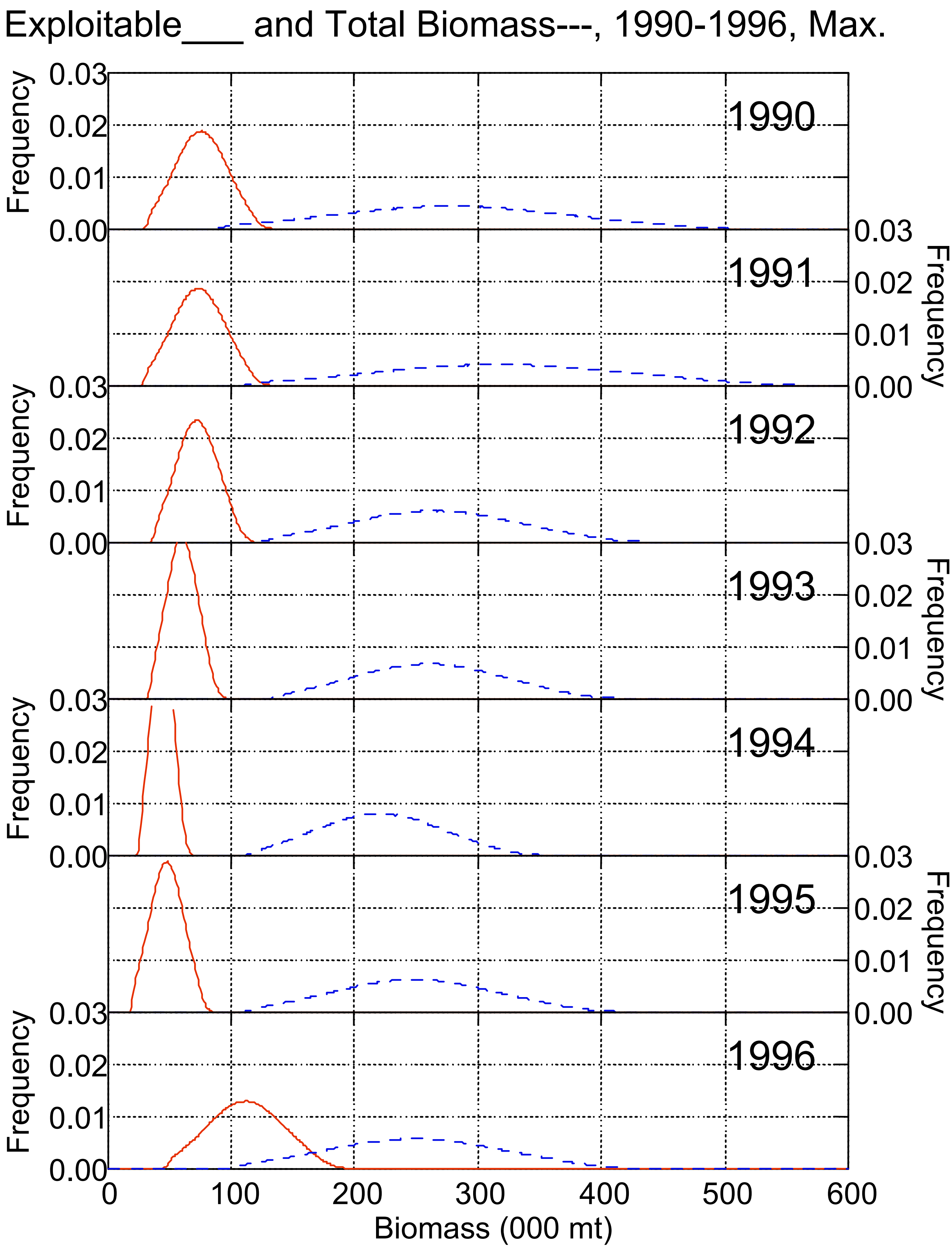


Fig. B7.5 a. Sampling distribution of exploitable(solid line) and total biomass (dashed line) of spiny dogfish, 1990-1996, under the assumption of the maximum trawl footprint.

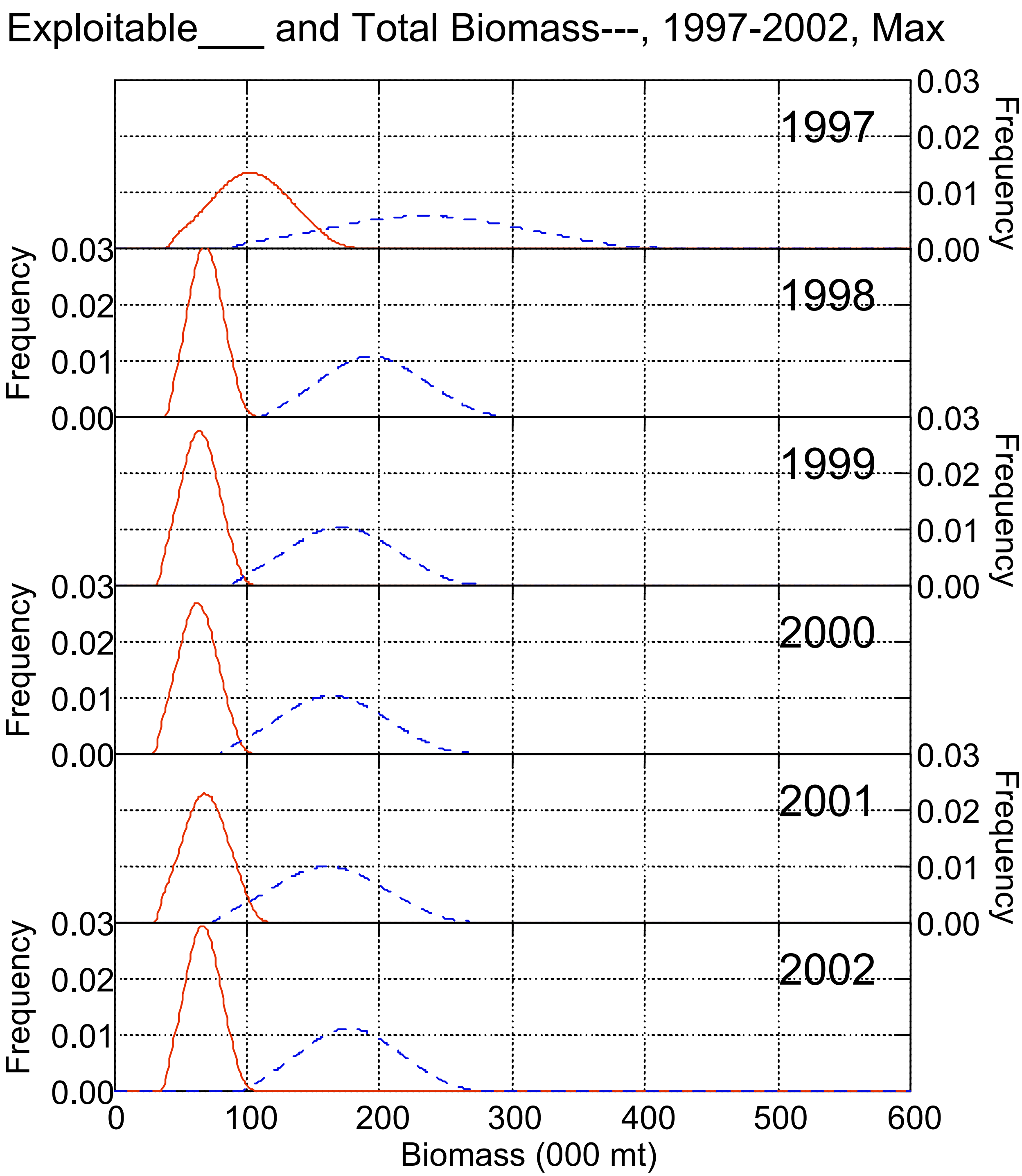


Fig. B7.5 b. Sampling distribution of exploitable(solid line) and total biomass (dashed line) of spiny dogfish, 1997-2002, under the assumption of the maximum trawl footprint.

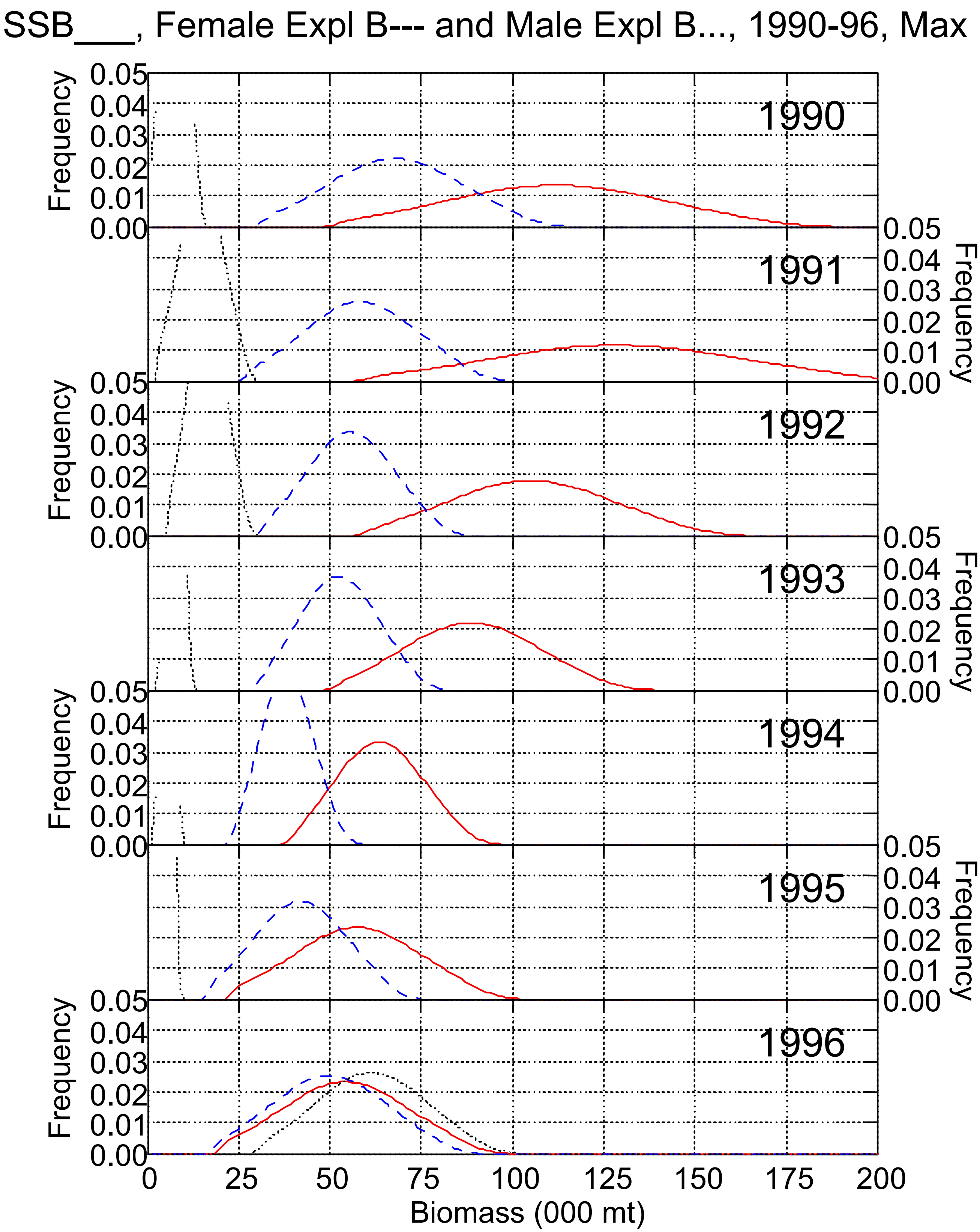


Fig. B7.6 a. Sampling distribution of spawning stock biomass (solid line), female exploitable biomass (dashed) and male exploitable biomass (dashed line) of spiny dogfish, 1990-1996, under the assumption of the maximum trawl footprint.

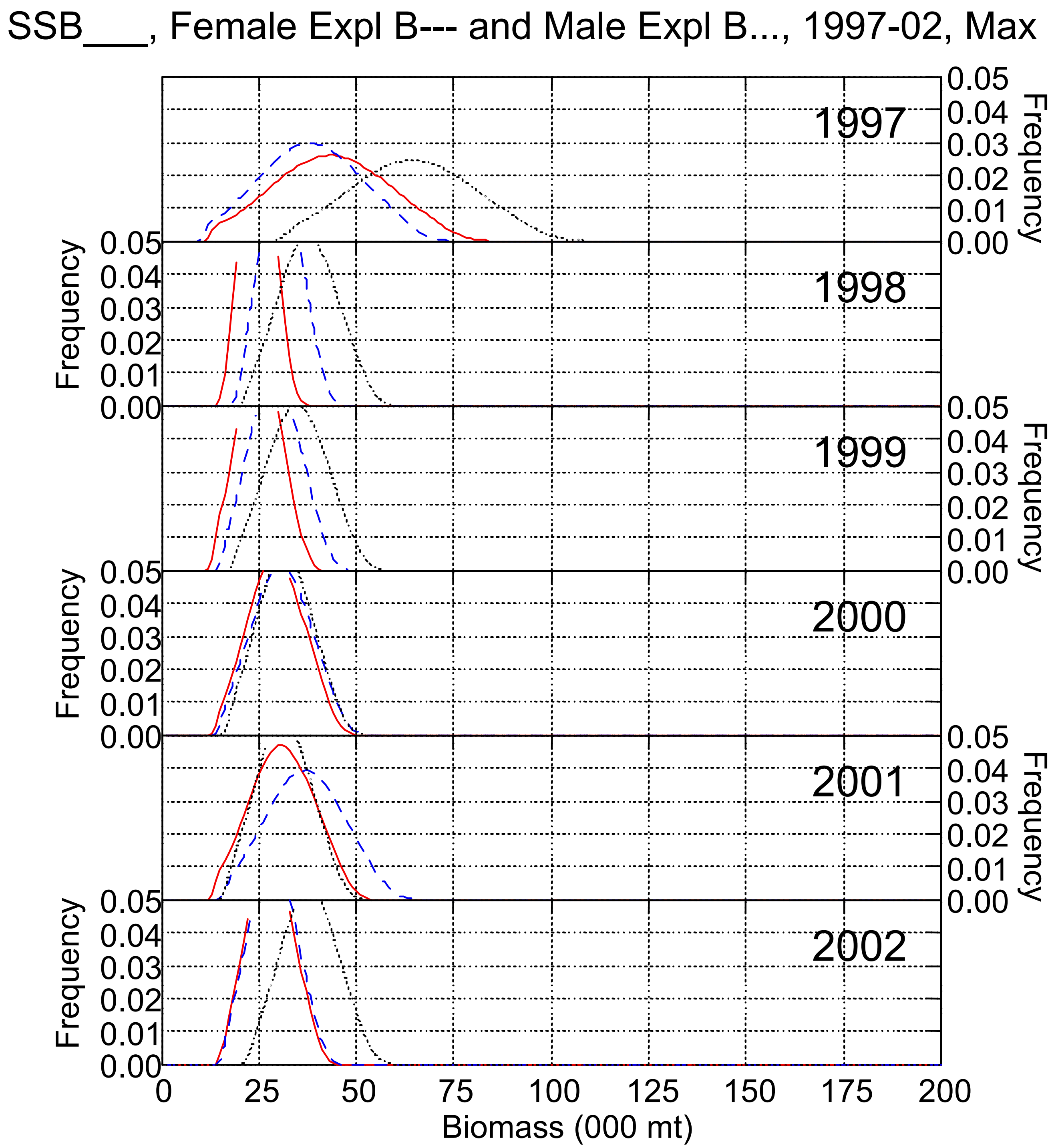


Fig. B7.6b. Sampling distribution of spawning stock biomass (solid line), female exploitable biomass (dashed) and male exploitable biomass (dashed line) of spiny dogfish, 1997-2002, under the assumption of the maximum trawl footprint.

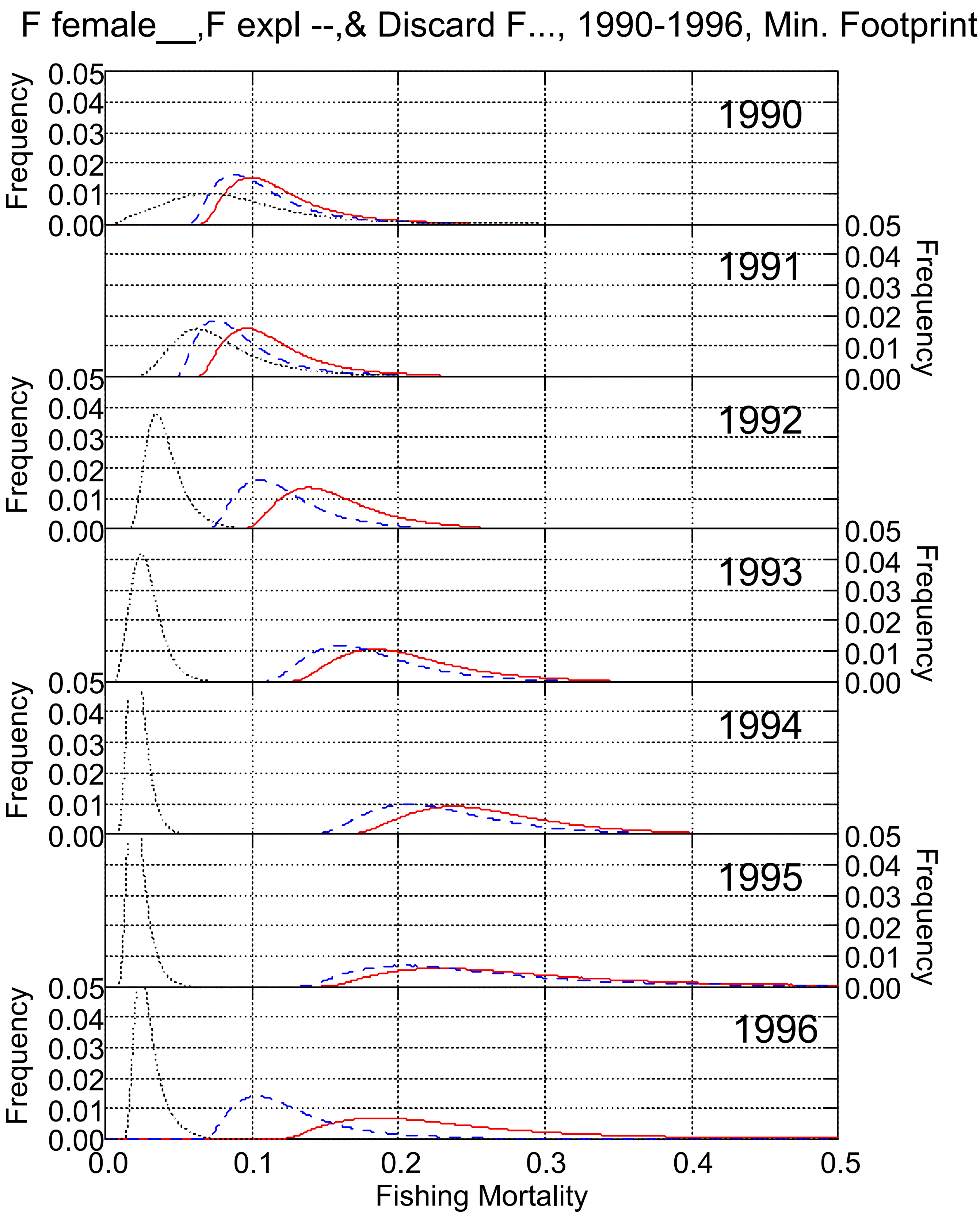


Fig. B7.7 a. Sampling distribution of fishing mortality on fema le exploitable biomass (solid line), on total exploitable biomass (dashed) and fishing mortality from discards on total biomass (dots) of spiny dogfish, 1990-1996, under the assumption of the minimum trawl footprint.

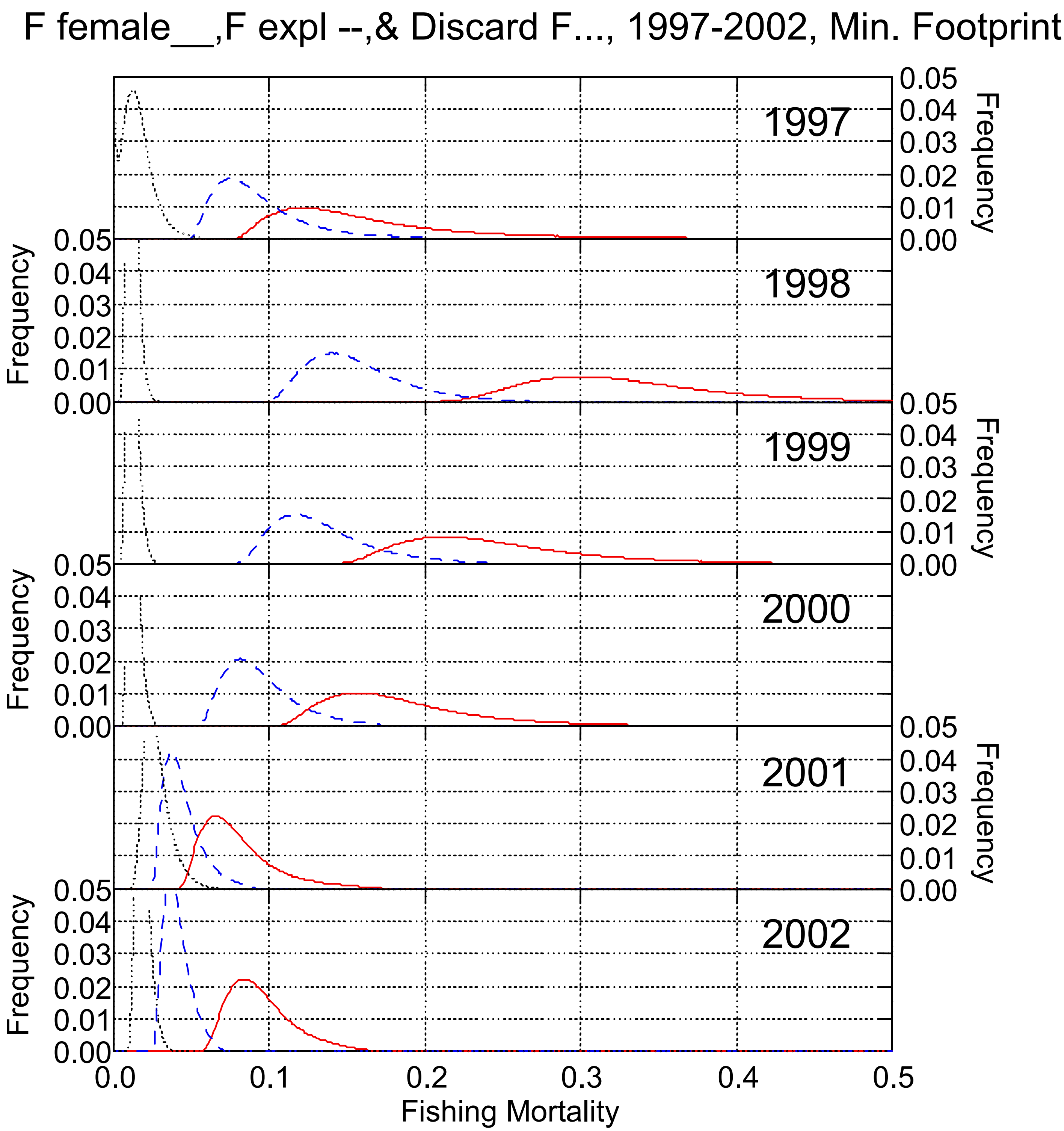


Fig. B7.7 b. Sampling distribution of fishing mortality on female exploitable biomass (solid line), on total exploitable biomass (dashed) and fishing mortality from discards on total biomass (dots) of spiny dogfish, 1997-2002, under the assumption of the minimum trawl footprint.

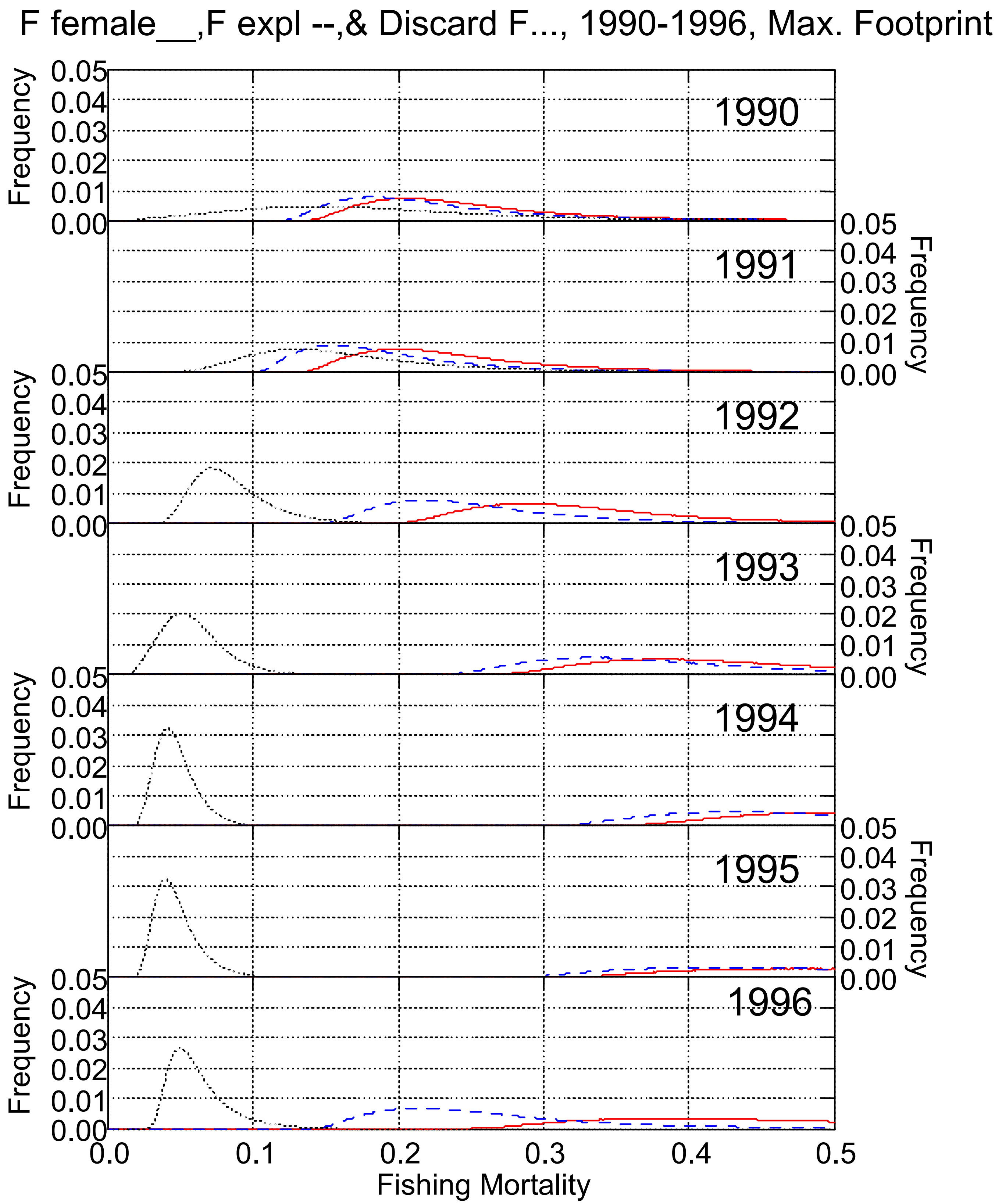


Fig. B7.8 a. Sampling distribution of fishing mortality on female exploitable biomass (solid line), on total exploitable biomass (dashed) and fishing mortality from discards on total biomass (dots) of spiny dogfish, 1990-1996, under the assumption of the maximum trawl footprint.

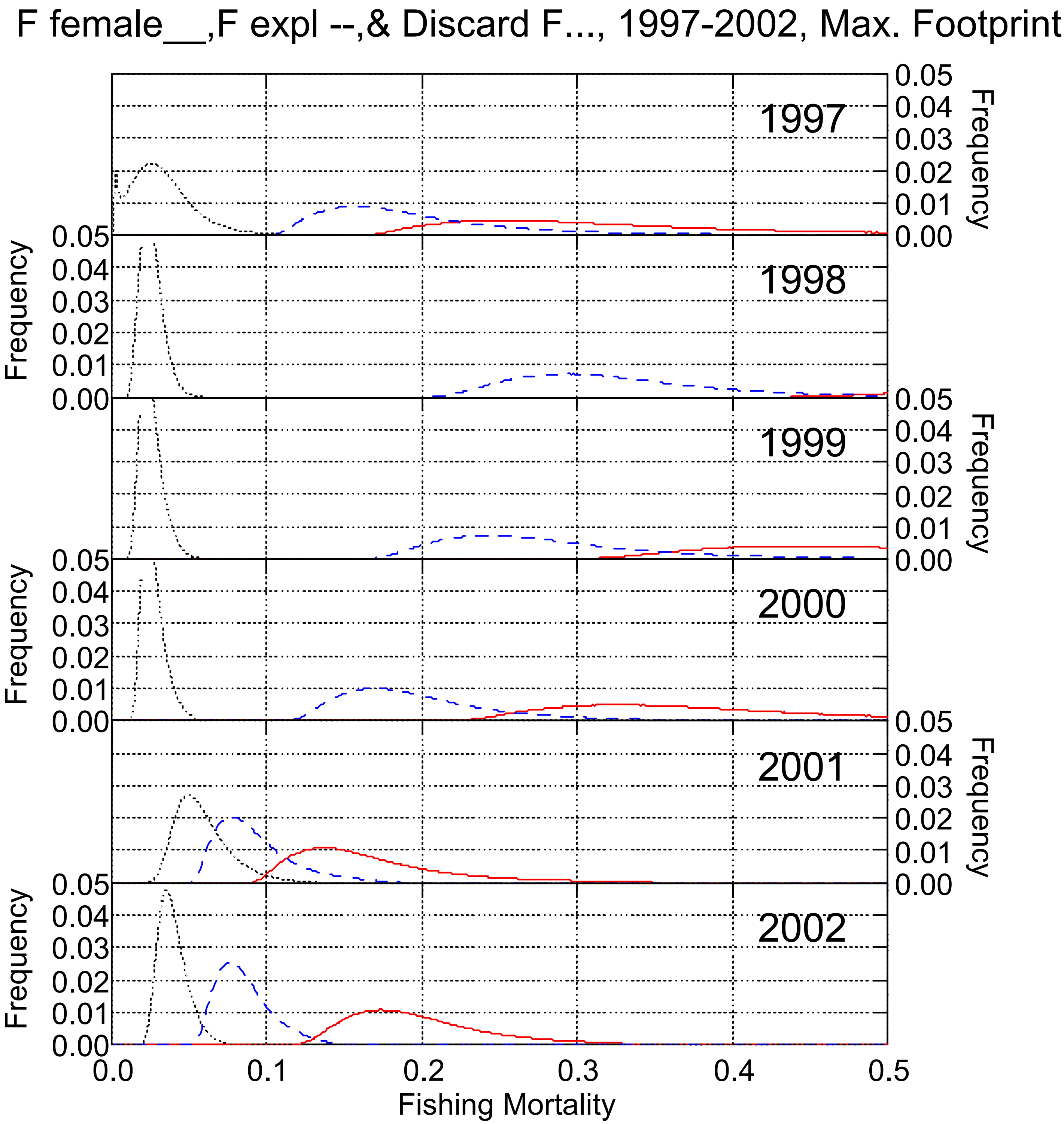


Fig. B7.8 b. Sampling distribution of fishing mortality on female exploitable biomass (solid line), on total exploitable biomass (dashed) and fishing mortality from discards on total biomass (dots) of spiny dogfish, 1997-2002, under the assumption of the maximum trawl footprint.

1968-96, 1968-2003 Comparison

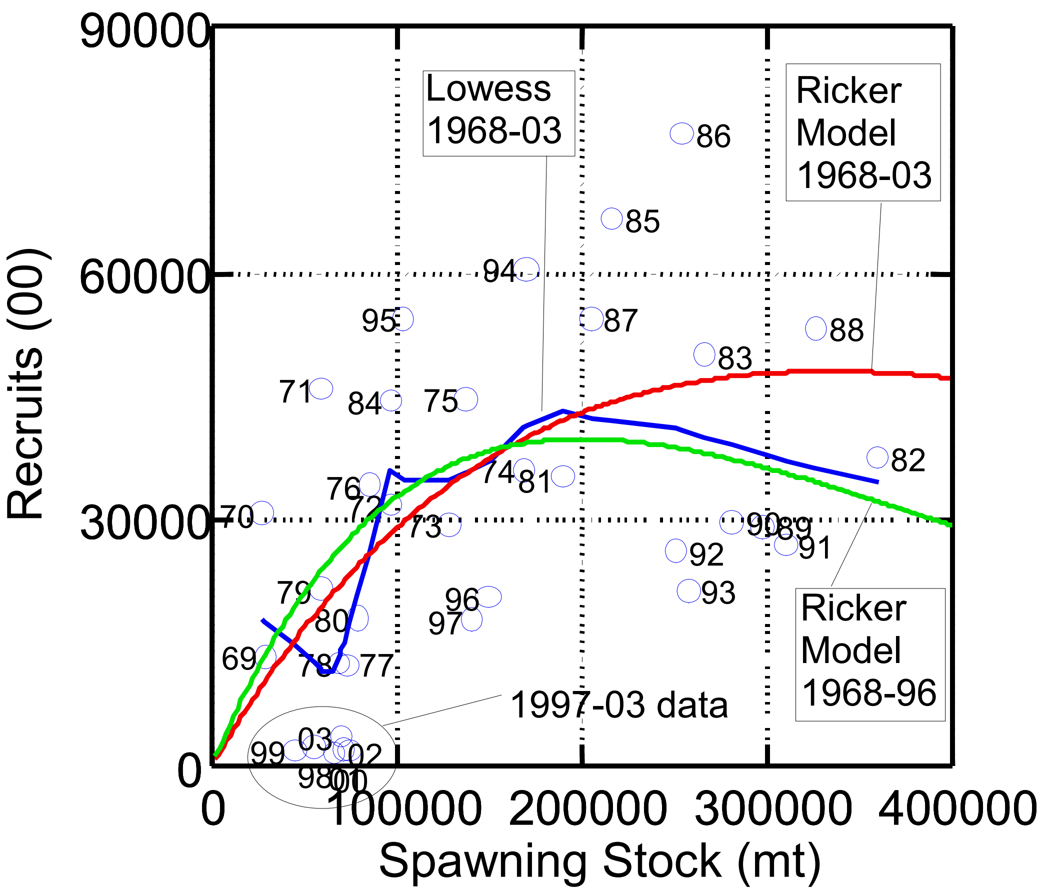


Figure B8.1 Comparison of parametric and nonparametric S-R curves for spiny dogfish for 1968-1996 (top), 1968-2003 (bottom). Point estimates of SSB_{max} based on nominal footprint of 0.01 nm^2 and unscaled NEFSC spring trawl survey catch rates. Nonparametric models based on Lowess smooths with tension = 0.6, suggest no change in SSBmax estimates. Biomass corresponding to 0.01 nm^2 footprint is 215 k mt. This corresponds to a NEFSC Spring Survey average catch of 33.2 kg/tow. Using the Ricker model for 1968-03 inflates the SSB_{max} to 294 k mt (45.2 kg/tow), owing to the low recruitment between 1997-03.

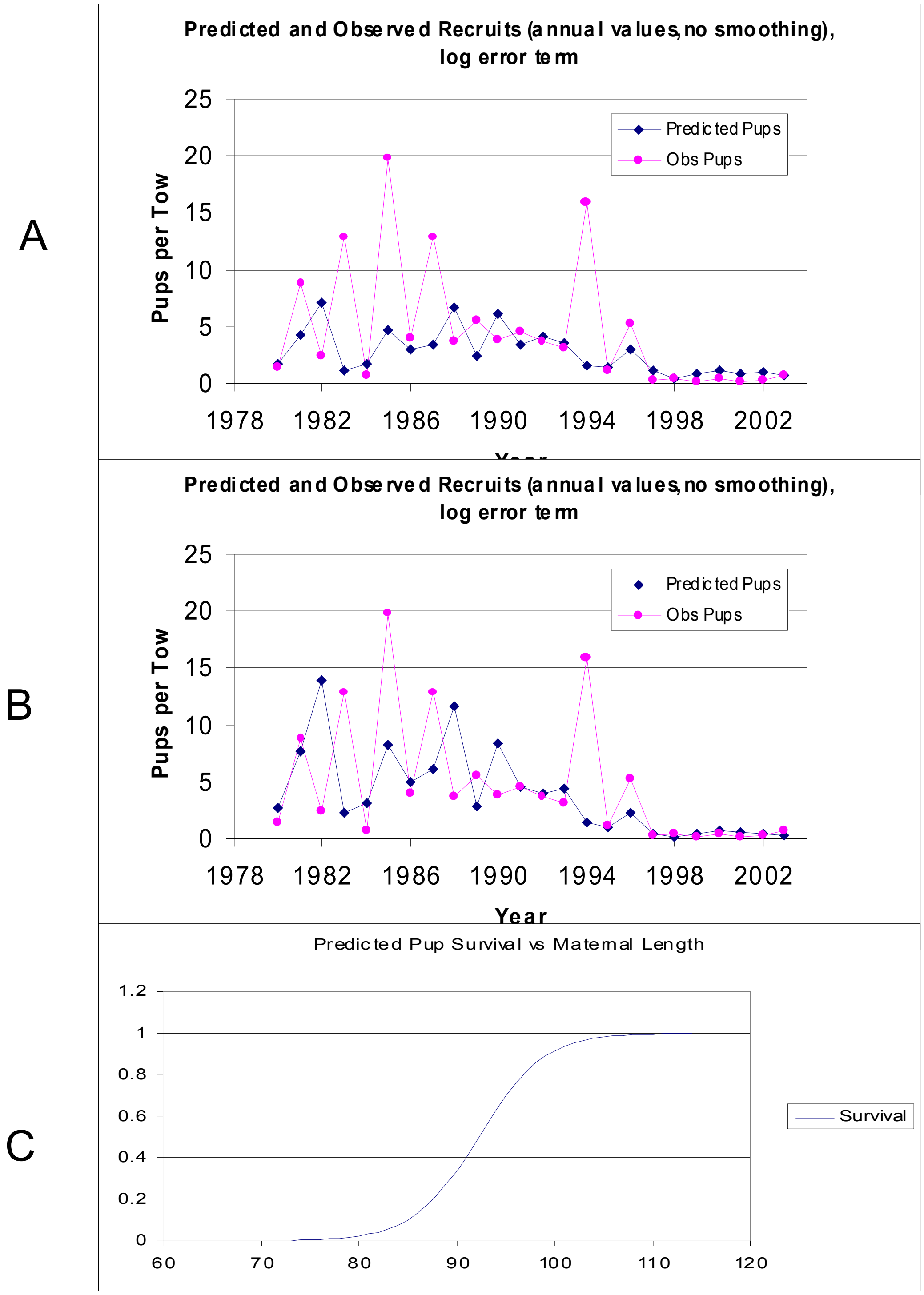


Fig. B8.2. Comparison of observed and predicted numbers of pups for two alternative demographic models. A Constant first year survival, with no maternal effect. B. First year survival increases with maternal size. The empirical estimate of first year survival vs maternal size is depicted in panel C.

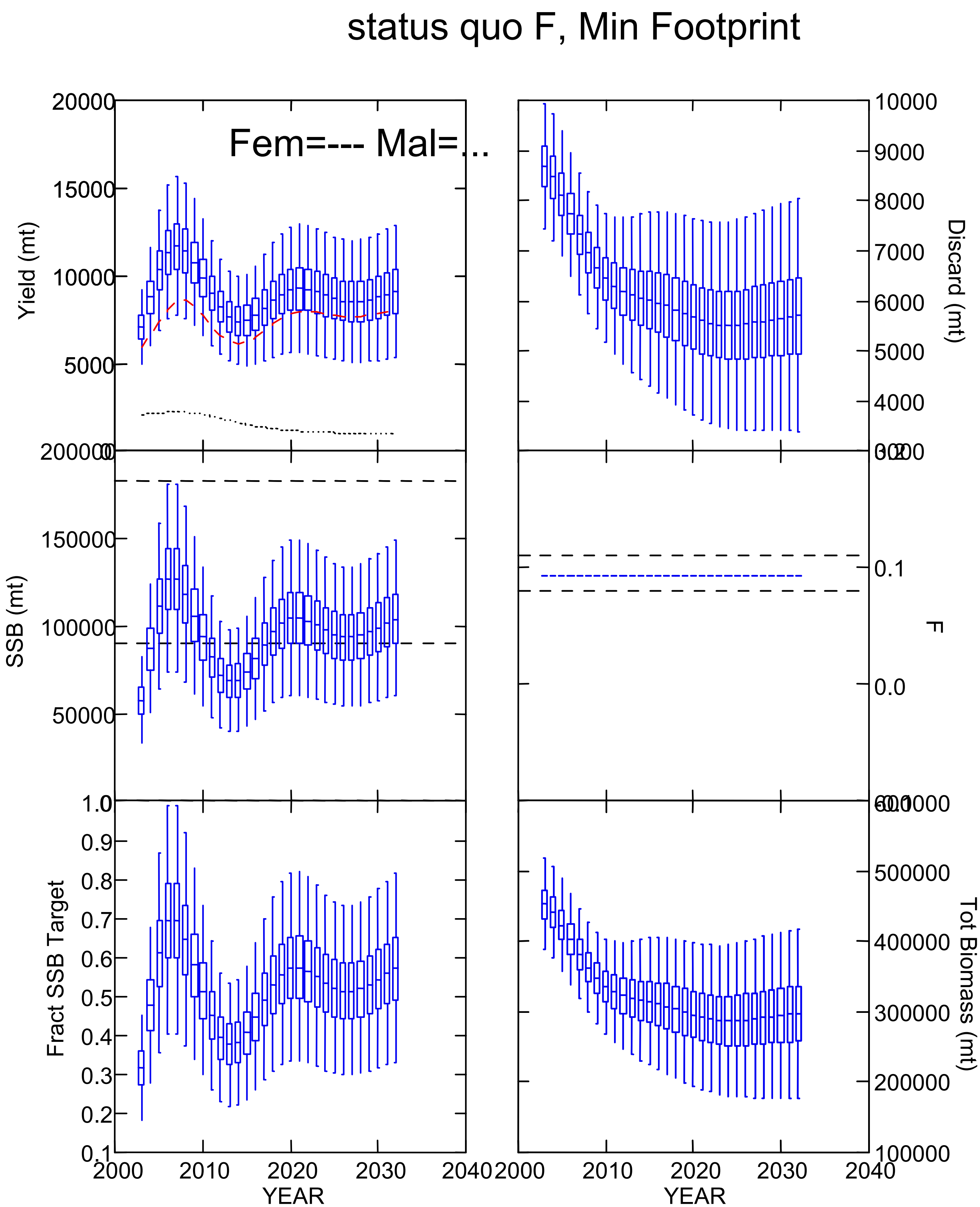


Fig. B9.1 Summary of projection model simulation results under the status quo F scenario. Minimum footprint is assumed. See text for details.

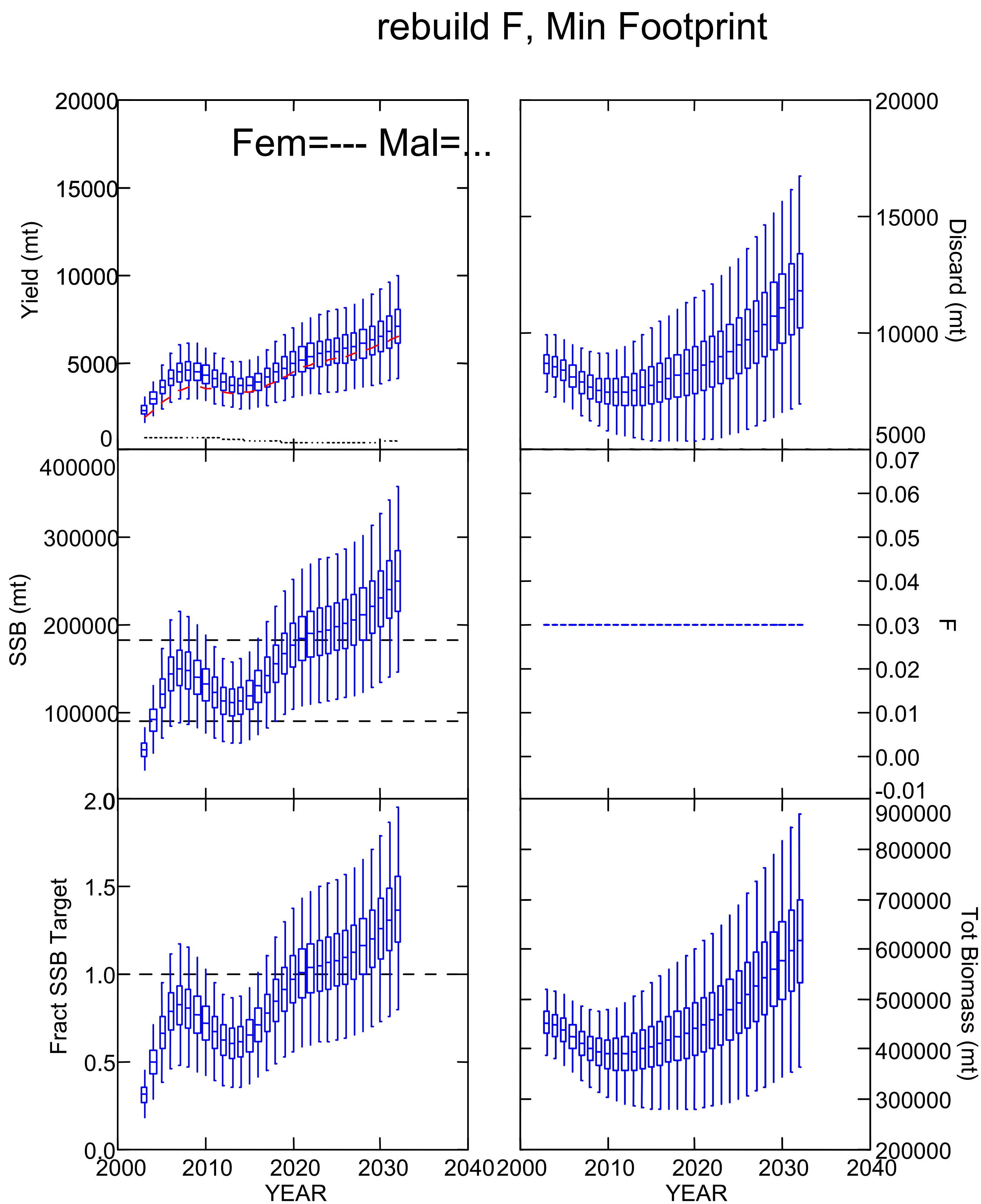


Fig. B9.2 Summary of projection model simulation results under the rebuild F scenario. Minimum footprint is assumed. See text for details.

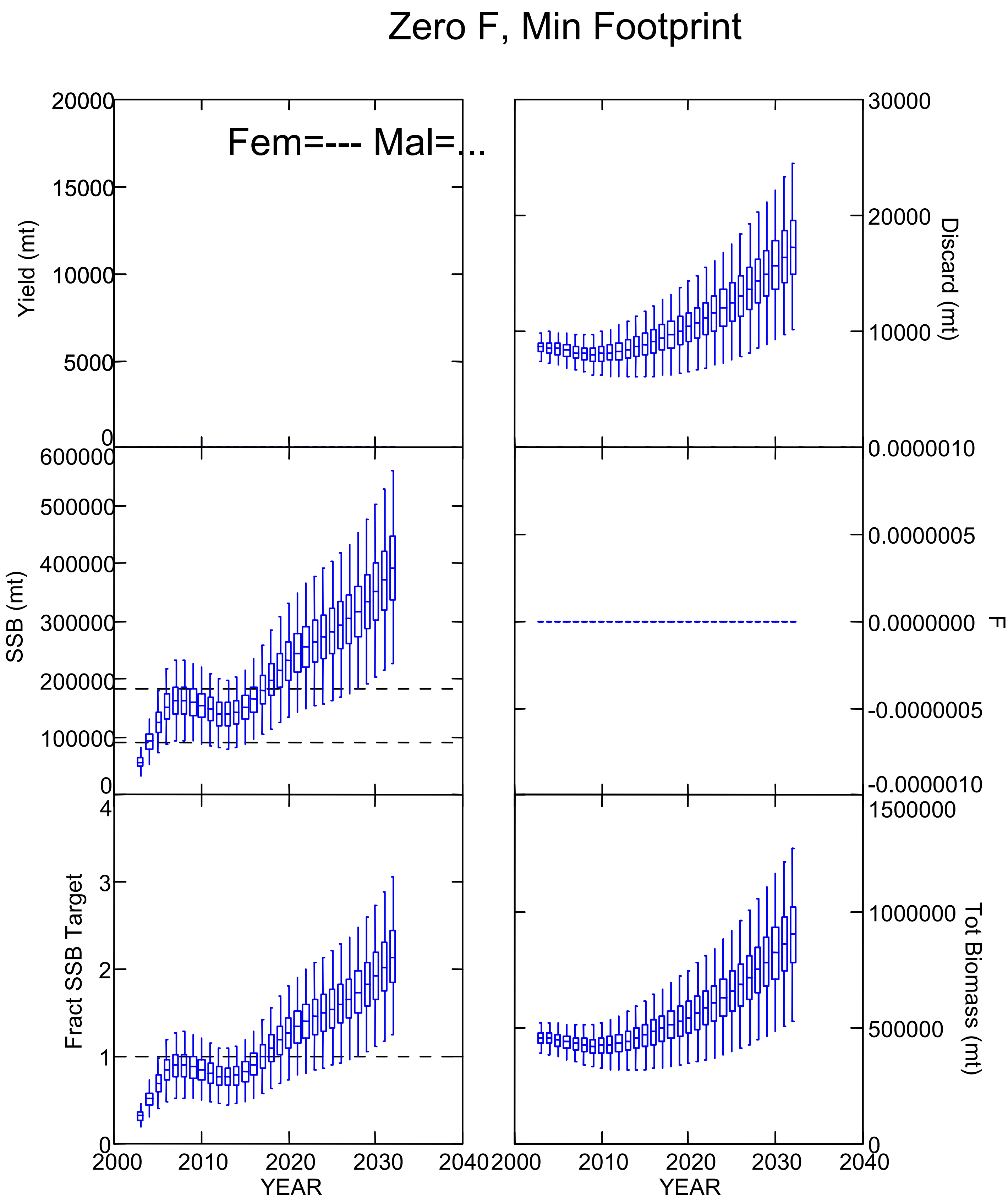


Fig. B9.3 Summary of projection model simulation results under the Zero F scenario. Minimum footprint is assumed. See text for details.

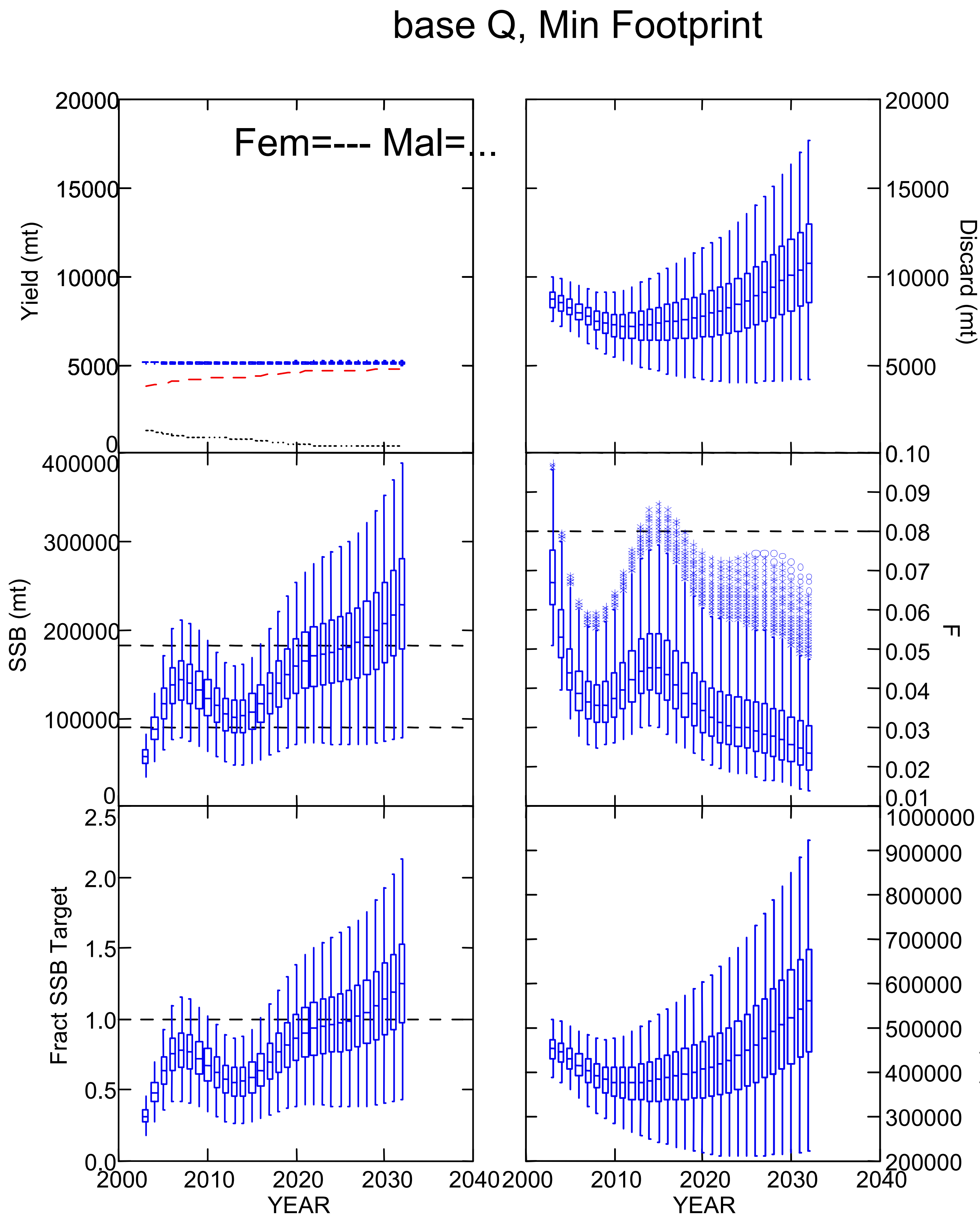


Fig. B9.4 Summary of projection model simulation results under the baseline Quota scenario. Minimum footprint is assumed. See text for details.

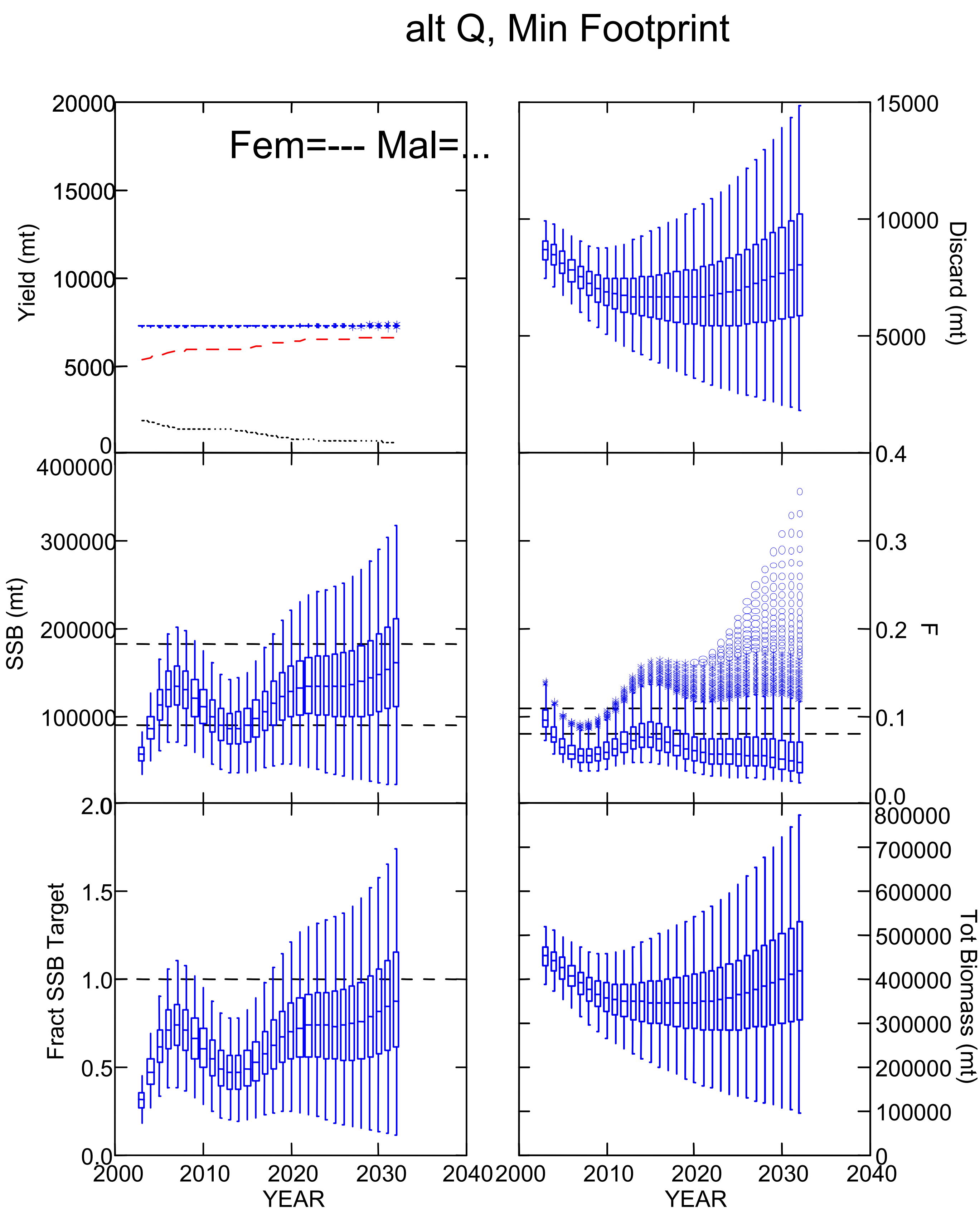


Fig.B 9.5 Summary of projection model simulation results under the alternative Quota scenario. Minimum footprint is assumed. See text for details.

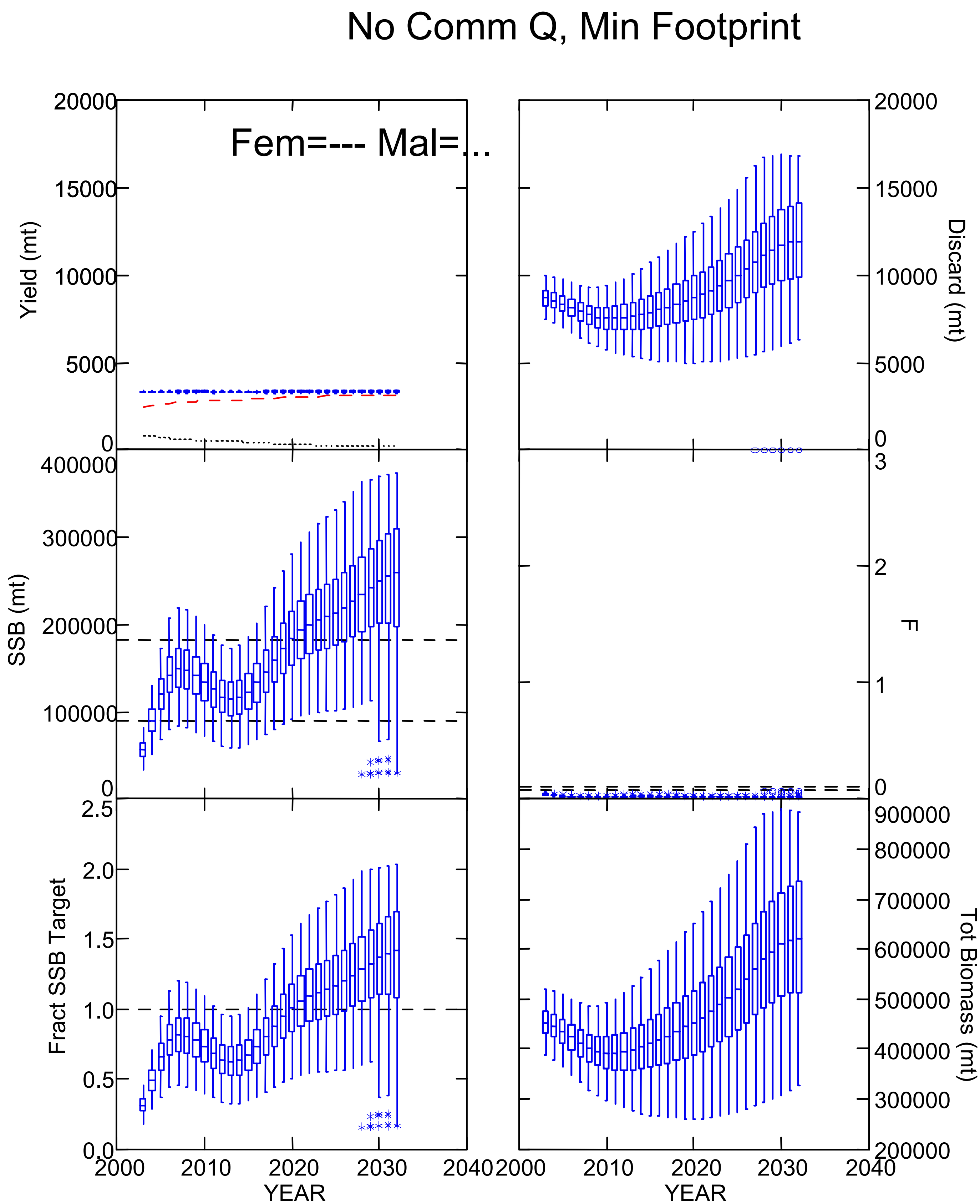


Fig. B9.6 Summary of projection model simulation results under the No Commercial Quota scenario. Minimum footprint is assumed. See text for details.

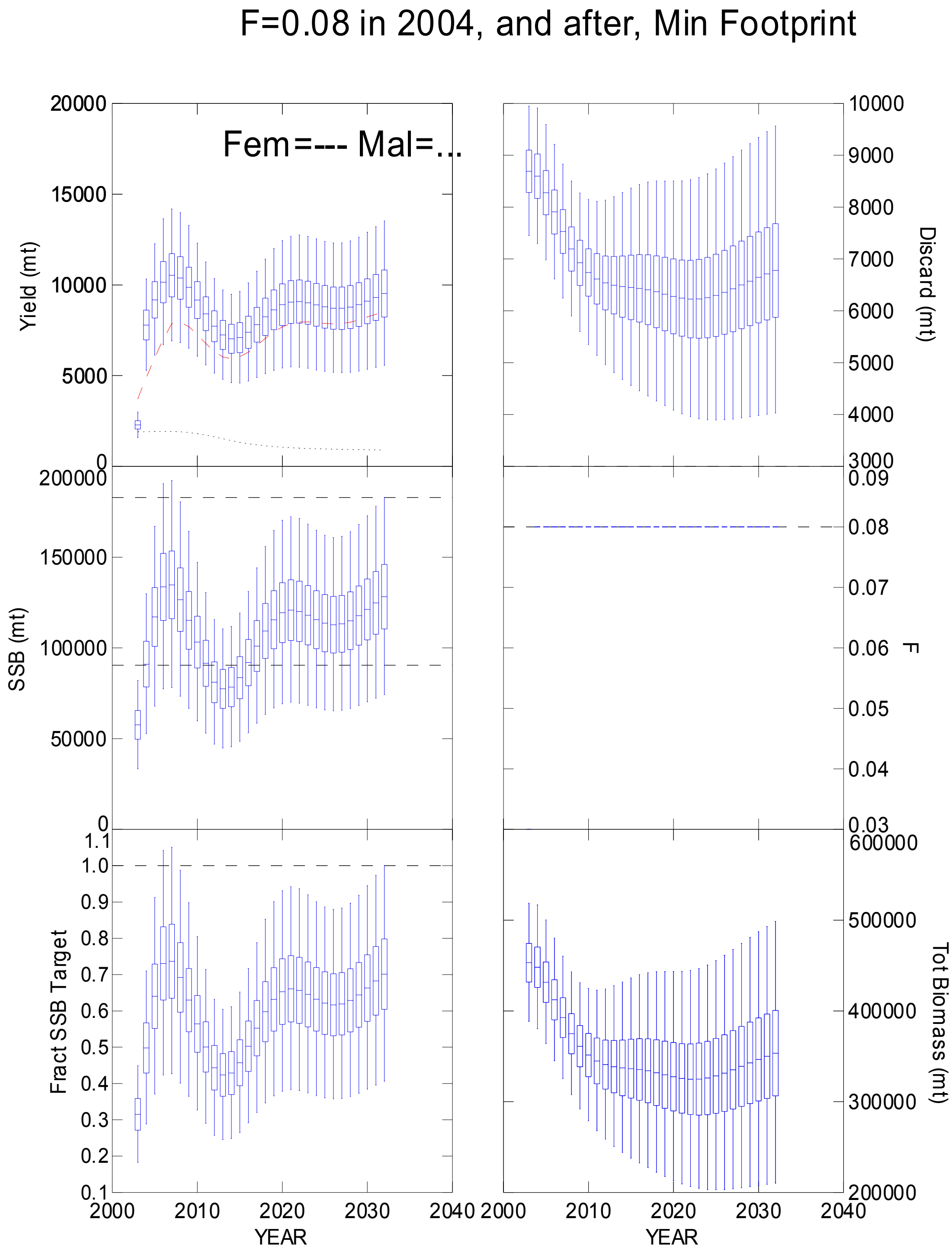


Fig. B9.7 Summary of projection model simulation results under the federal FMP specified F level of 0.08 in 2004. See text for additional details.

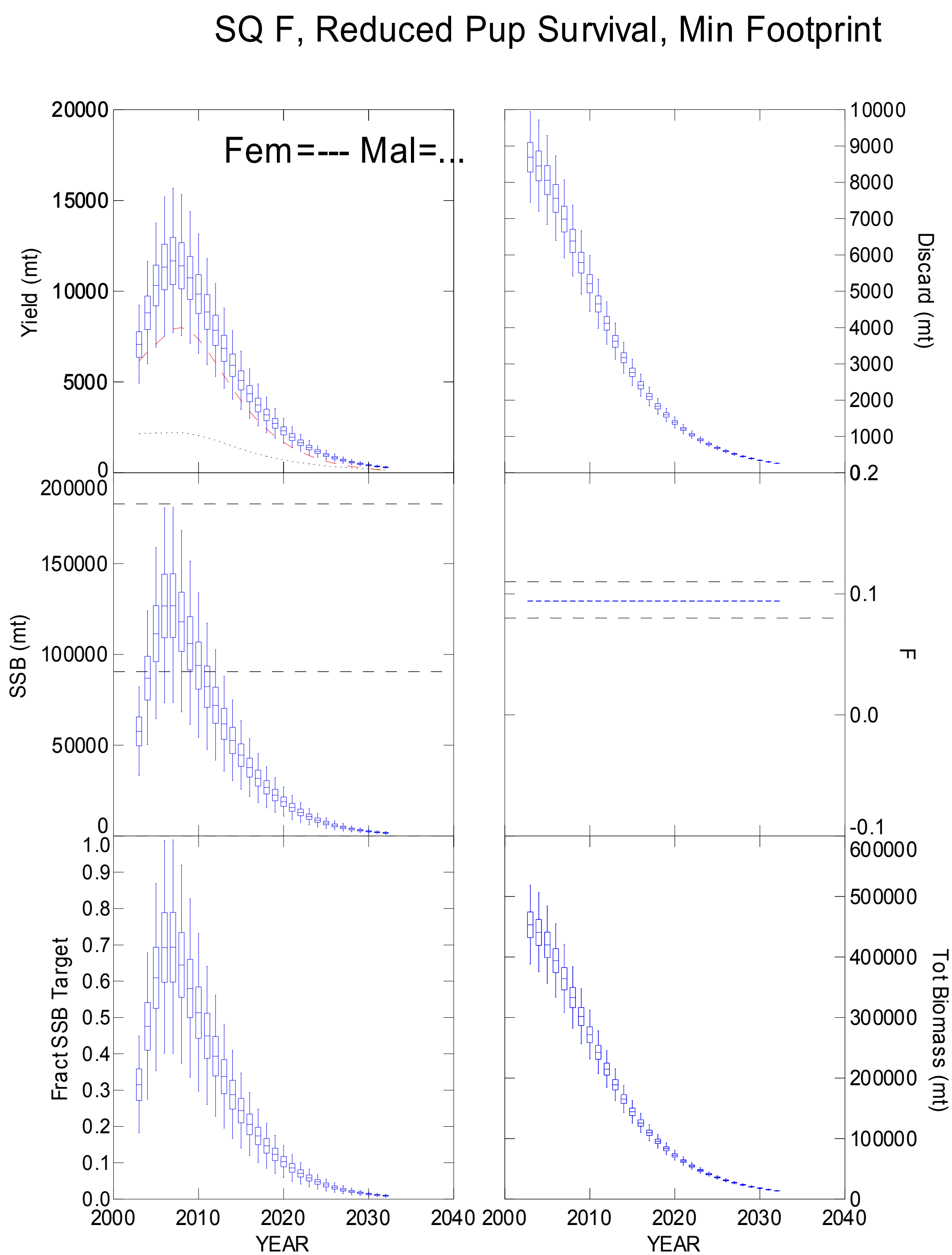


Fig. B9.8 Summary of projection model simulation results under the assumption that the status quo F continues and first year pup survival is expressed as a function of maternal size. This scenario suggests that the population will neither rebuild or stabilize under the status quo F. See text for additional details.

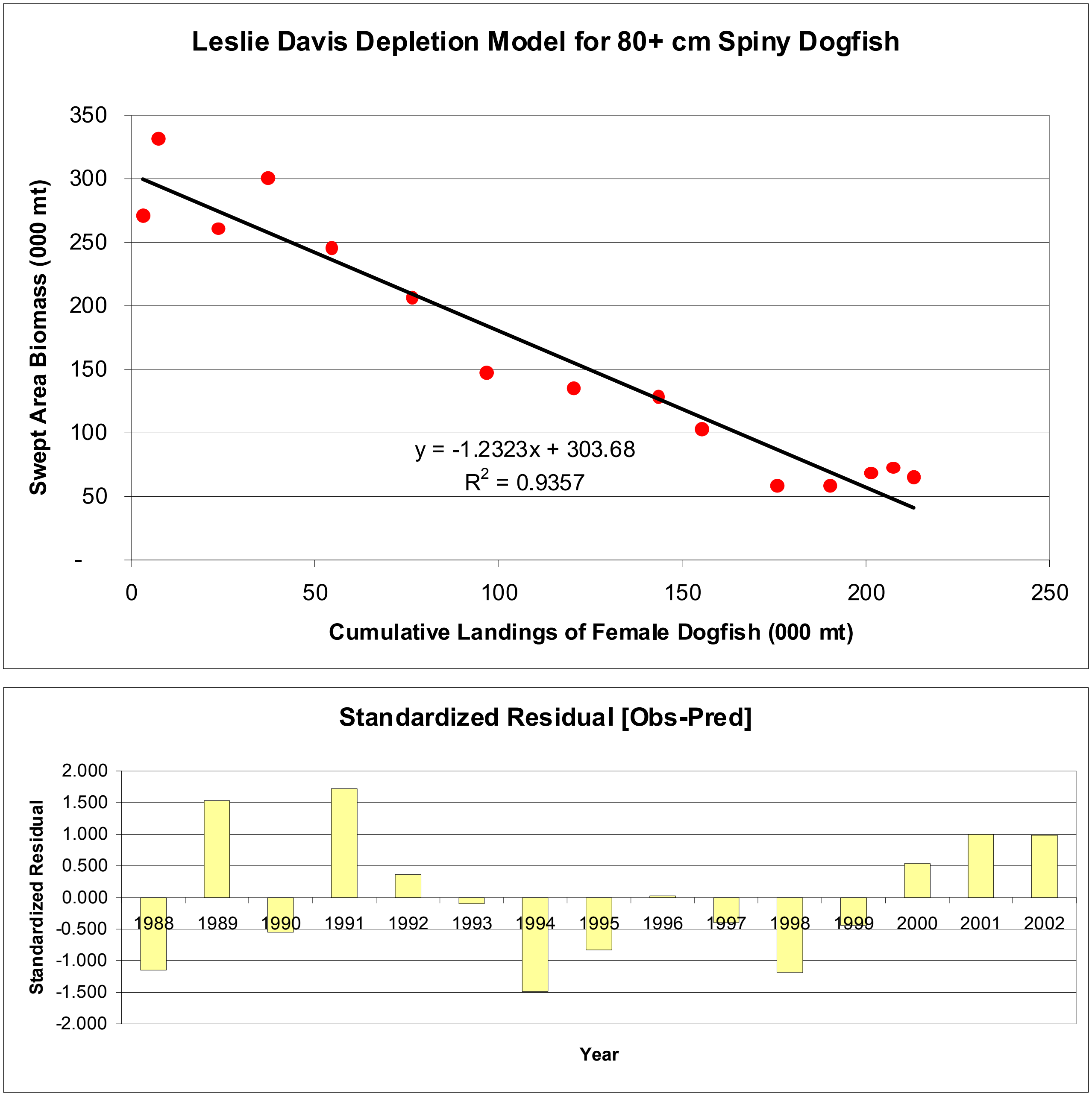
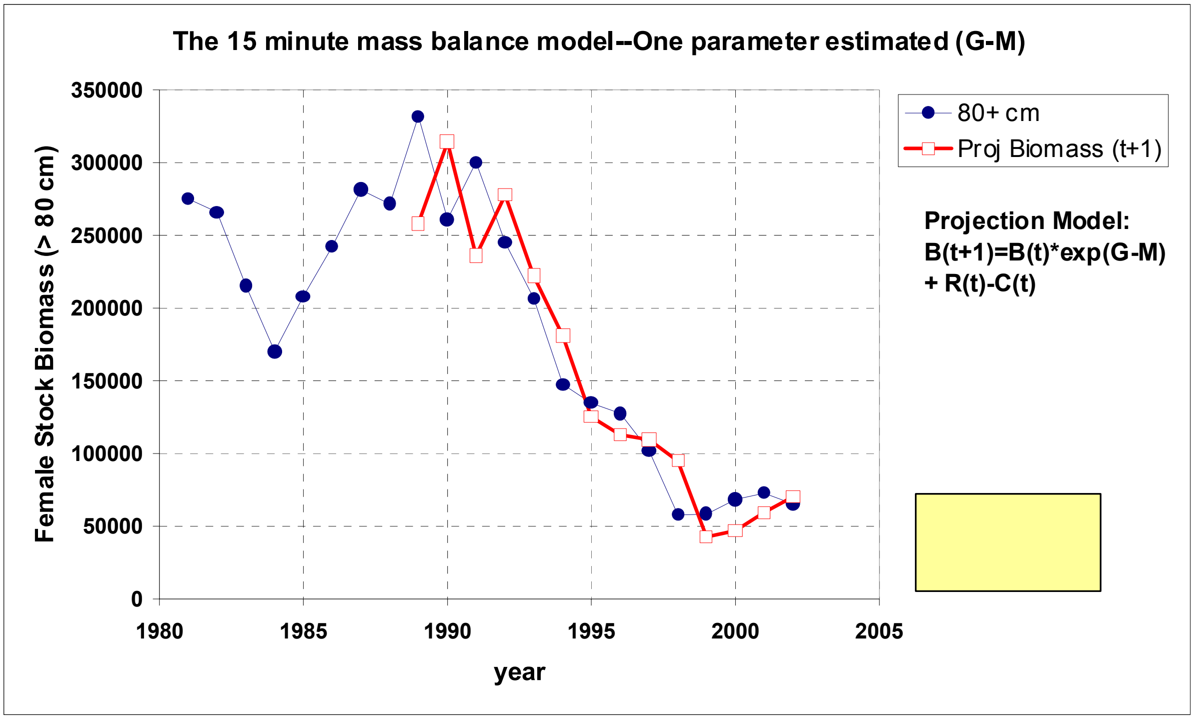
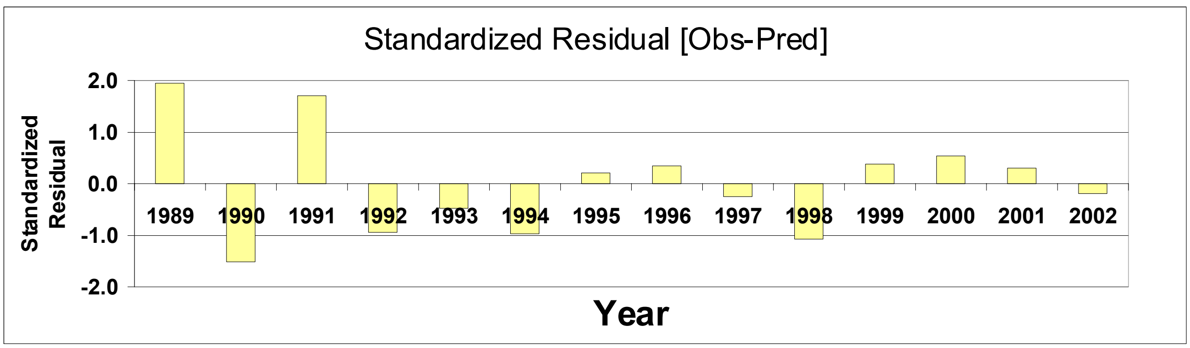
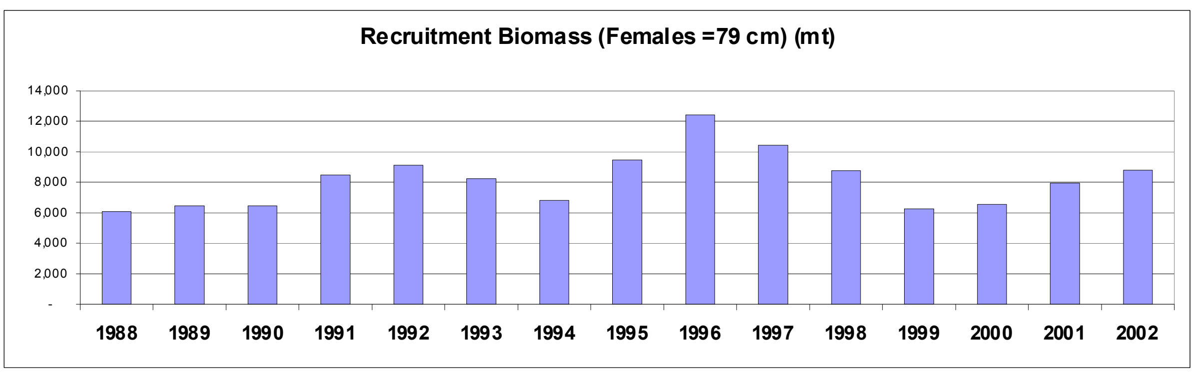


Fig. B10.1. Summary of Leslie-Davis depletion model for female spiny dogfish, assuming a closed population. See text for additional details.







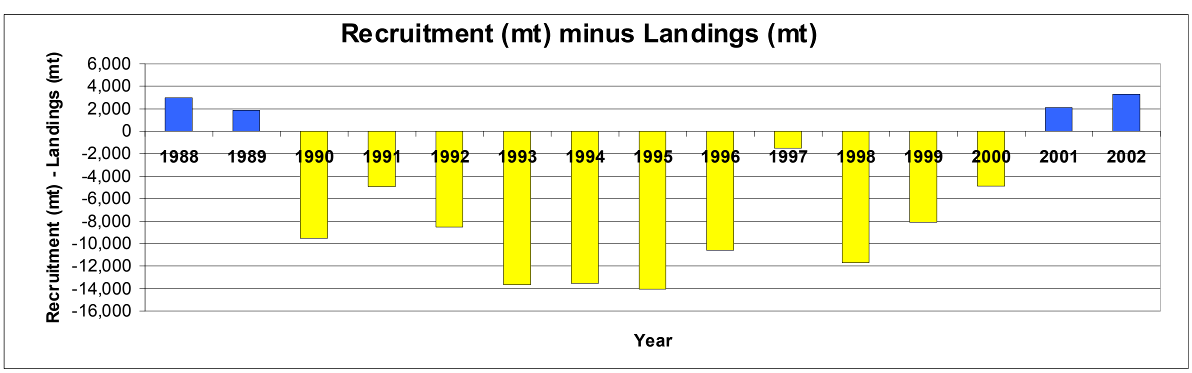


Fig. B10.2. Summary of one-parameter mass balance model. See text for details.