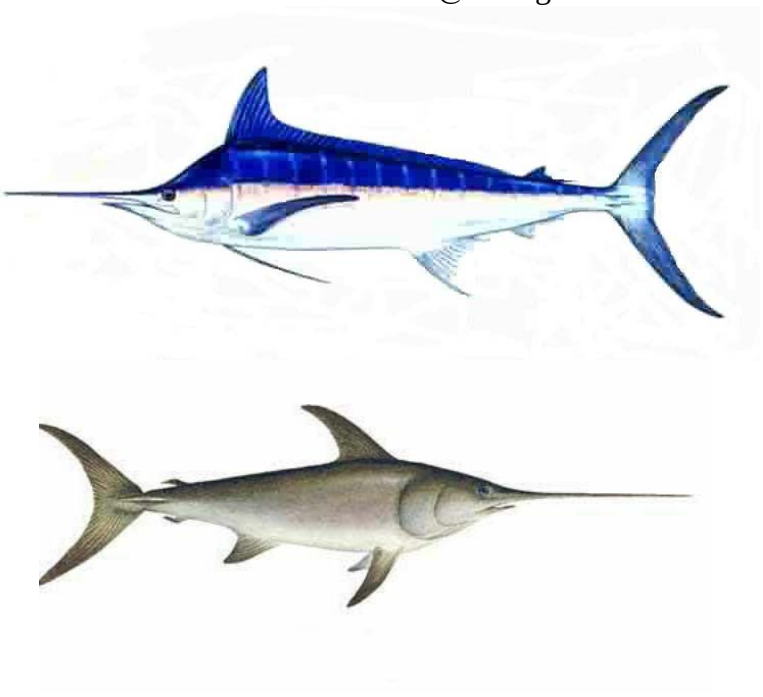
Patterns in Fishery Catches, Standardized CPUEs, and Length Compositions of the Western and Central North Pacific Striped Marlin Stock

Jon Brodziak
NOAA NMFS, Pacific Islands Fisheries Science Center
Honolulu, Hawaii, USA

Lyn Katahira
University of Hawaii, Joint Institute for Marine and Atmospheric Research
Honolulu, Hawaii, USA

Email: Jon.Brodziak@noaa.gov



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Patterns in Fishery Catches, Standardized CPUEs, and Length Compositions of the Western and Central North Pacific Striped Marlin Stock

Jon Brodziak and Lyn Katahira

Pacific Islands Fisheries Science Center, Honolulu, HI 96822-2326
Email: Jon.Brodziak@NOAA.GOV

Abstract

This working paper depicts patterns in the catch of the Japanese distant water longline fleet (JDWLL), the standardized catch per unit effort (CPUE) estimated by fleet and by area where appropriate, and the length composition data available for the current assessment of the western and central North Pacific Ocean (WCPO) striped marlin stock. There are a total of 59 graphs showing the temporal patterns of catch, standardized CPUE, sample sizes of length frequency data, and length composition by fleet. The reported catch of WCPO striped marlin in numbers of fish harvested by the JDWLL fleet in all stock areas showed a declining trend since the 1960s. The reported quarterly catch of WCPO striped marlin in numbers of fish harvested by the JDWLL fleet also showed variation occurs across quarters of the year. The average quarterly mean fish weights of WCPO striped marlin harvested by the JDWLL fleet also showed variability across quarters since 1975. Trends in standardized JDWLL CPUE showed interannual variability and heterogeneous temporal patterns but the standardized JDWLL CPUE series by assessment area all showed a consistent declining trend in the 2000s. Overall, the number of moderate to strong positive correlations among CPUE time series increased from the 1975-1986 assessment time period to the 2000-2009 assessment time period. Plots of sample size by fleet showed that most of the available length data were collected from the JDWLL fleets in areas 2 and 3 and the Japanese Coastal longline fleet (JCLL) with some additional samples collected from JDWLL in all areas during 1970-1975 and also collected from the USA longline fleet since the mid-1990s. Overall, the available length compositions showed that the mean length of sampled striped marlin varied on a quarterly and annual basis by fishing fleet.

This working paper depicts patterns in the catch of the Japanese distant water longline fleet (JDWLL), the standardized catch per unit effort (CPUE) estimated by fleet and by area where appropriate, and the length composition data available for the current assessment of the western and central North Pacific Ocean (WCPO) striped marlin stock. There are a total of 59 graphs showing the temporal patterns of catch, standardized CPUE, sample sizes of length frequency data, and length composition by fleet.

The reported catch of WCPO striped marlin in numbers of fish harvested by the JDWLL fleet in all stock areas showed a declining trend since the 1960s (Figure 1). There was also a declining trend in catch numbers in assessment Areas 1, 2, and 3 (Figures 2-4) since the 1970s. The time trends in reported catch weight of WCPO striped marlin showed a similar pattern (Figures 5-8).

The reported quarterly catch of WCPO striped marlin in numbers of fish harvested by the JDWLL fleet also showed variation occurs across quarters of the year (Figures 9-12). Catch numbers in all areas during a given year generally appeared higher in quarters 1 and 2 and appeared lower in quarter 3 (Figure 9). Catch numbers in assessment area 1 appeared higher in quarter 1 and appeared lower in quarter 4 (Figure 10). In assessment areas 2 and 3, catch numbers were generally higher in quarters 1 and 2 and appeared lower in quarter 3 (Figures 11 and 12). Temporal patterns in reported catch weights

exhibited similar patterns to those for catch numbers (Figures 13-16).

The average quarterly mean fish weights of WCPO striped marlin harvested by the JDWLL fleet in also showed variability across quarters since 1975 when annual estimates of mean weight were available (Figures 17-20). The average weights in all areas during a given year were generally higher in quarters 3 and 4 during the 1980s (Figure 17) but since 1990, the average quarterly weights have fluctuated. Average quarterly fish weights for each of the three assessment areas appeared to fluctuate independently of each other (Figures 18-20).

Trends in standardized JDWLL CPUE showed interannual variability and heterogeneous temporal patterns (Figure 21, error bars represent +/- one standard deviation) but the standardized JDWLL CPUE series by assessment area all showed a consistent declining trend in the 2000s (Figure 21). Standardized CPUE series of Japanese coastal longline and driftnet fleets also appeared to show a declining trend in recent years (Figure 22). There was no recent trend information from standardized CPUE for the Japanese high seas driftnet fishery (Figure 22) and there was no apparent trend in quarterly standardized CPUE for the Taiwanese longline fleet (Figure 22). Annual estimates of standardized CPUE for the Taiwanese longline fleet also appeared to fluctuate without trend (Figure 23), while standardized annual CPUE for the USA and Korean longline fleets exhibited declining trends in recent years (Figure 23).

Correlations among time series of standardized CPUE by fleet were examined for the three time periods used to standardize the JDWLL CPUE. These time periods were 1975-1986, 1987-1999, and 2000-2009. Pearson correlation coefficients (ρ) provided a measure of the association among pairs of CPUE series. Associations were categorized as follows: very strong when $0.8 < |\rho| < 1.0$; strong when $0.6 < |\rho| < 0.8$; moderate when $0.4 < |\rho| < 0.6$; weak when $0.2 < |\rho| < 0.4$; and none when $0.0 < |\rho| < 0.2$. Only moderate to very strong correlations were reported here.

During the first time period, 1975-1986, there was a strong positive correlation ($\rho=0.70$) between the JDWLL CPUE series in areas 1 and 2. There also were moderate positive correlations among the JWDLL CPUE series in areas 1 and 3 ($\rho=0.42$) and in areas 2 and 3 ($\rho=0.56$).

During the second time period, 1987-1999, there were three pairs of CPUE series that had strong positive correlations: the JDWLL CPUE in area 2 and the Japanese drift net (JDN) CPUE ($\rho=0.78$); the JDWLL CPUE in area 2 and the Taiwanese longline CPUE ($\rho=0.72$); and the Taiwanese (TWN) longline CPUE and the USA longline CPUE ($\rho=0.67$). There was one pair of CPUE series that had a strong negative correlation; this was the JDWLL CPUE in area 1 and the USA longline CPUE ($\rho= -0.63$). Two pairs of CPUE series had moderate positive correlations: the JDWLL CPUE in area 2 and the Japanese coastal longline (JCLL) CPUE ($\rho=0.57$); and the JDWLL CPUE in area 3 and the JCLL CPUE ($\rho=0.42$). There was also one moderate negative correlation between the JDWLL CPUE in area 1 and the JCLL CPUE ($\rho= -0.46$).

During the third and most recent time period, 2000-2009, there was one very strong positive correlation between the JDWLL CPUE in area 2 and the Korean (KOR) longline CPUE ($\rho=0.81$). There were a total of seven strong positive correlations among CPUE series. These were: JDWLL CPUE in areas 1 and 3 ($\rho=0.79$); JDWLL in area 1 and JCLL CPUE ($\rho=0.71$); JDWLL in area 3 and JCLL CPUE ($\rho=0.71$); JDWLL in area 3 and USA CPUE ($\rho=0.73$); JDWLL in area 3 and KOR CPUE ($\rho=0.61$); JCLL and JDN CPUE ($\rho=0.73$); and USA and TWN CPUE ($\rho=0.61$). There were also a total of eight moderate positive correlations among CPUE series. These were: JDWLL CPUE in areas 1 and 2 ($\rho=0.46$); JDWLL in area 1 and JDN CPUE ($\rho=0.51$);

JDWLL in area 1 and USA CPUE (ρ=0.49); JDWLL in area 1 and KOR CPUE (ρ=0.50); JDWLL CPUE in areas 2 and 3 (ρ=0.59); JDWLL in area 2 and JCLL CPUE (ρ=0.55); JDWLL in area 2 and JDN CPUE (ρ=0.50); and JCLL and KOR CPUE (ρ=0.42). There was also one moderate negative correlation; this was JDN and TWN CPUE (ρ= -0.42). Overall, the number of moderate to strong positive correlations among CPUE time series increased from the 1975-1986 assessment time period to the 2000-2009 assessment time period.

The number of available striped marlin length frequency samples (length units are cm of eye-fork length) measured in numbers of fish lengths showed variation in the number of samples by fleet (Figure 24). In the early 1970s, most of the samples were from the JDWLL fleet, while during 1975-2000, most of the length samples were collected from the JDWLL fleets in areas 1 and 3 and from the JCLL fleet (Figure 24). In recent years, there were also some samples collected from the USA and JDN fleets (Figure 24). Annual totals of the number of fish lengths available by quarter also showed some interannual variation (Figures 25 and 26) with the largest sample sizes being collected during 1985-2000. Plots of sample size by fleet (Figure 27-37) showed that most of the available length data were collected from the JDWLL fleets in areas 2 and 3 and the JCLL fleet with some additional samples collected from JDWLL in all areas during 1970-1975 and also collected from the USA since the mid-1990s.

Plots of quarterly mean fish lengths (length units are cm of eye-fork length) by year-quarter and fleet showed within-year variation in the size of striped marlin being harvested (Figures 38-48, error bars represent +/- one standard deviation). Plots of quarterly mean lengths by quarter and fleet showed that there was interannual variation in the quarterly mean fish lengths harvested by the fleets through time (Figures 49-59, error bars represent +/- one standard deviation). Overall, the available length compositions showed that the mean length of sampled striped marlin varied on a quarterly and annual basis by fishing fleet.

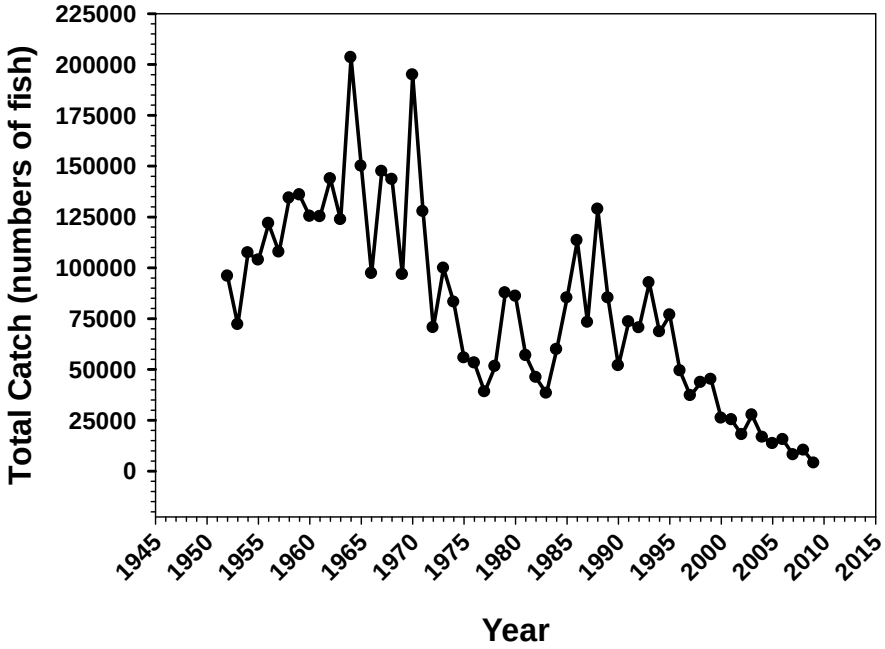

Figure 1. Japanese distant-water longline total catch in numbers of fish by year in all Areas.

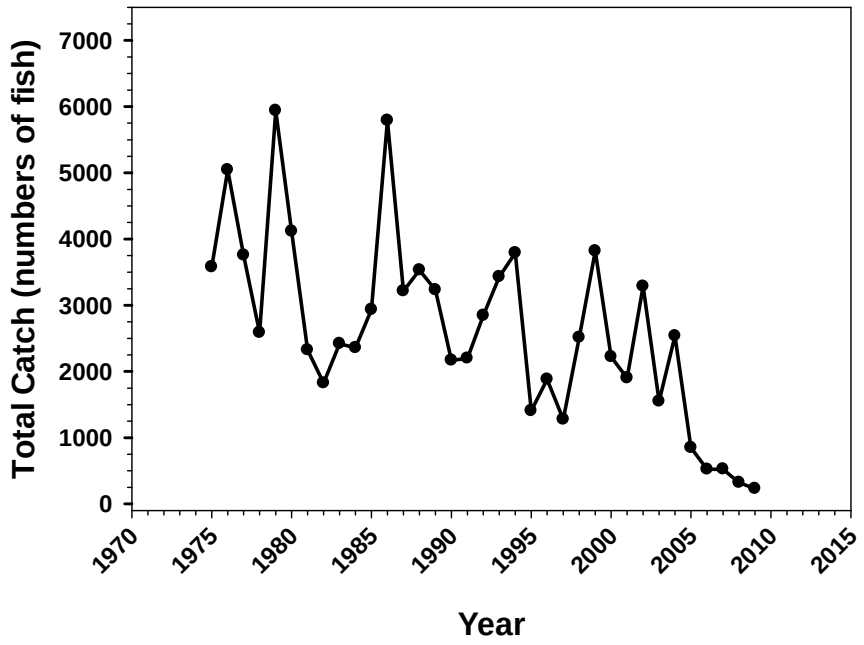

Figure 2. Japanese distant-water longline total catch in numbers of fish by year in Area 1.

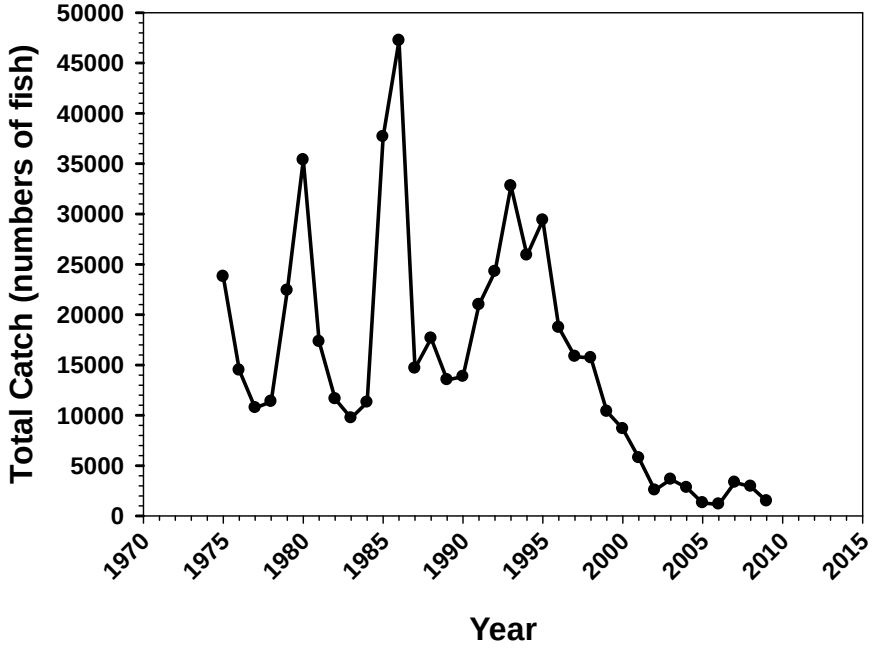

Figure 3. Japanese distant-water longline catch in numbers of fish by year in Area 2.

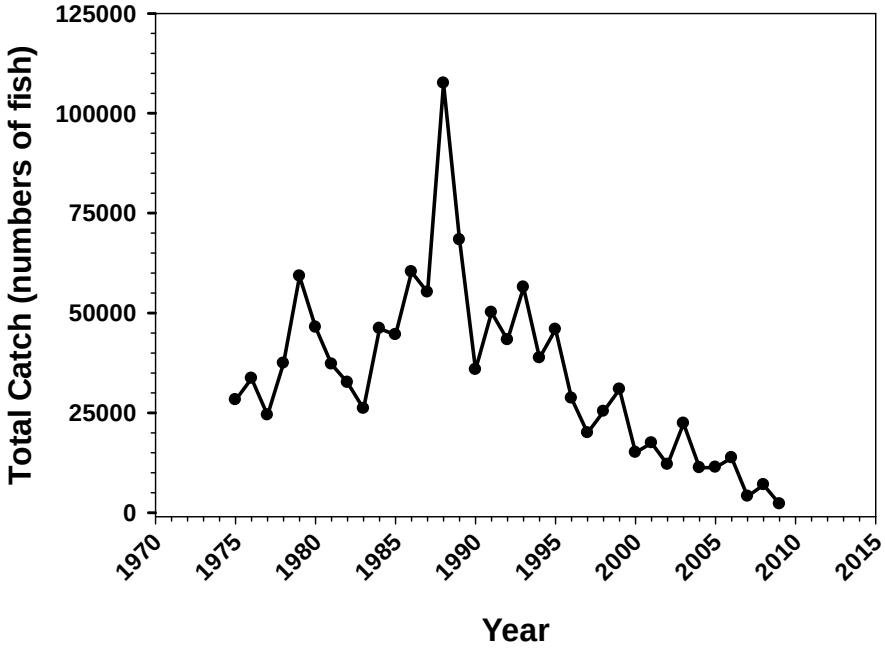

Figure 4. Japanese distant-water longline total catch in numbers of fish by year in Area 3.

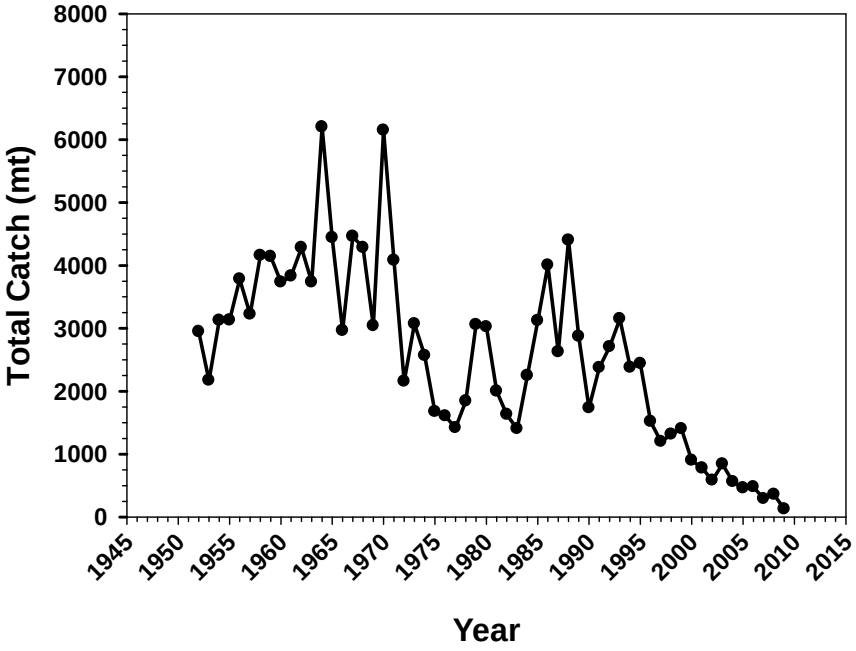

Figure 5. Japanese distant-water longline total catch weight by year in all Areas.

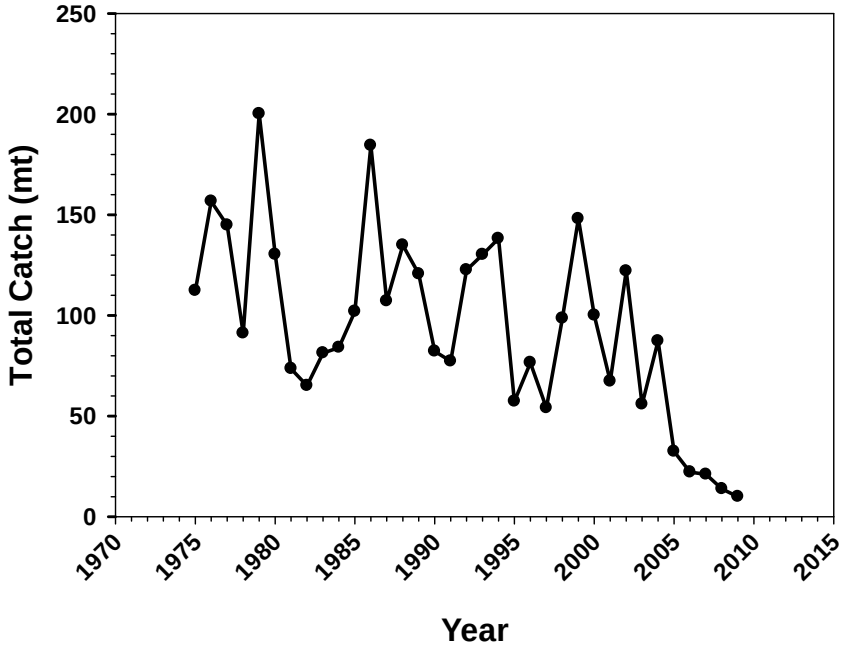

Figure 6. Japanese distant-water longline total catch weight by year in Area 1.

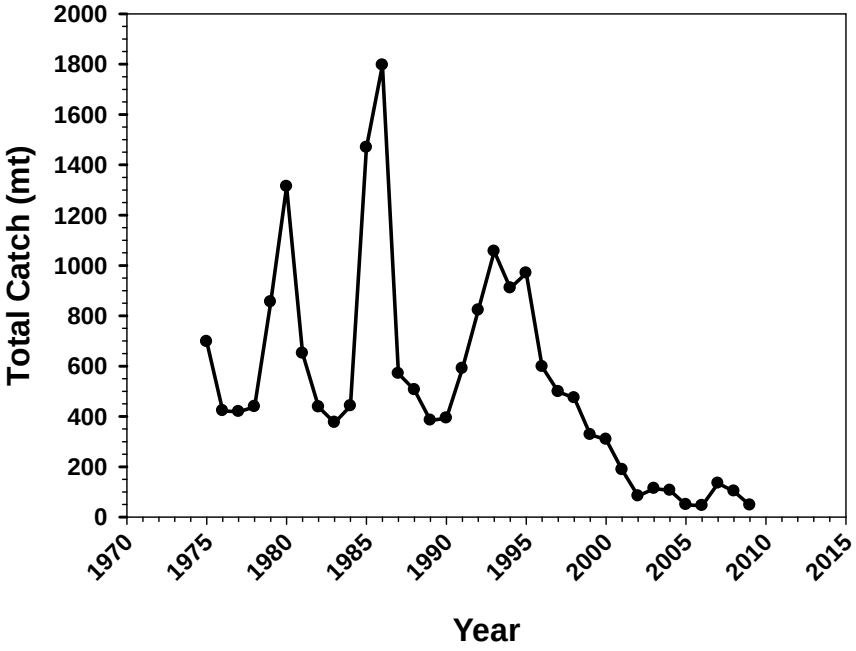

Figure 7. Japanese distant-water longline total catch weight by year in Area 2.

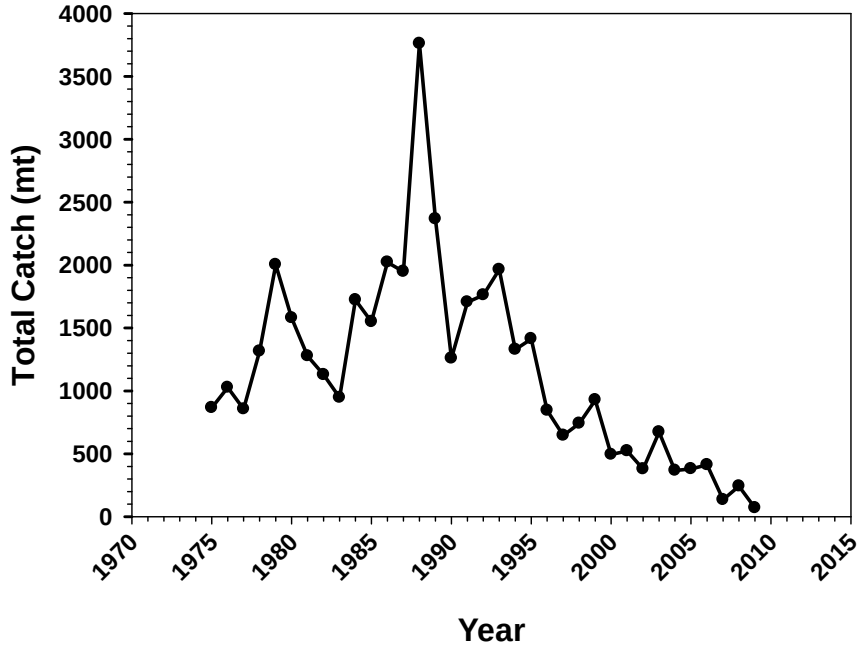

Figure 8. Japanese distant-water longline total catch weight by year in Area 3.

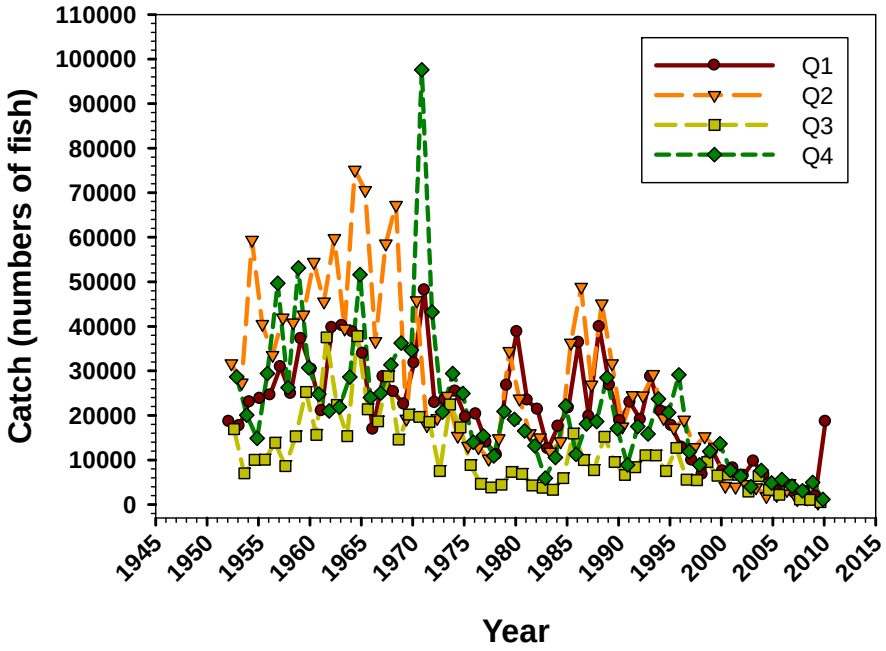

Figure 9. Japanese distant-water longline catch in numbers of fish by quarter and year in all Areas.

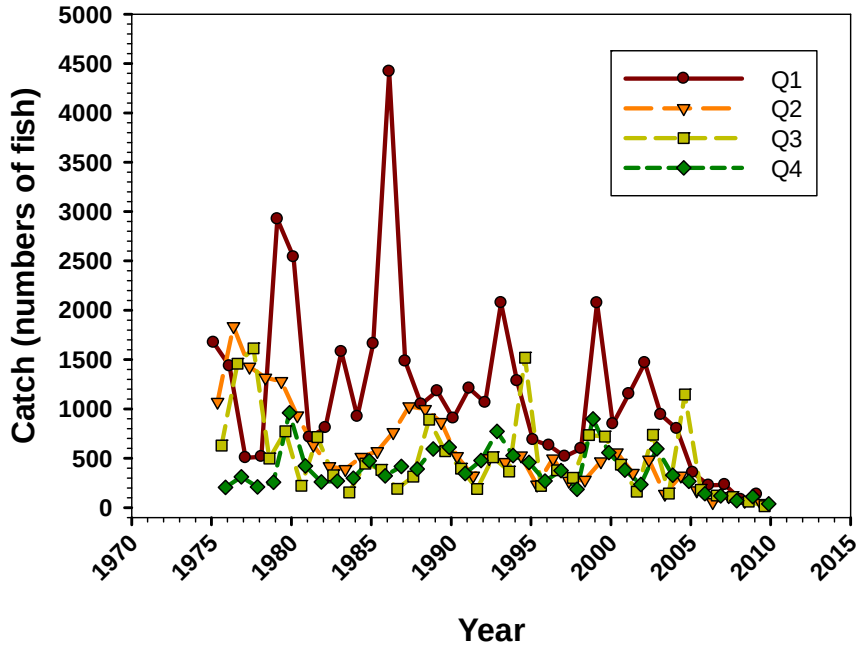

Figure 10. Japanese distant-water longline catch in numbers of fish by quarter and year in Area 1.

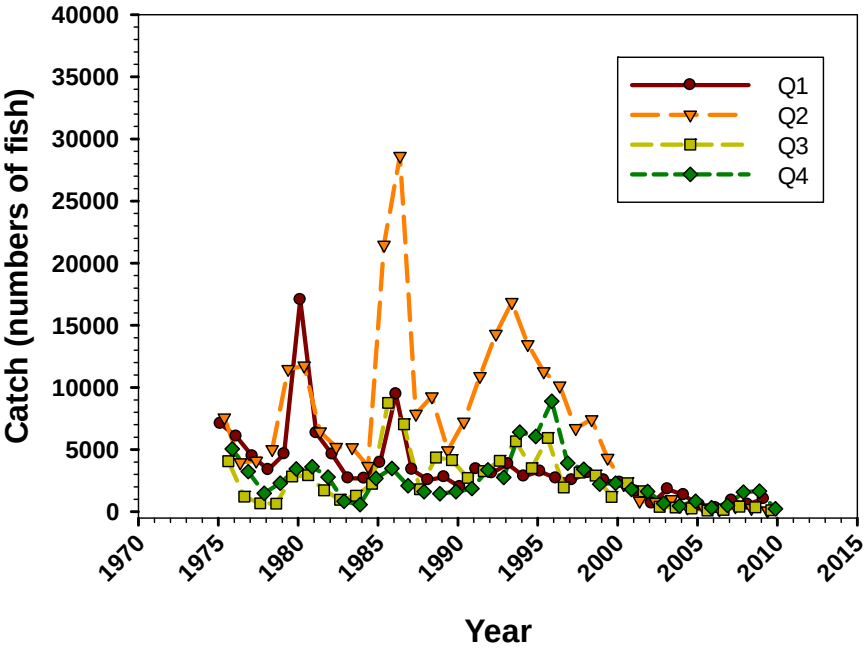

Figure 11. Japanese distant-water longline catch in numbers of fish by quarter and year in Area 2.

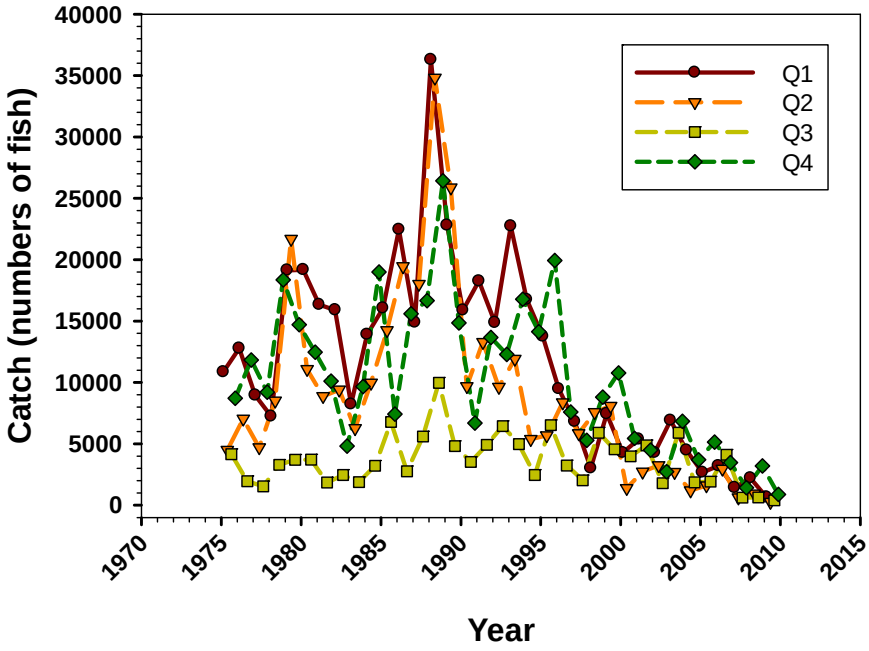

Figure 12. Japanese distant-water longline catch in numbers of fish by quarter and year in Area 3.

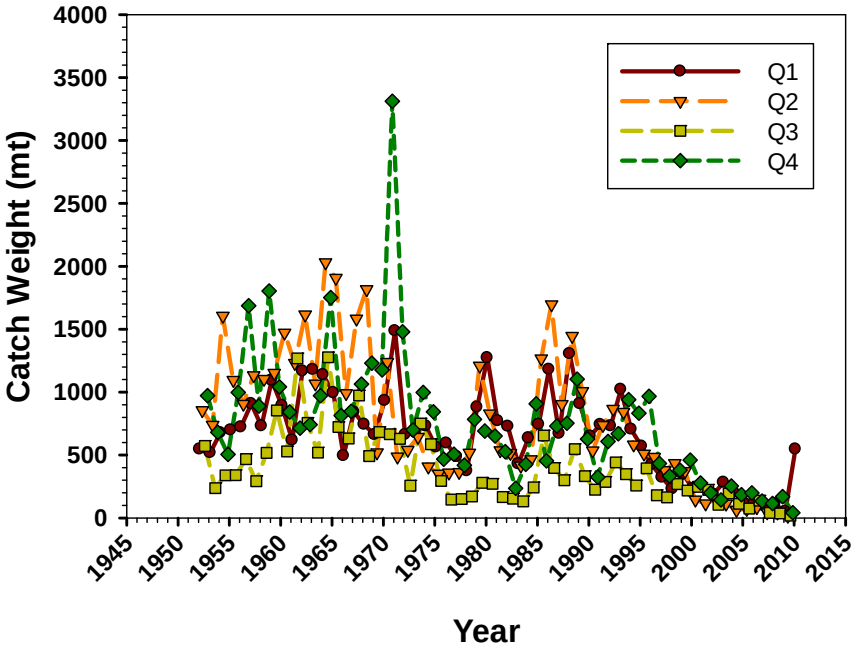

Figure 13. Japanese distant-water longline catch weight by quarter and year in all Areas.

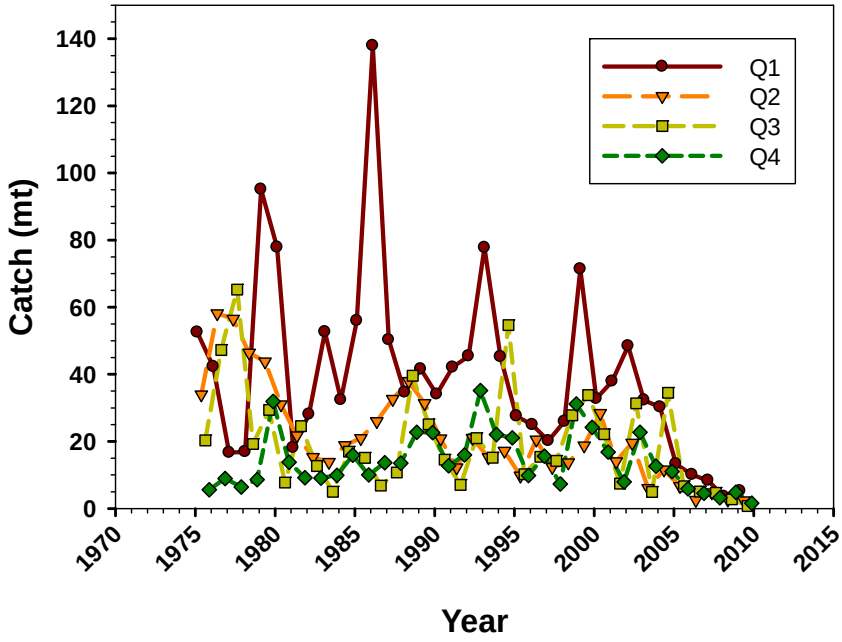

Figure 14. Japanese distant-water longline catch weight by quarter and year in Area 1.

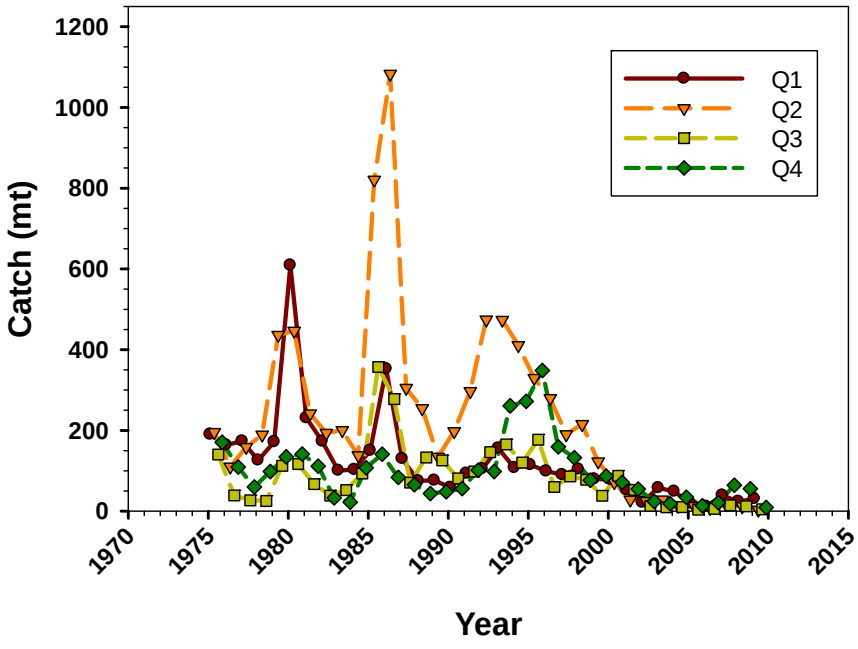

Figure 15. Japanese distant-water longline catch weight by quarter and year in Area 2.

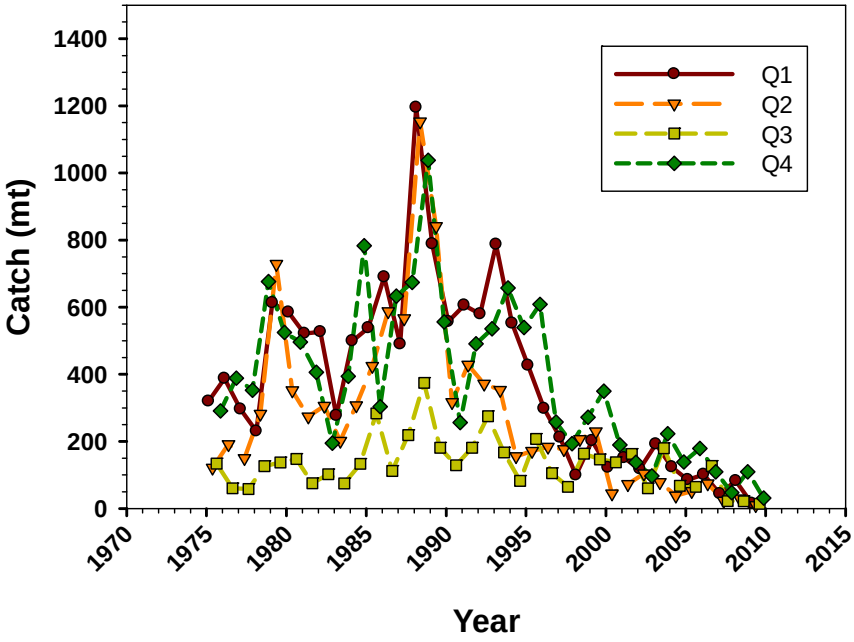

Figure 16. Japanese distant-water longline catch weight by quarter and year in Area 3.

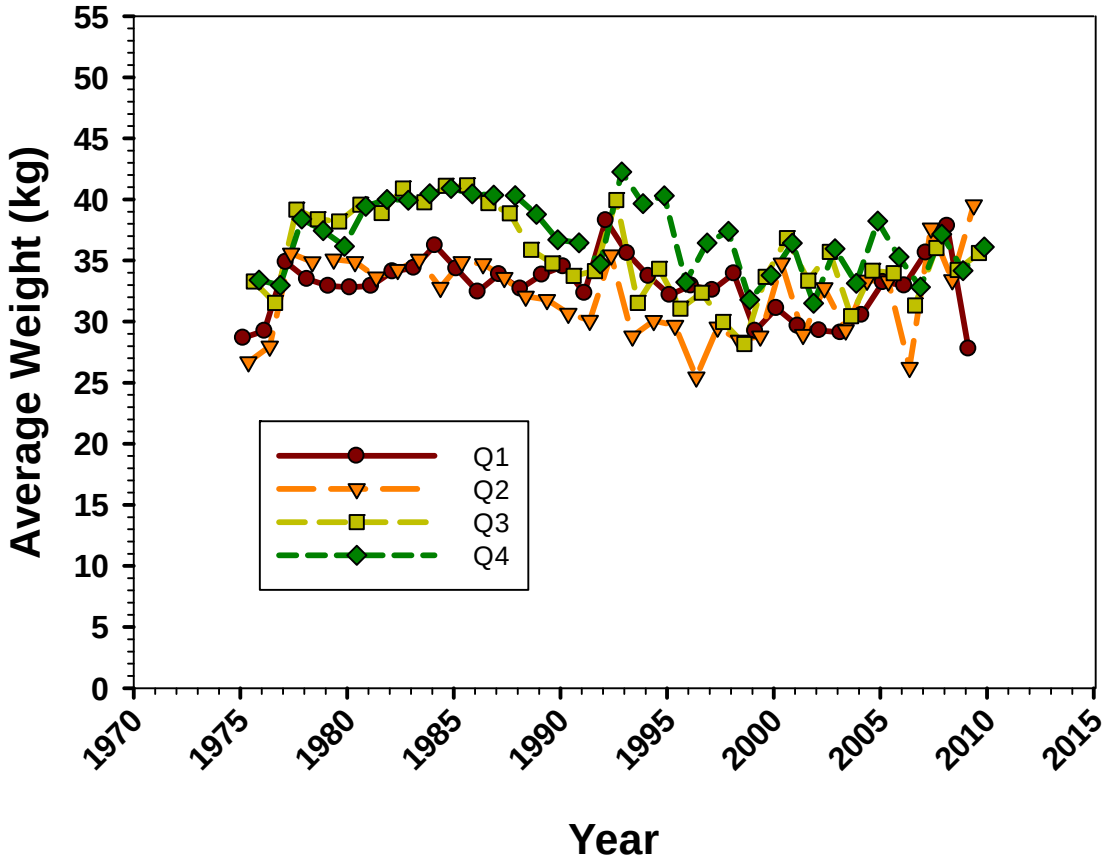

Figure 17. Japanese distant-water longline average fish weight by quarter and year in all Areas.

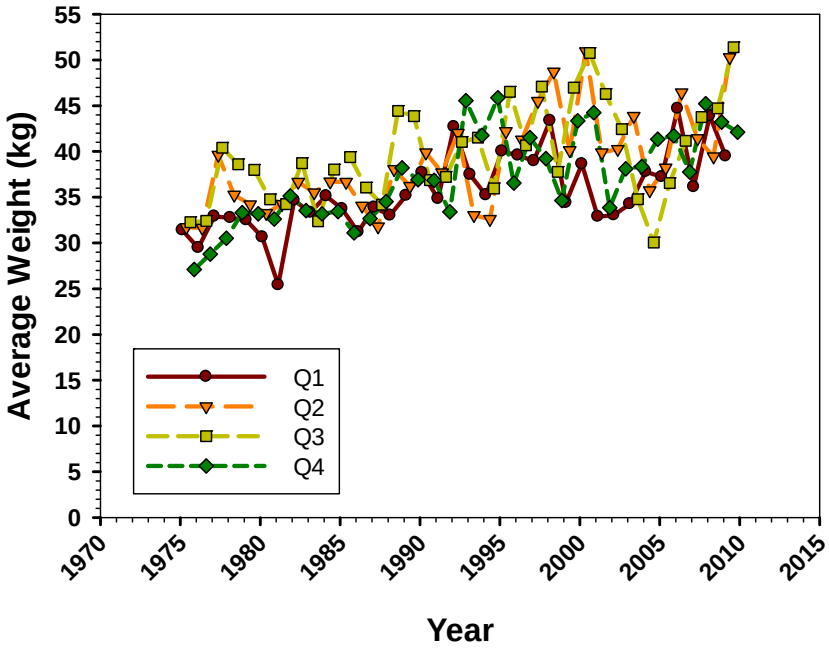

Figure 18. Japanese distant-water longline average fish weight by quarter and year in Area 1.

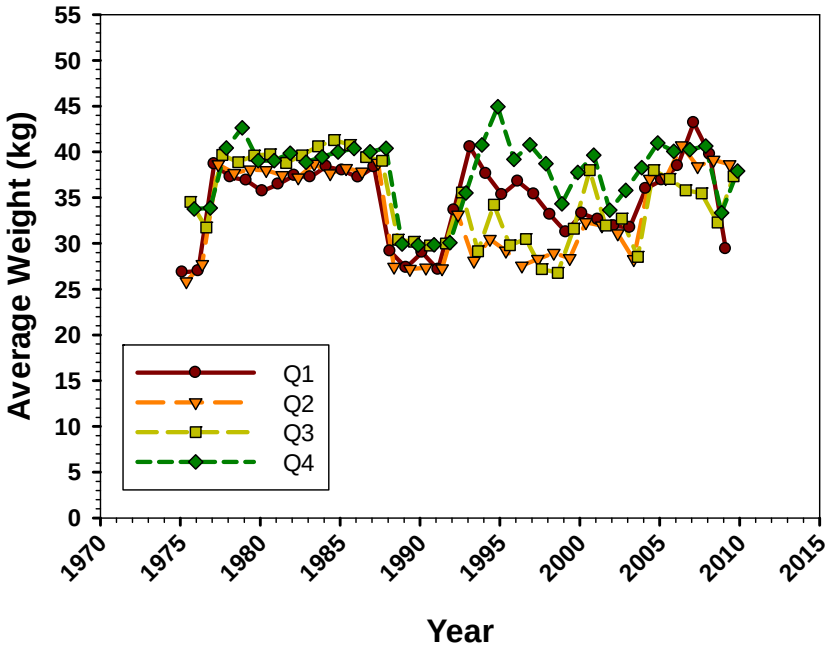

Figure 19. Japanese distant-water longline average fish weight by quarter and year in Area 2.

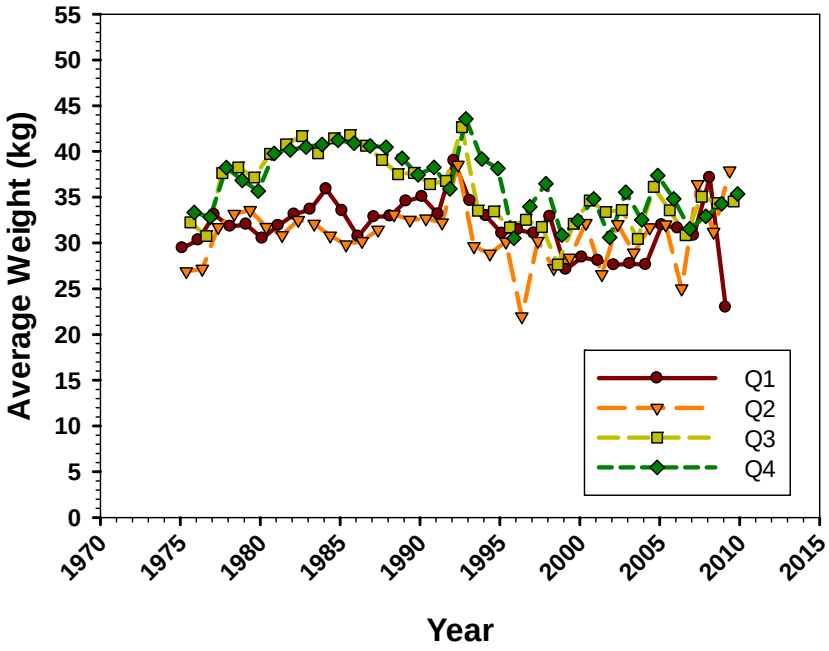

Figure 20. Japanese distant-water longline average fish weight by quarter and year in Area 3.

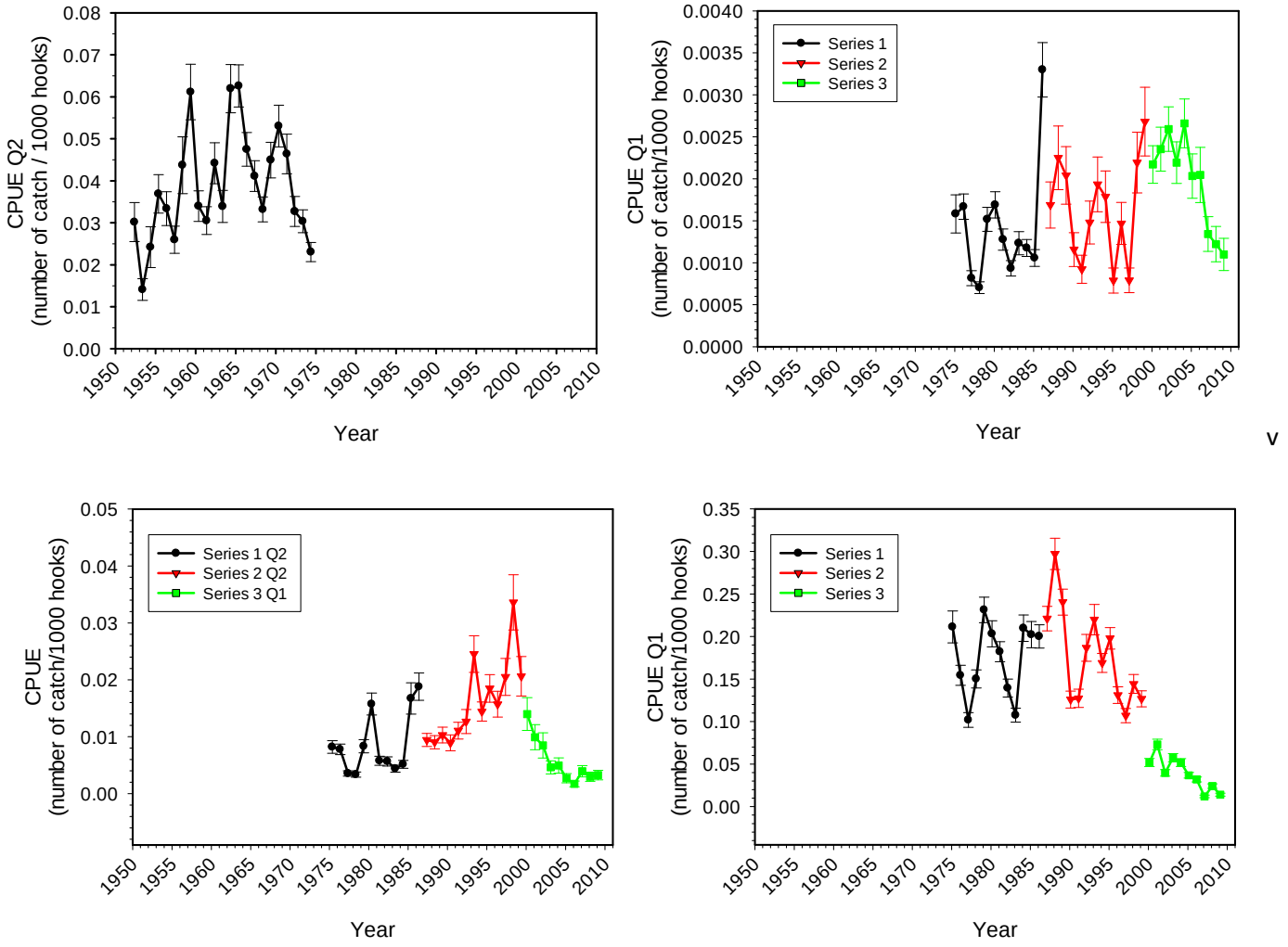

Figure 21. North Pacific striped marlin CPUE by fleet. Japanese distant-water longline 1952-1969 (top left); Japanese distant-water longline 1975-2009 Area 1 (top right); Japanese distant-water longline 1975-2009 Area 2 (bottom left); Japanese distant-water longline 1975-2009 Area 3 (bottom right).

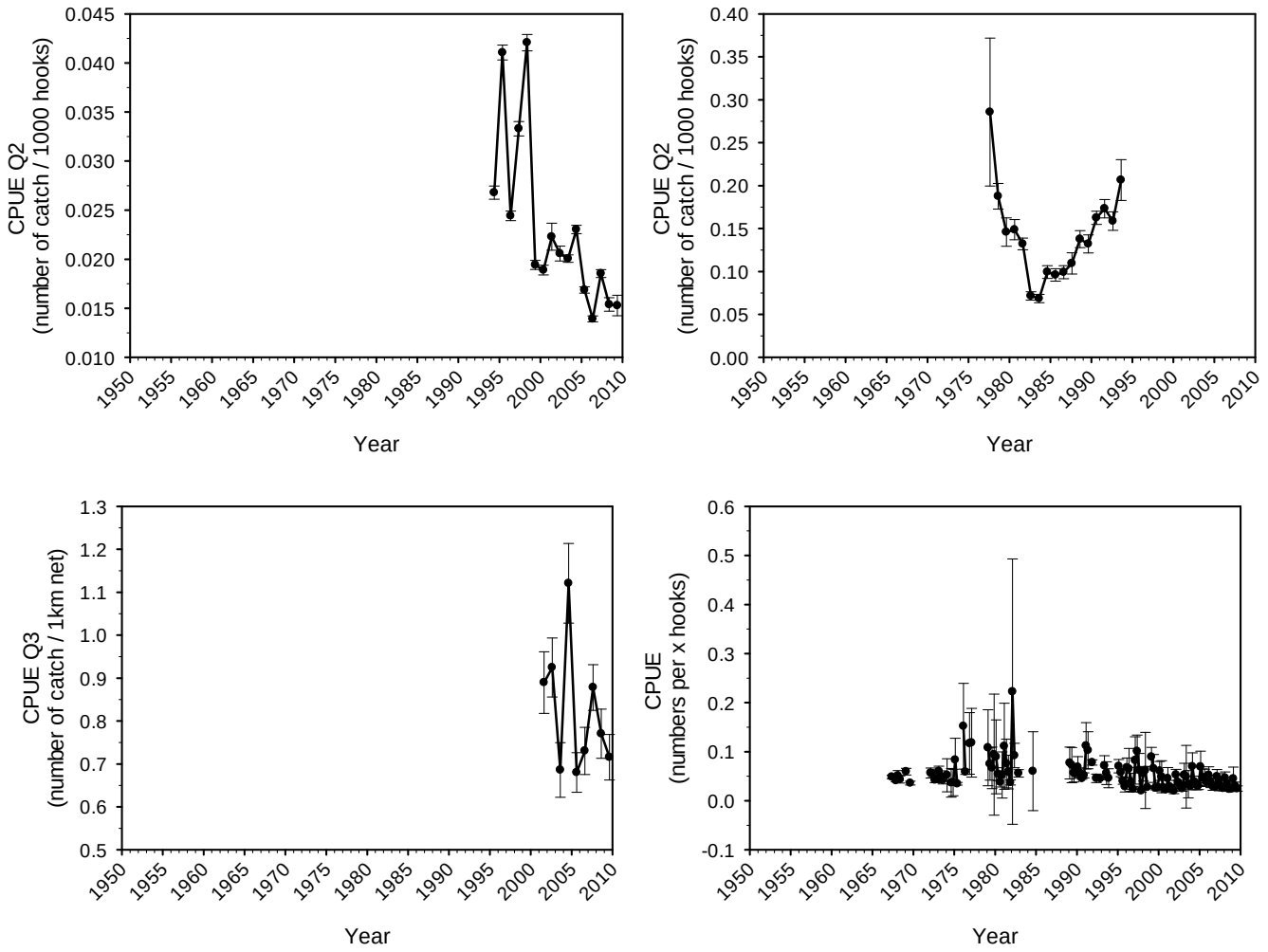

Figure 22. North Pacific Striped Marlin CPUE by fleet. Japanese Coastal Longline (top left); Japanese High Seas Driftnet (top right); Japanese Coastal Driftnet (bottom left); Chinese Taipei (bottom right).

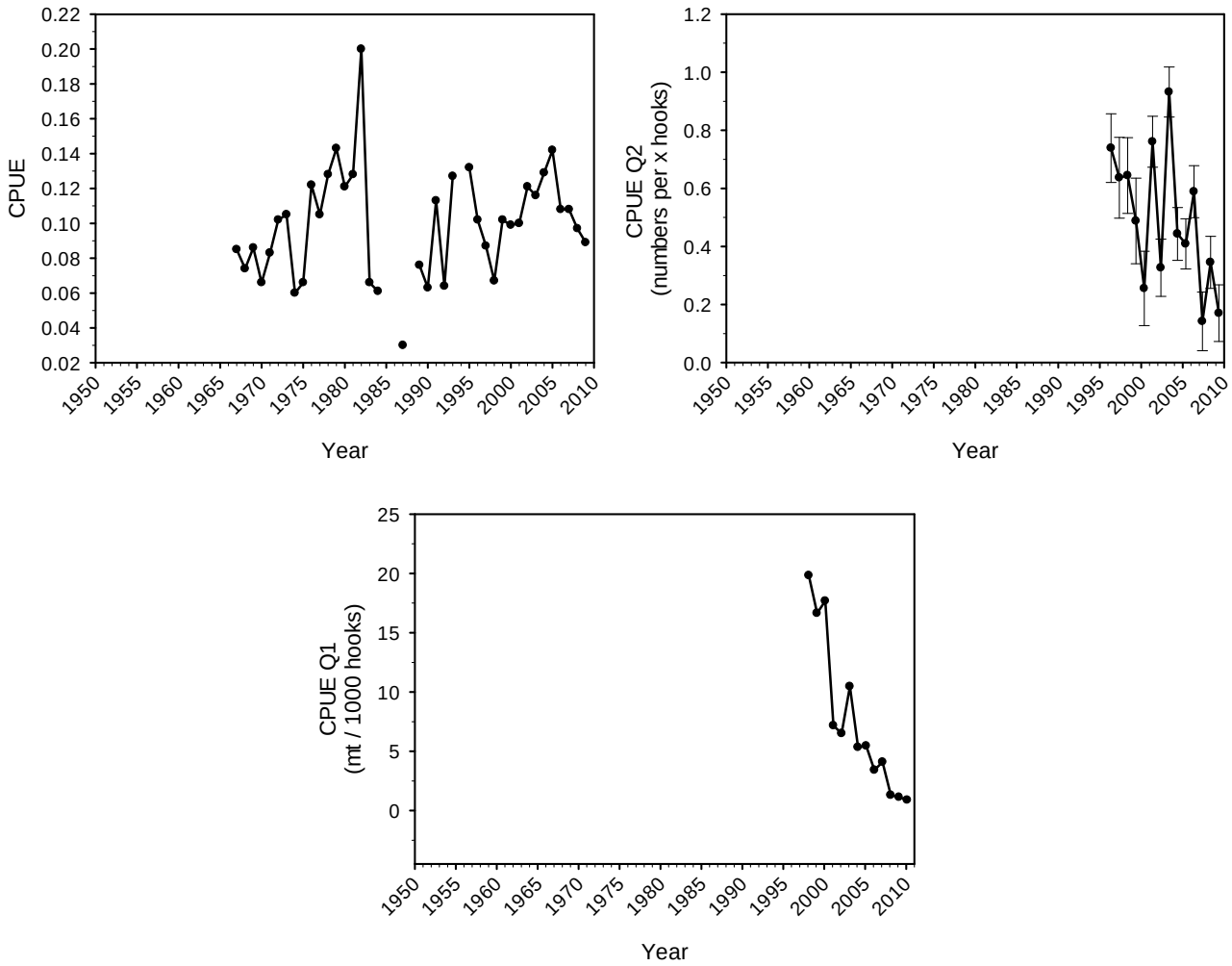

Figure 23. North Pacific striped marlin CPUE by fleet. Chinese Taipei (top left); U.S. (top right); Korea (bottom).

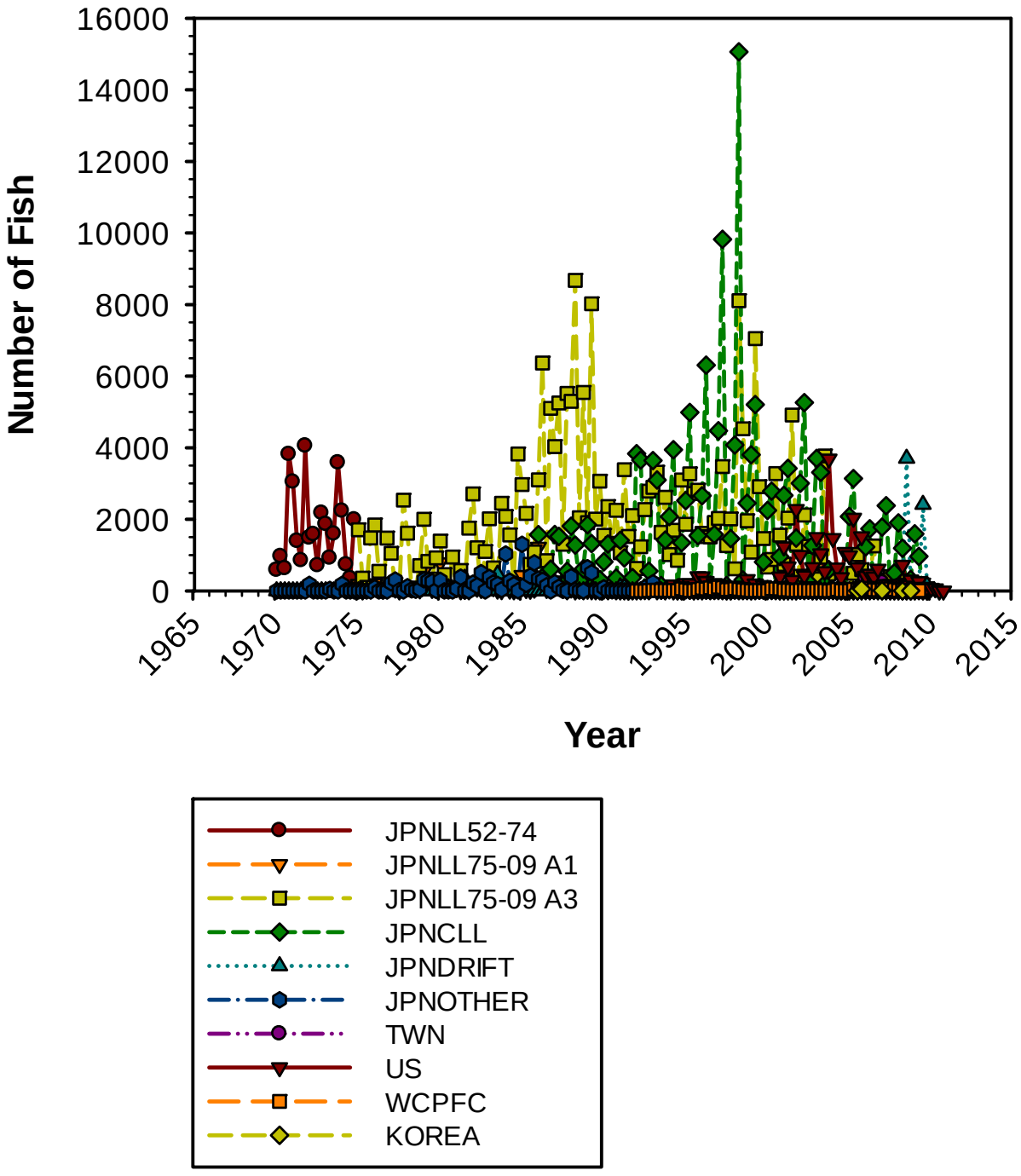

Figure 24. Total fish lengths by data source; Japanese distant-water longline 1952-1974 (JPNLL52-74), Japanese distant-water longline 1975-2009 in Area 1 (JPNLL75-09 A1), Japanese distant-water longline 1975-2009 in Area 3 (JPNLL75-09 A3), Japanese coastal longline (JPNCLL), Japanese drift net (JPNDRIFT), Japanese other (JPNOTHER), Chinese Taipei longline(TWN), United States longline (US), Western and Central Pacific Fisheries Commission longline (WCPFC), and Korean longline (KOREA).

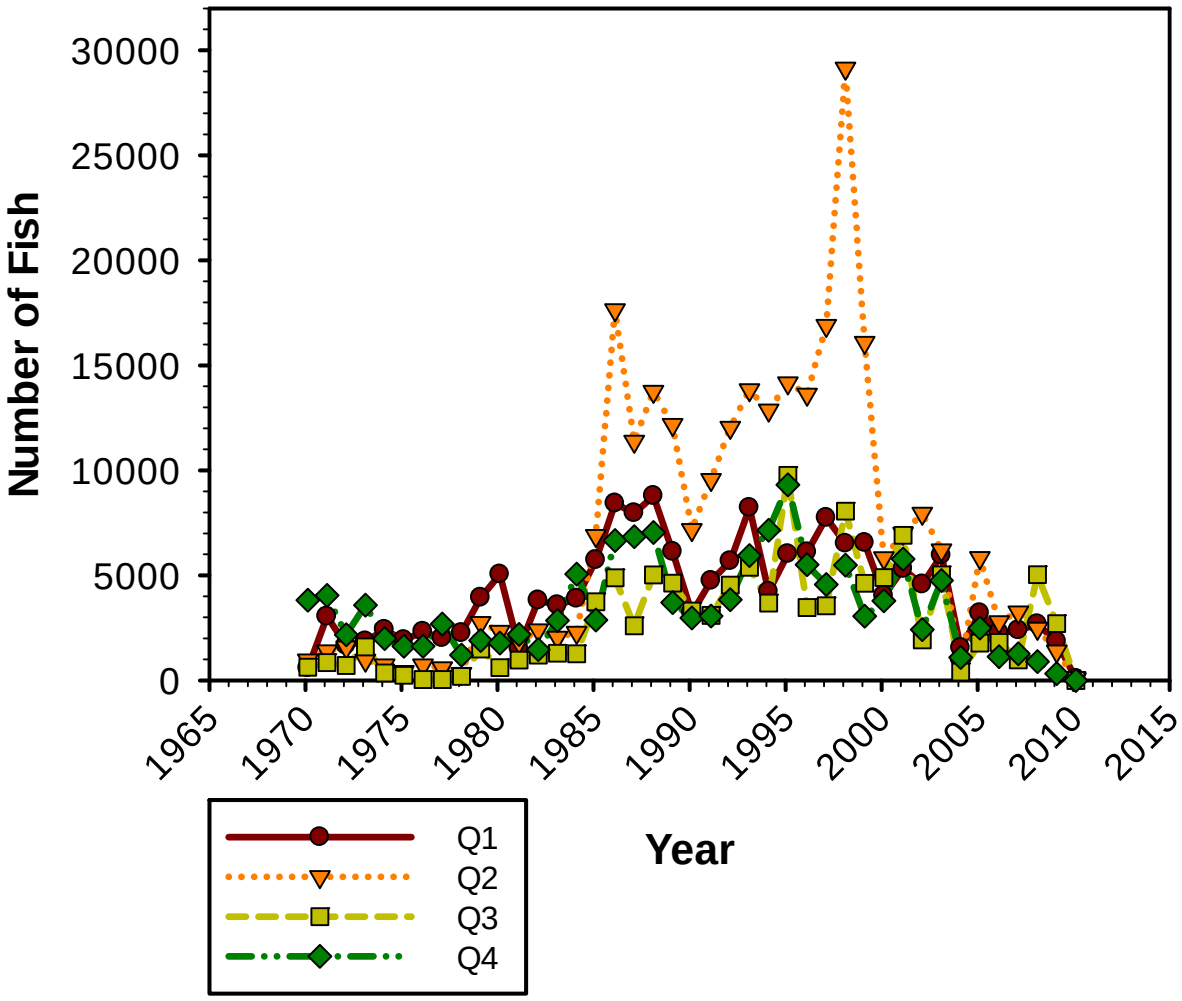

Figure 25. Total fish lengths by quarter.

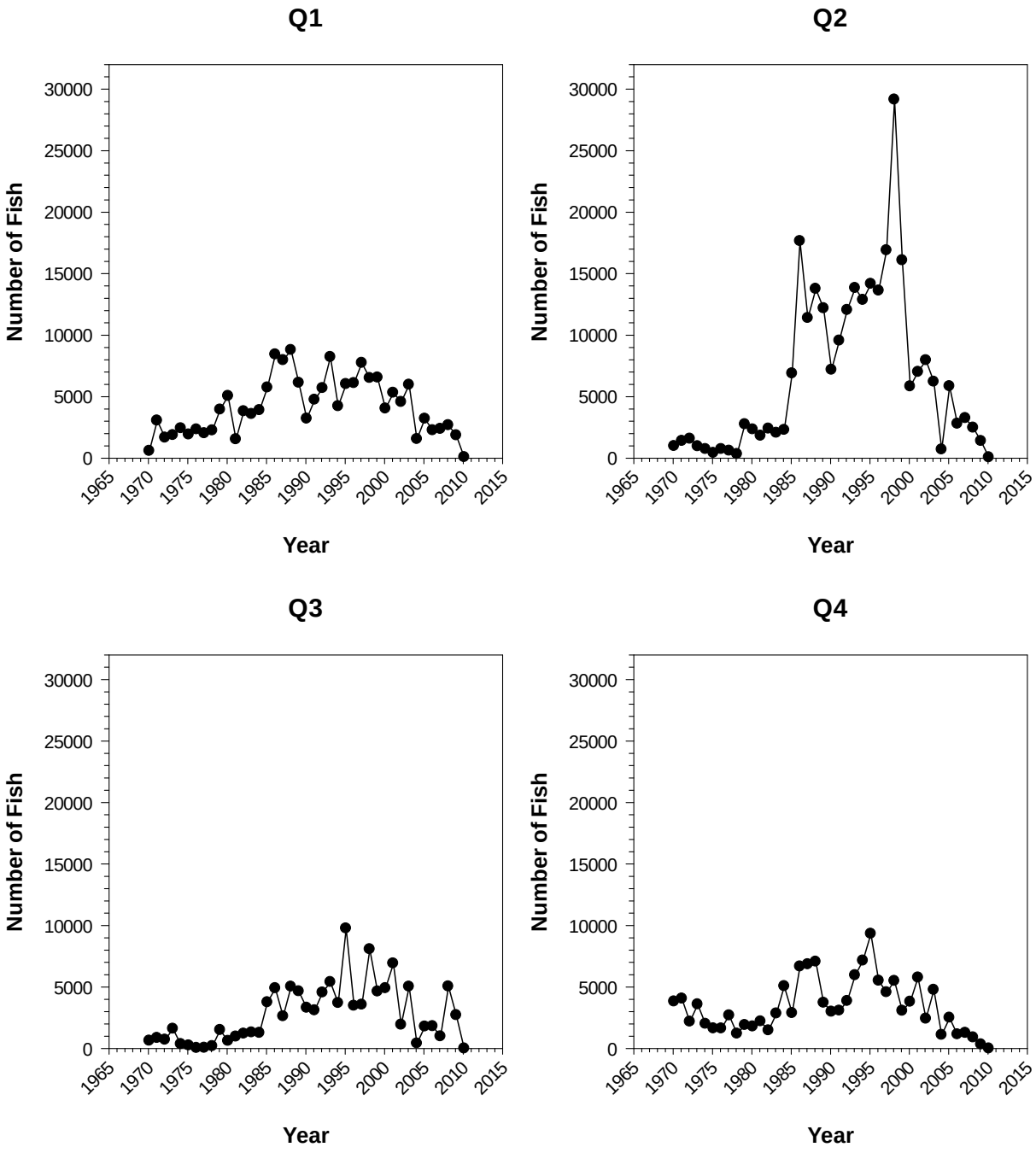

Figure 26. Total number of fish lengths by quarter (Q1-Q4).

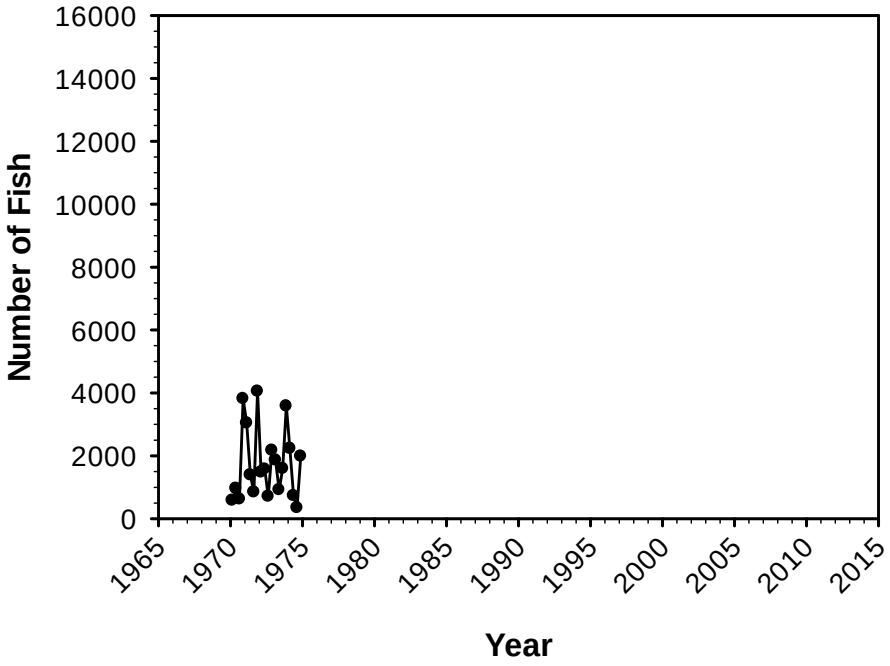

Figure 27. Total number of fish lengths from Japanese distant-water longliners 1952-1974.

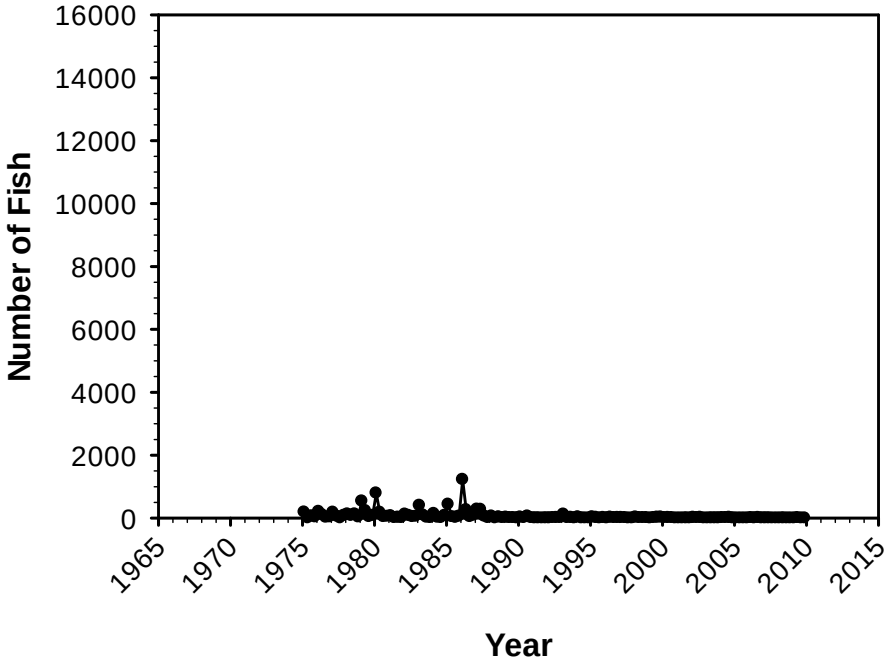

Figure 28. Total number of fish lengths from Japanese distant-water longliners 1975-2009 in Area 1.

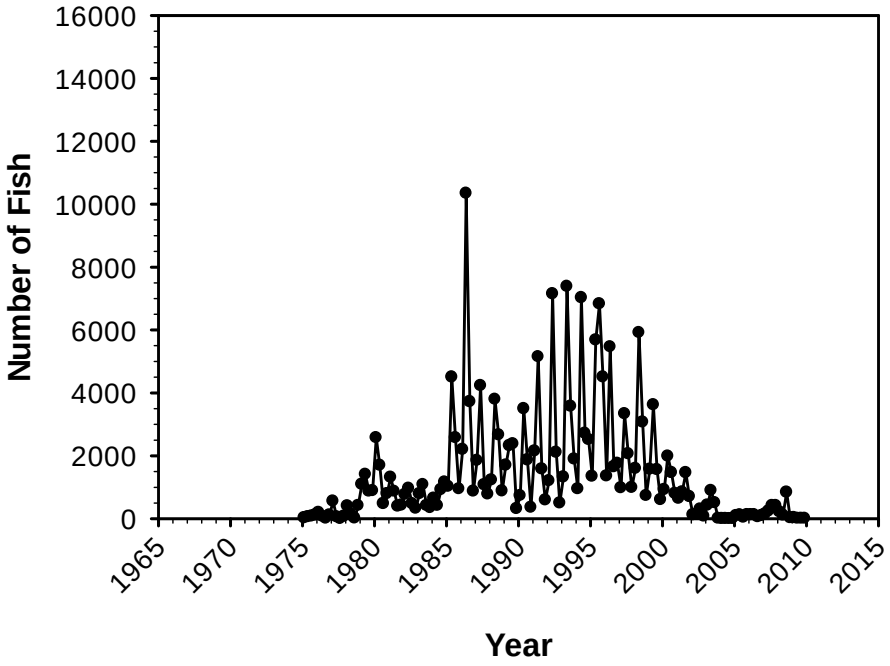

Figure 29. Total number of fish lengths from Japanese distant-water longliners 1975-2009 in Area 2.

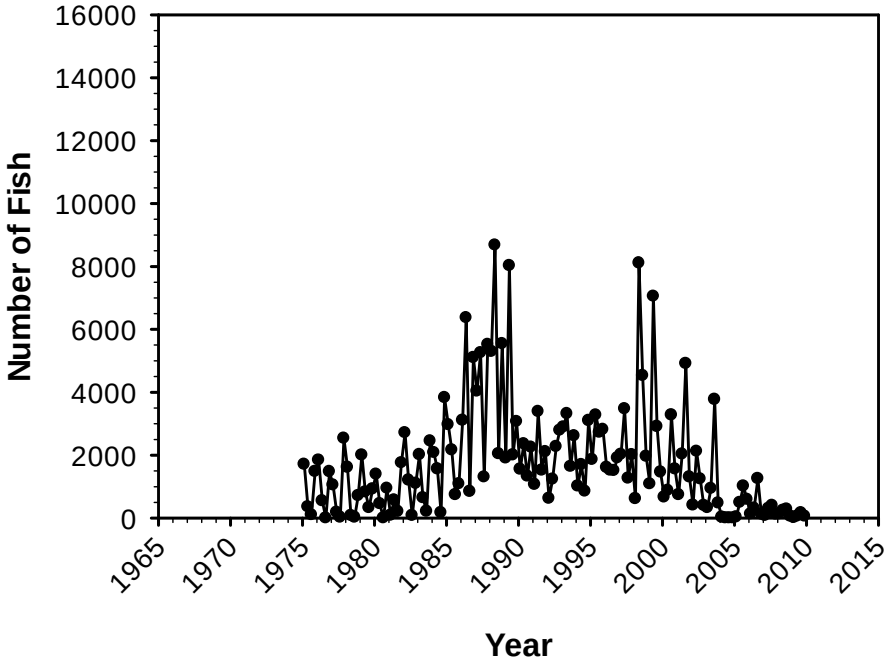

Figure 30. Total number of fish lengths from Japanese distant-water longliners 1975-2009 in Area 3.

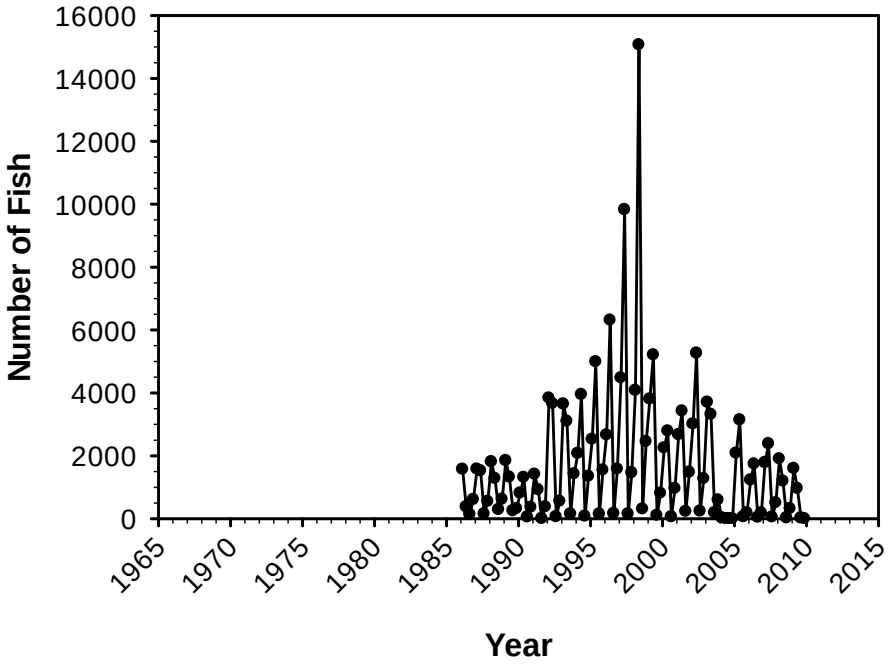

Figure 31. Total number of fish lengths from Japanese coastal longliners.

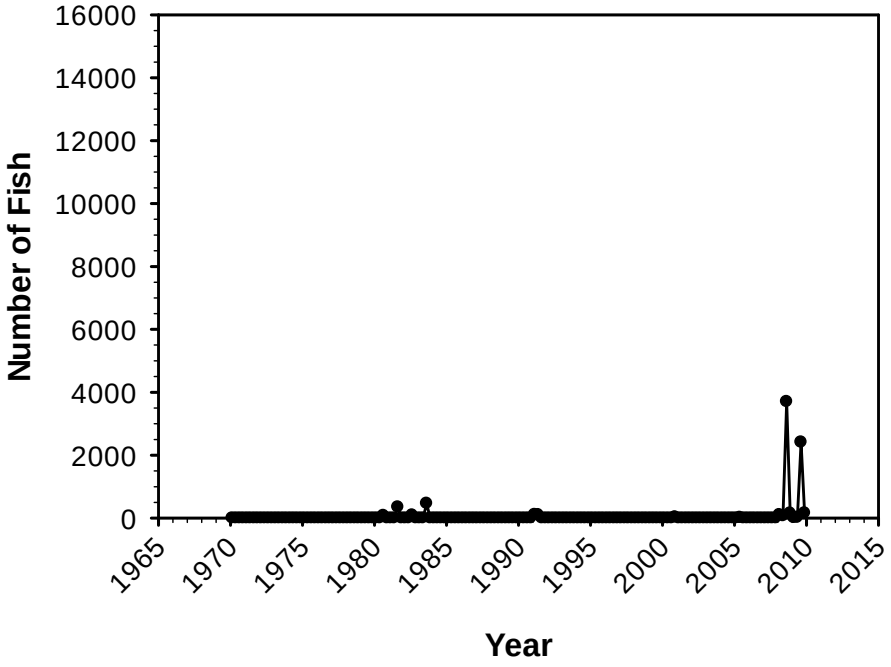

Figure 32. Total number of fish lengths from Japanese driftnet vessels.

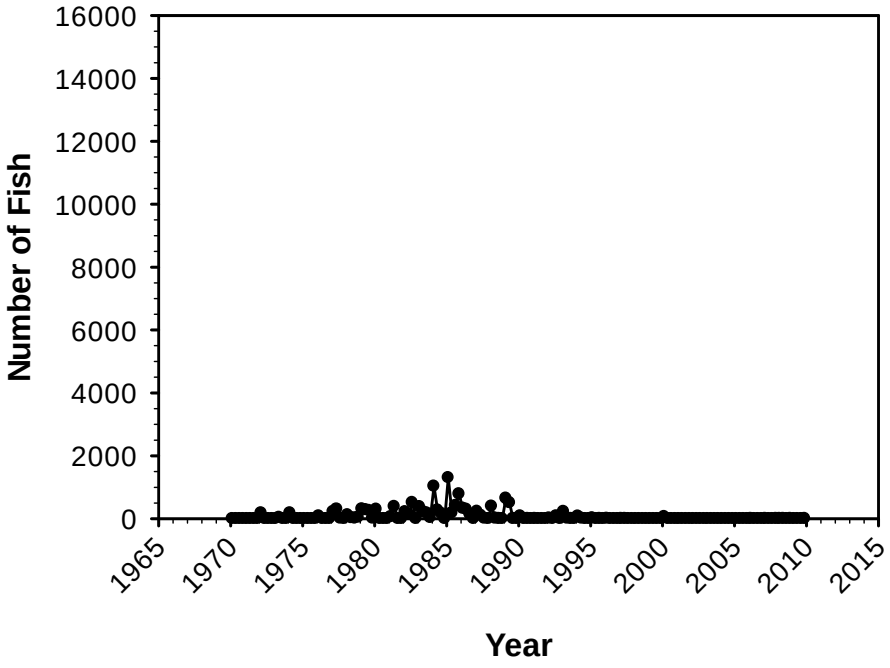

Figure 33. Total number of fish lengths from Japanese other vessels.

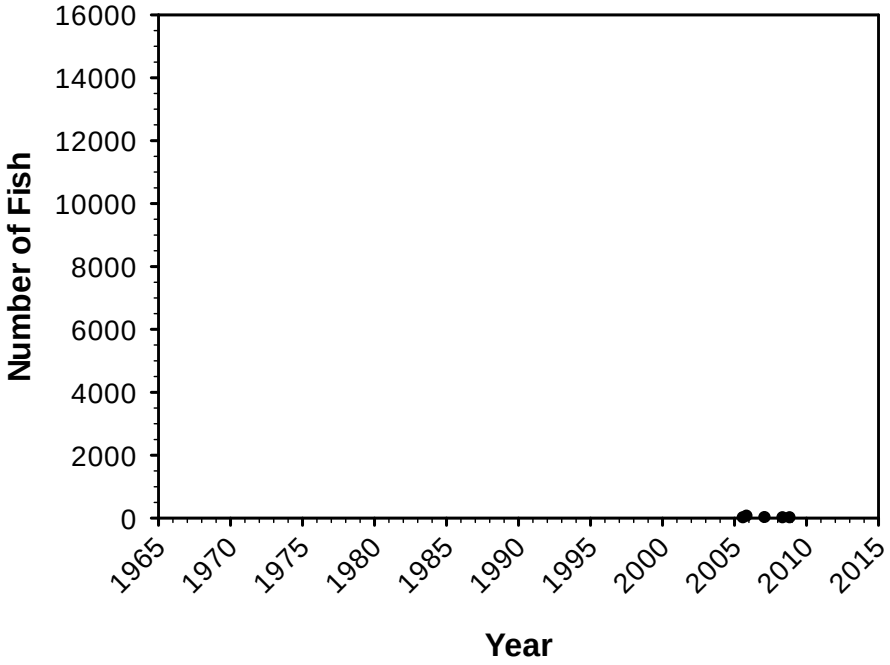

Figure 34. Total number of fish lengths from Korean longliners.

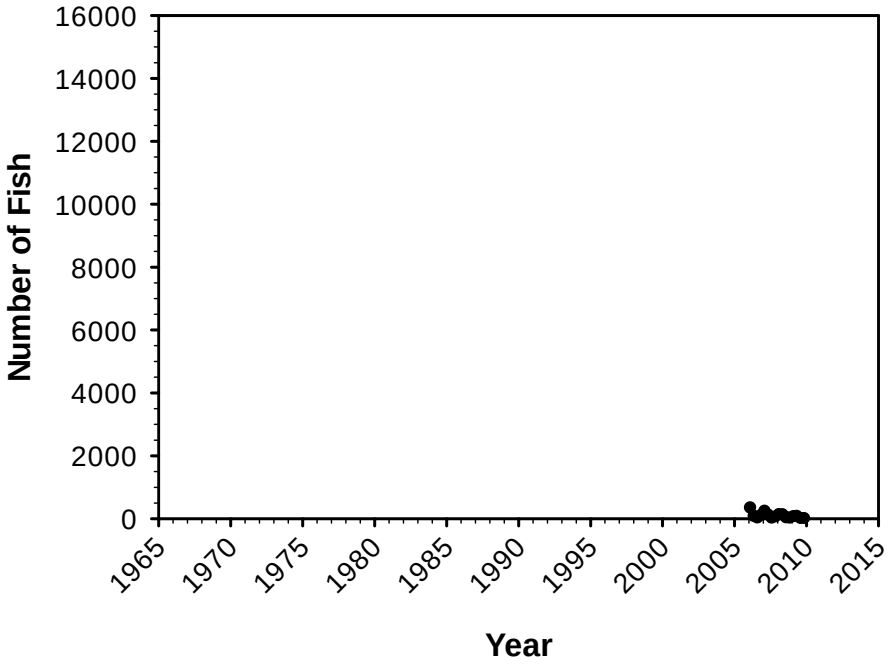

Figure 35. Total number of fish lengths from Chinese Taipei longliners.

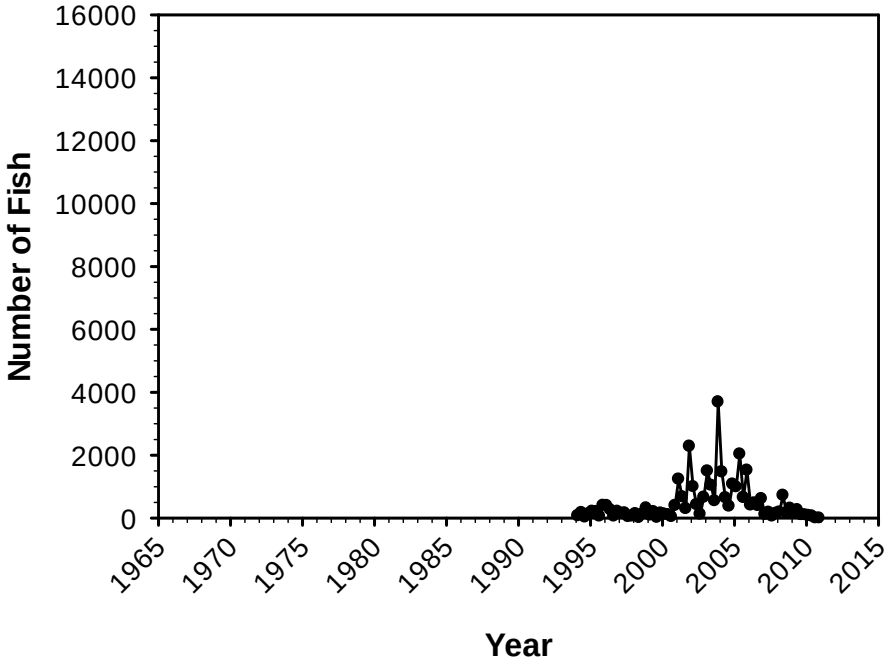

Figure 36. Total number of fish lengths from U.S. longliners.

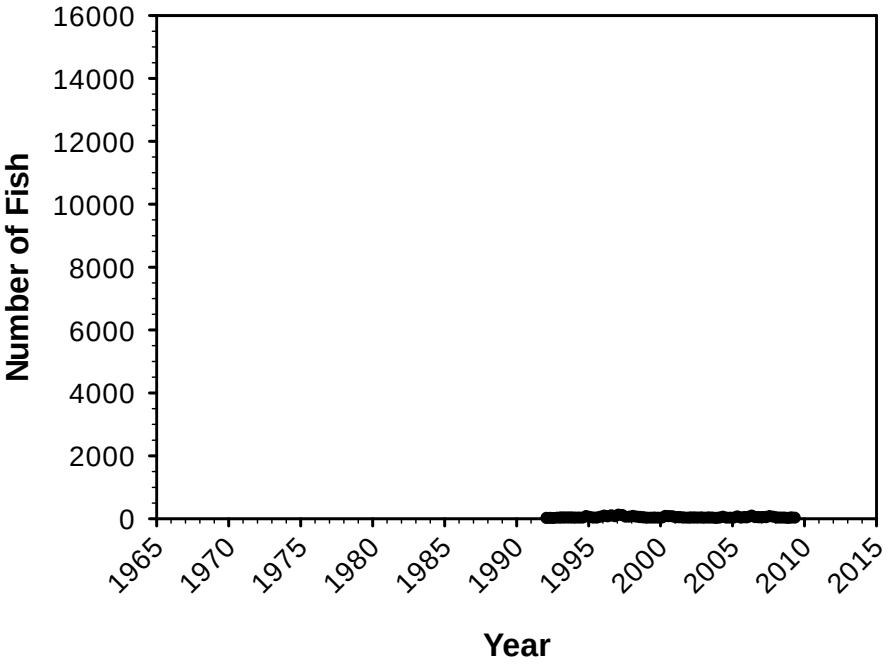

Figure 37. Total number of fish lengths from WCPFC longliners.

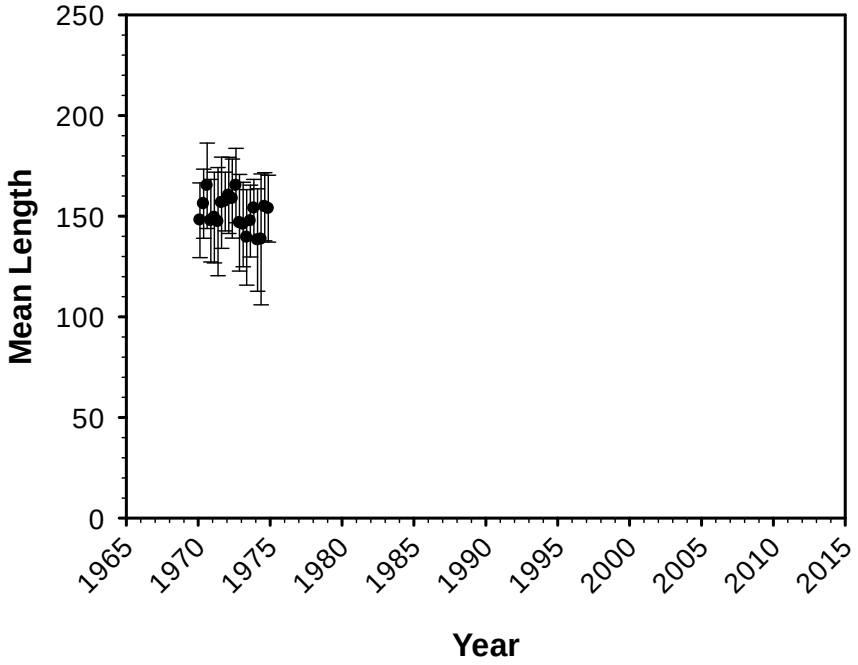

Figure 38. Mean length (cm) by year-quarter for Japanese longline vessels 1952-1974.

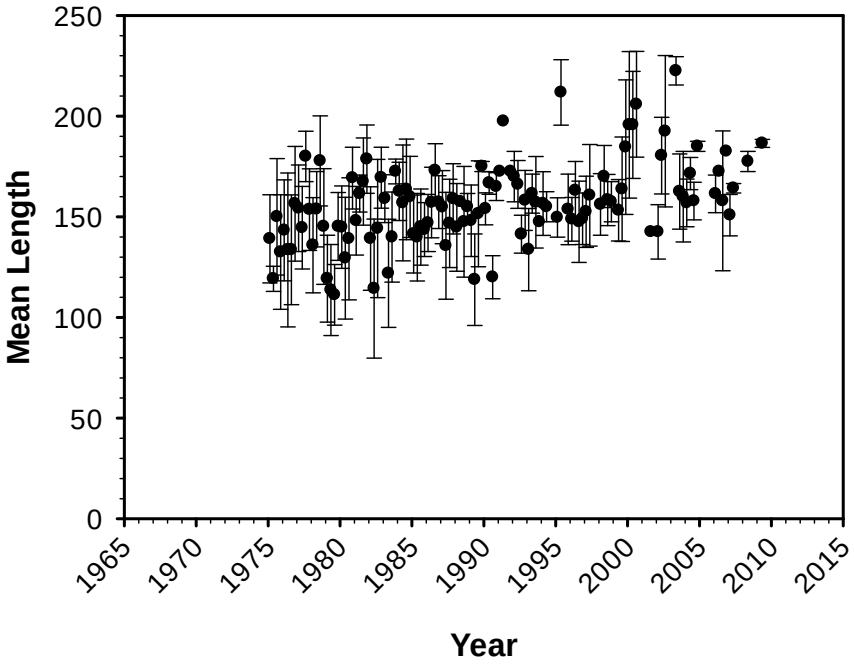

Figure 39. Mean length (cm) by year-quarter for Japanese longline vessels 1975-2009 in Area 1.

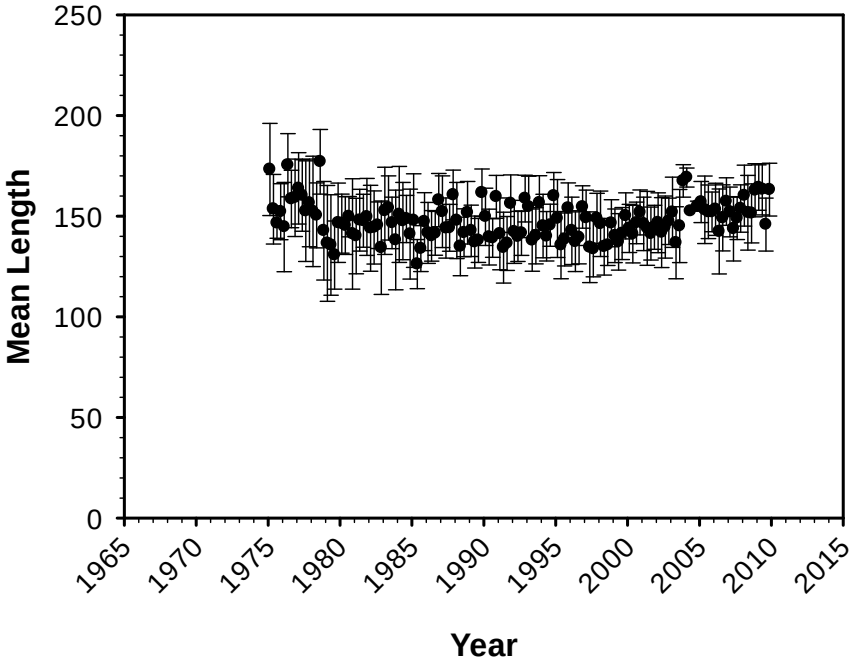

Figure 40. Mean length (cm) by year-quarter for Japanese longline vessels 1975-2009 in Area 2.

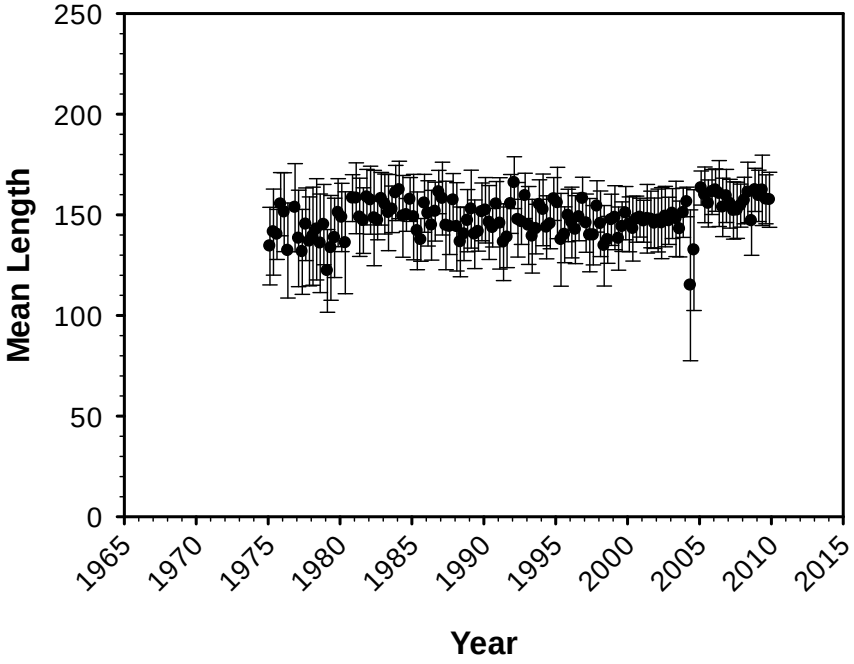

Figure 41. Mean length (cm) by year-quarter for Japanese longline vessels 1975-2009 in Area 3.

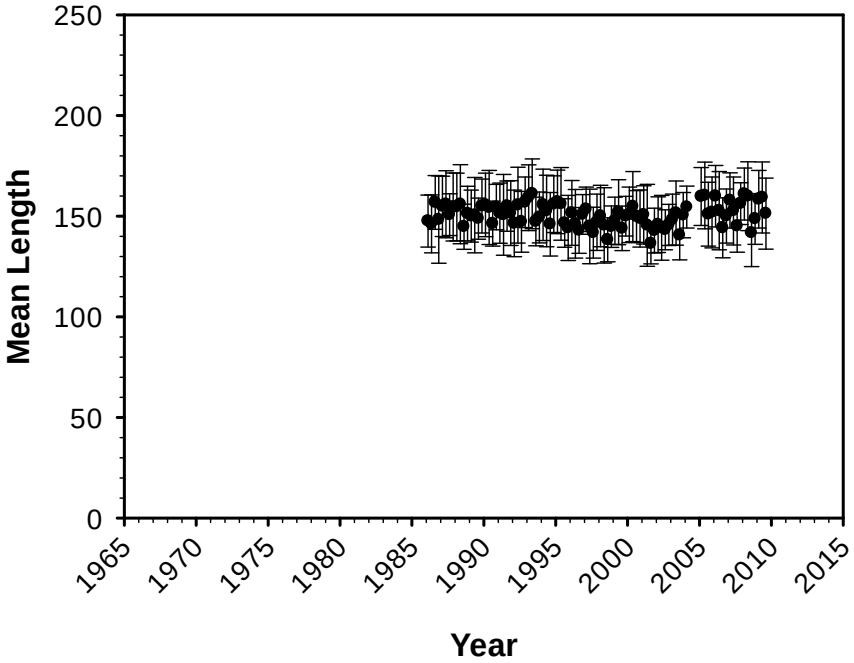

Figure 42. Mean length (cm) by year-quarter for Japanese coastal longline vessels.

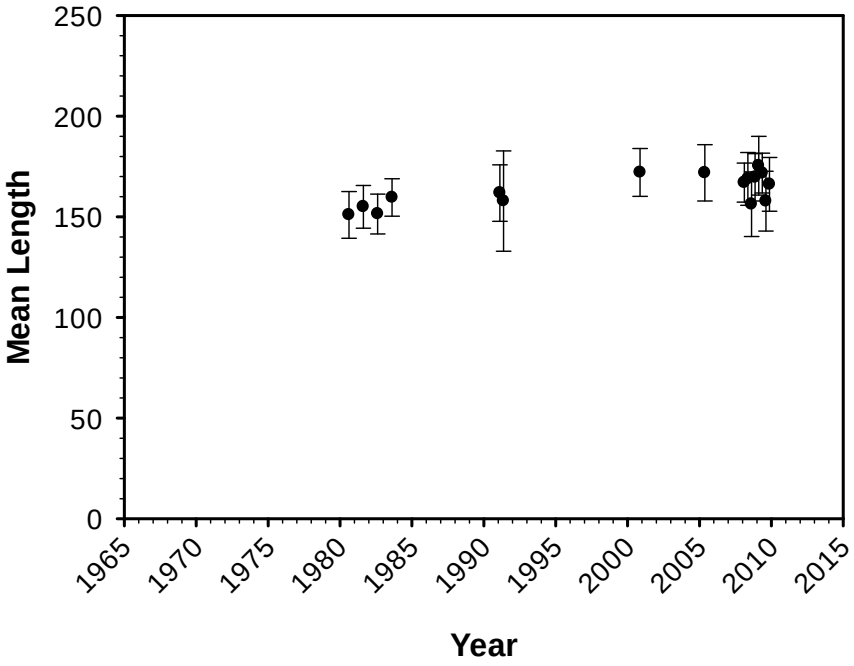

Figure 43. Mean length (cm) by year-quarter for Japanese drift net vessels.

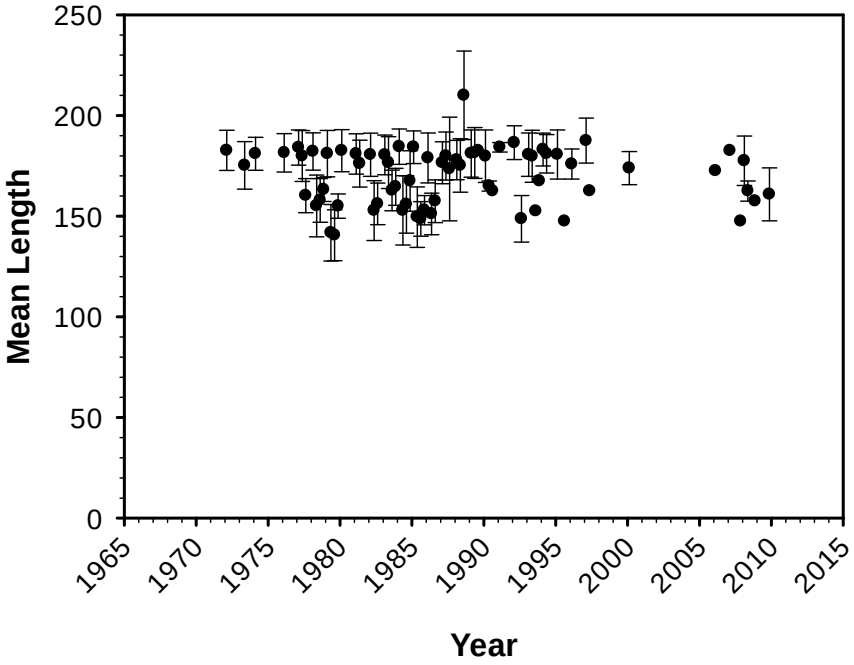

Figure 44. Mean length (cm) by year-quarter for Japanese other vessels.

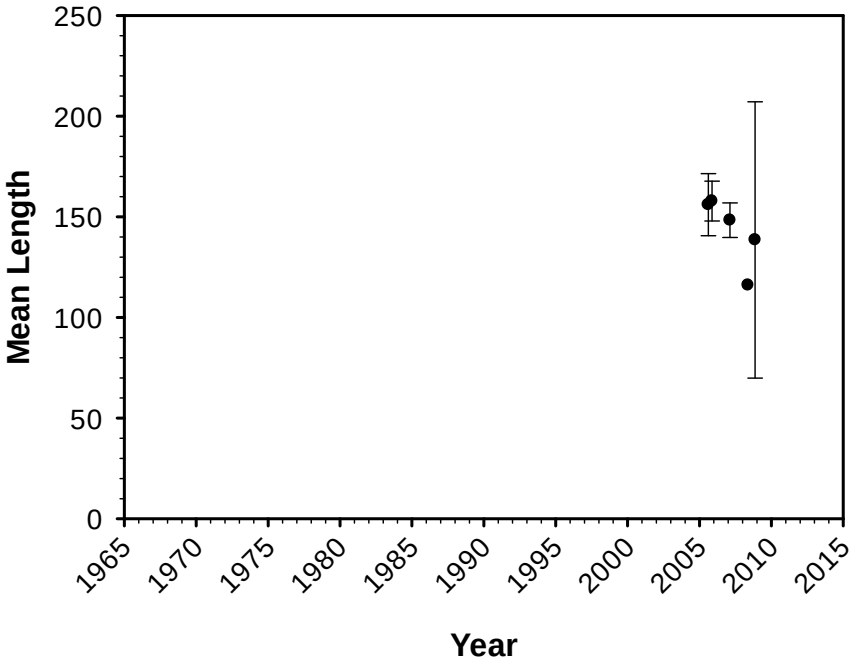

Figure 45. Mean length (cm) by year-quarter for Korean longline vessels.

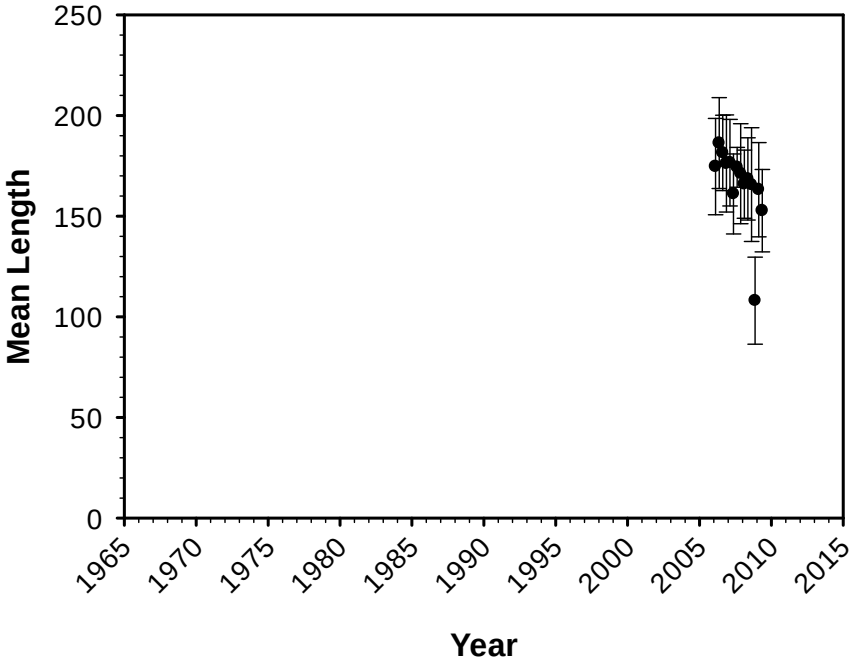

Figure 46. Mean length (cm) by year-quarter for Chinese Taipei longline vessels.

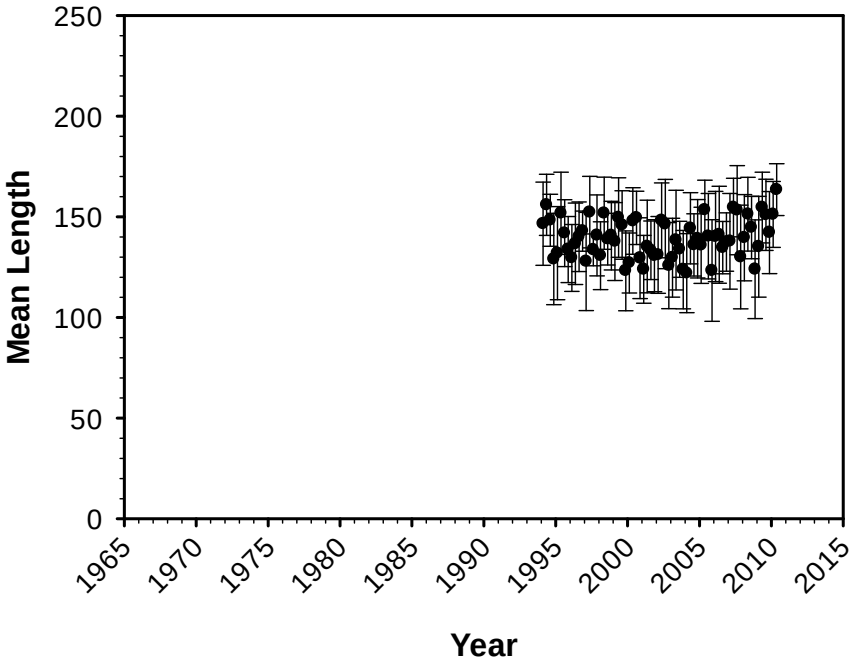

Figure 47. Mean length (cm) by year-quarter for U.S. longline vessels.

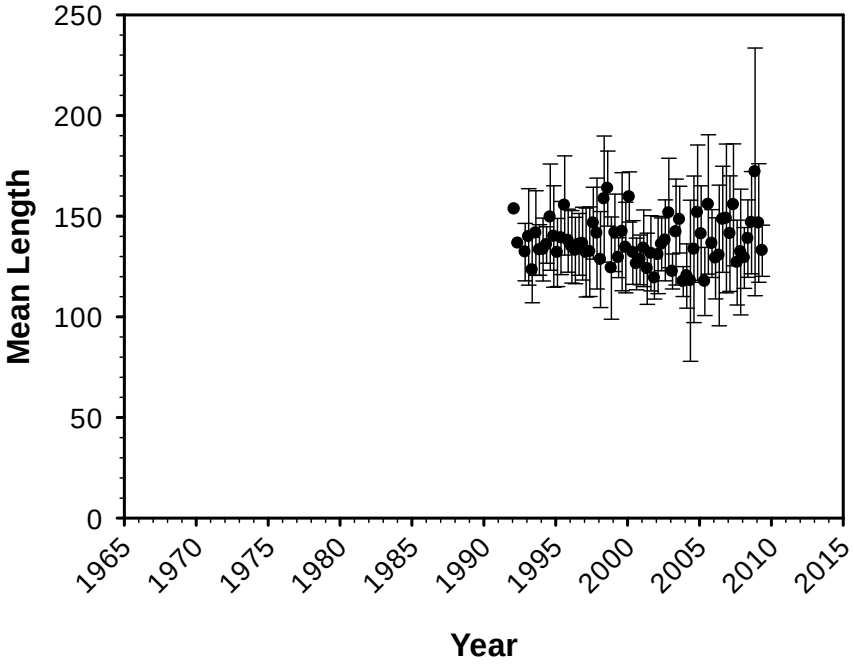

Figure 48. Mean length (cm) by year-quarter for WCPFC longline vessels.

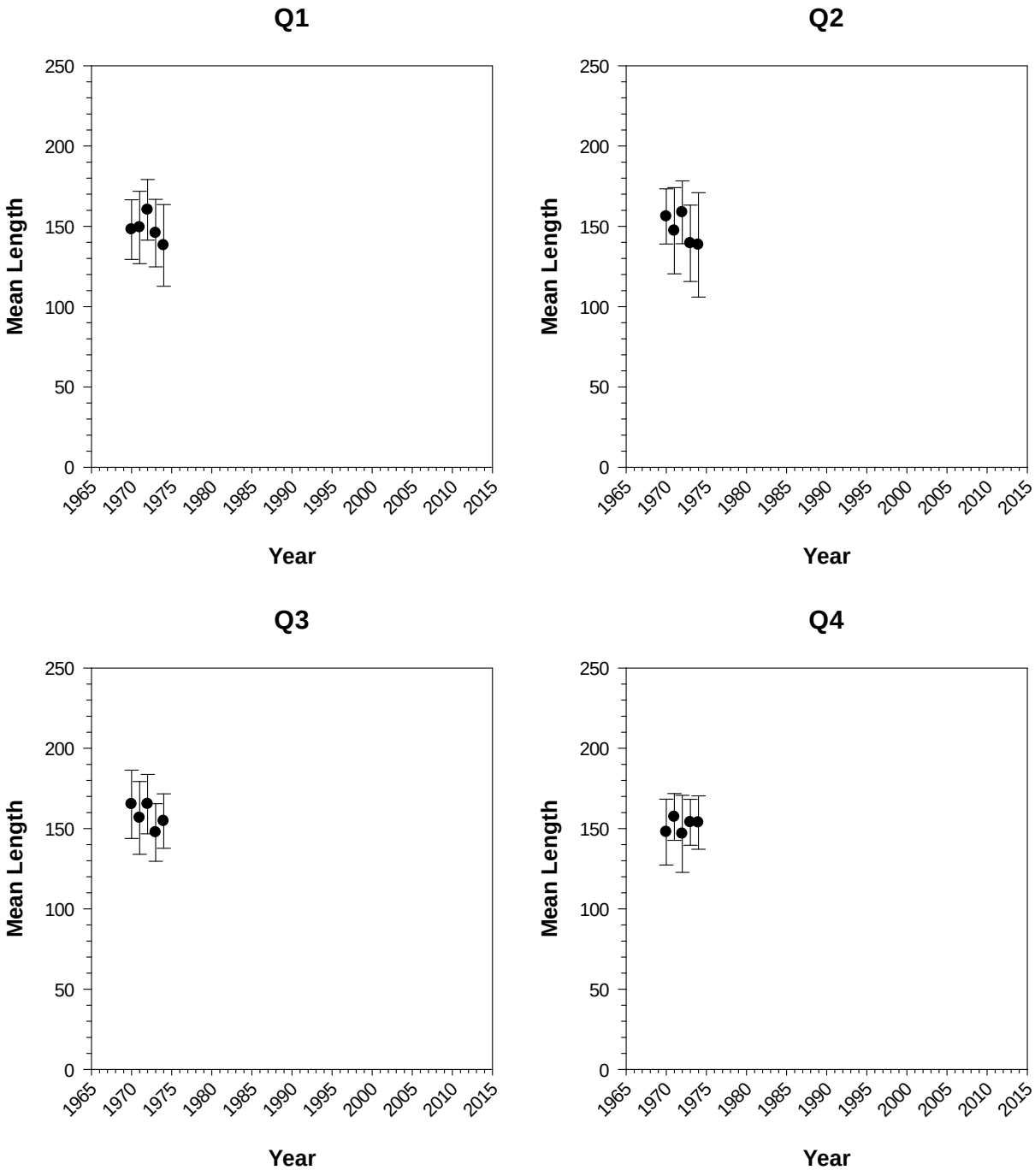

Figure 49. Quarterly mean lengths (cm) by year for Japanese longline vessels 1952-1974.

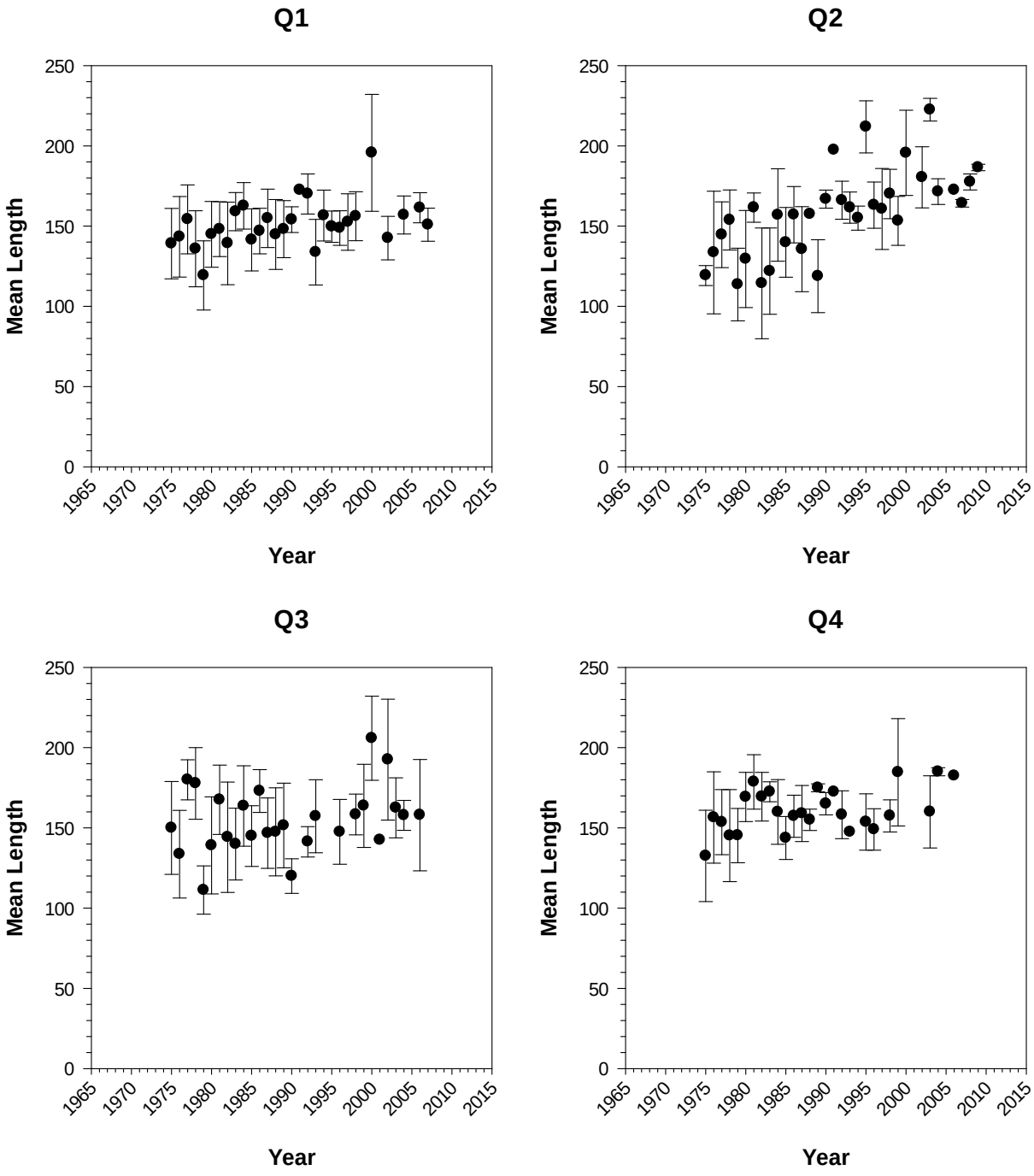

Figure 50 Quarterly mean lengths (cm) by year for Japanese longline vessels 1975-2009 in Area 1.

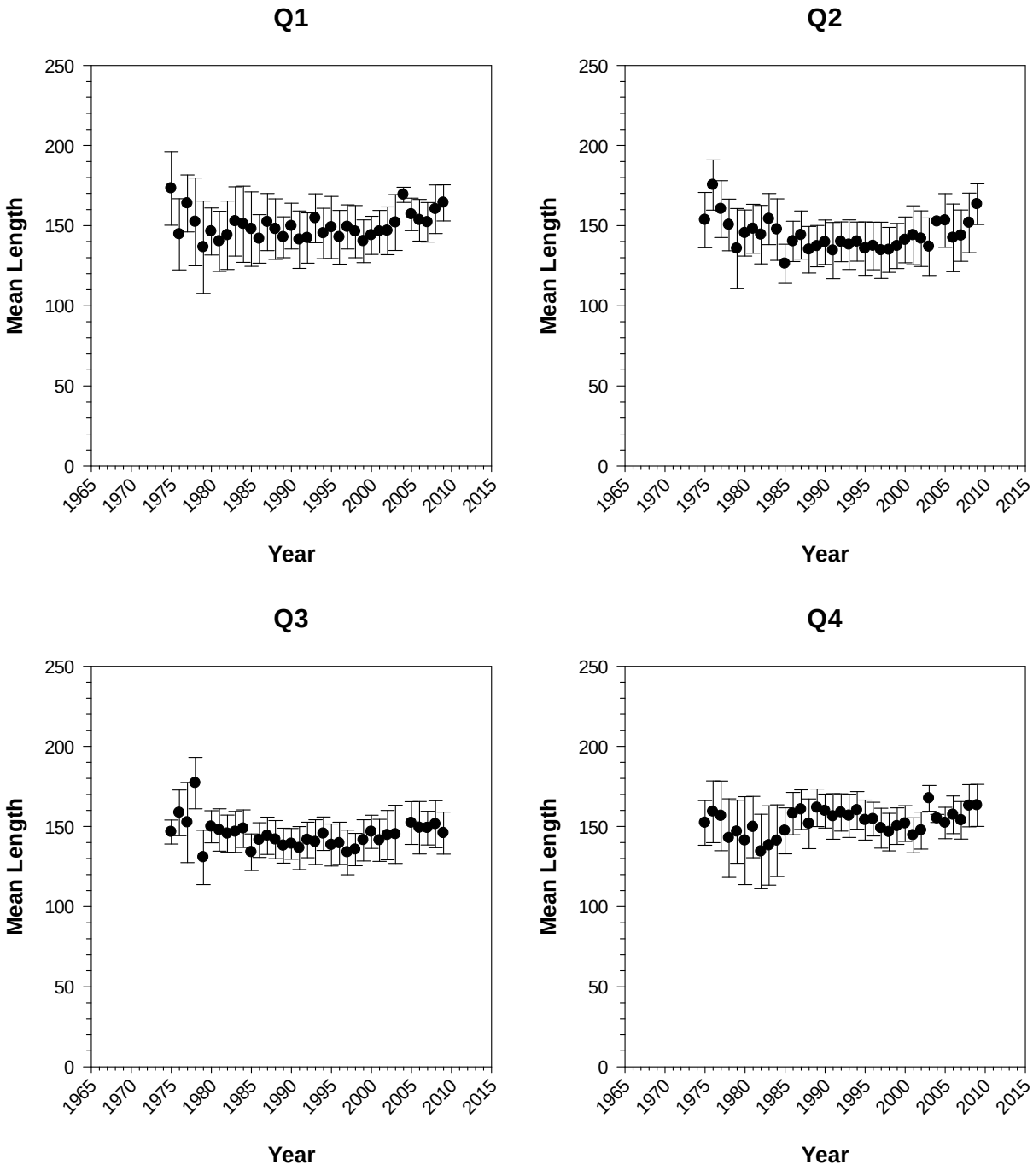

Figure 51. Quarterly mean lengths (cm) by year for Japanese longline vessels 1975-2009 in Area 2.

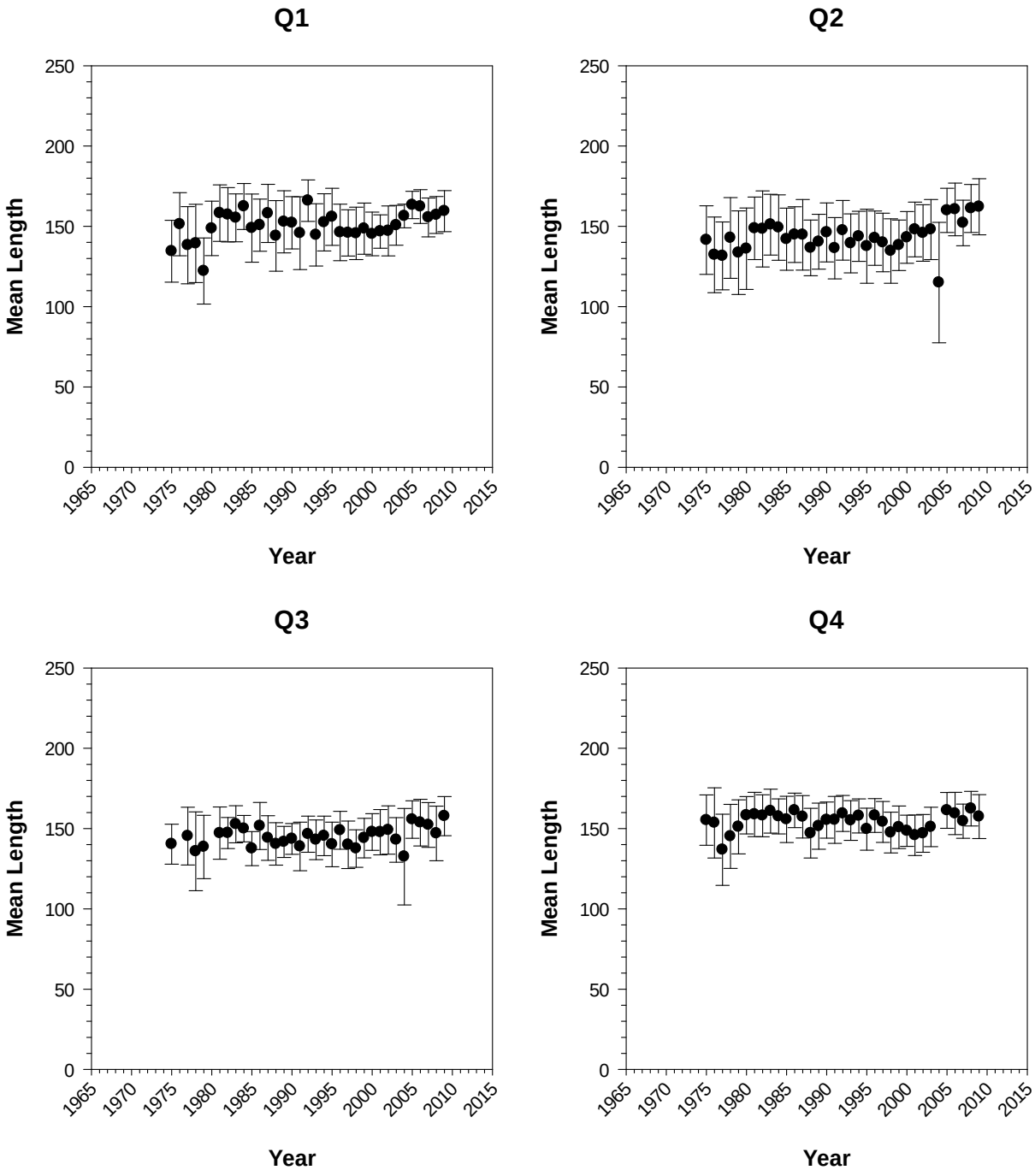

Figure 52. Quarterly mean lengths (cm) by year for Japanese longline vessels 1975-2009 in Area 3.

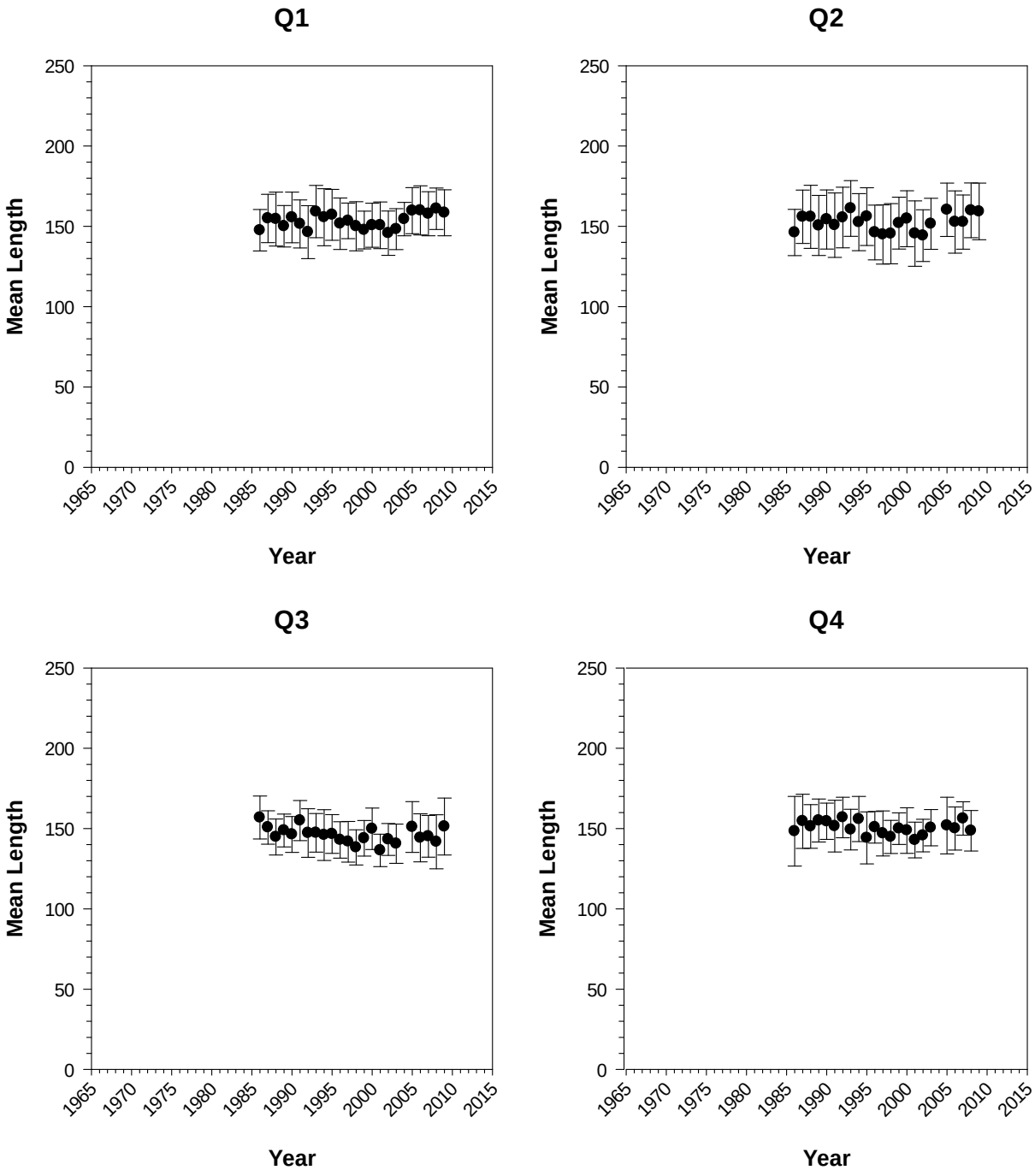

Figure 53. Quarterly mean lengths (cm) by year for Japanese coastal longline vessels.

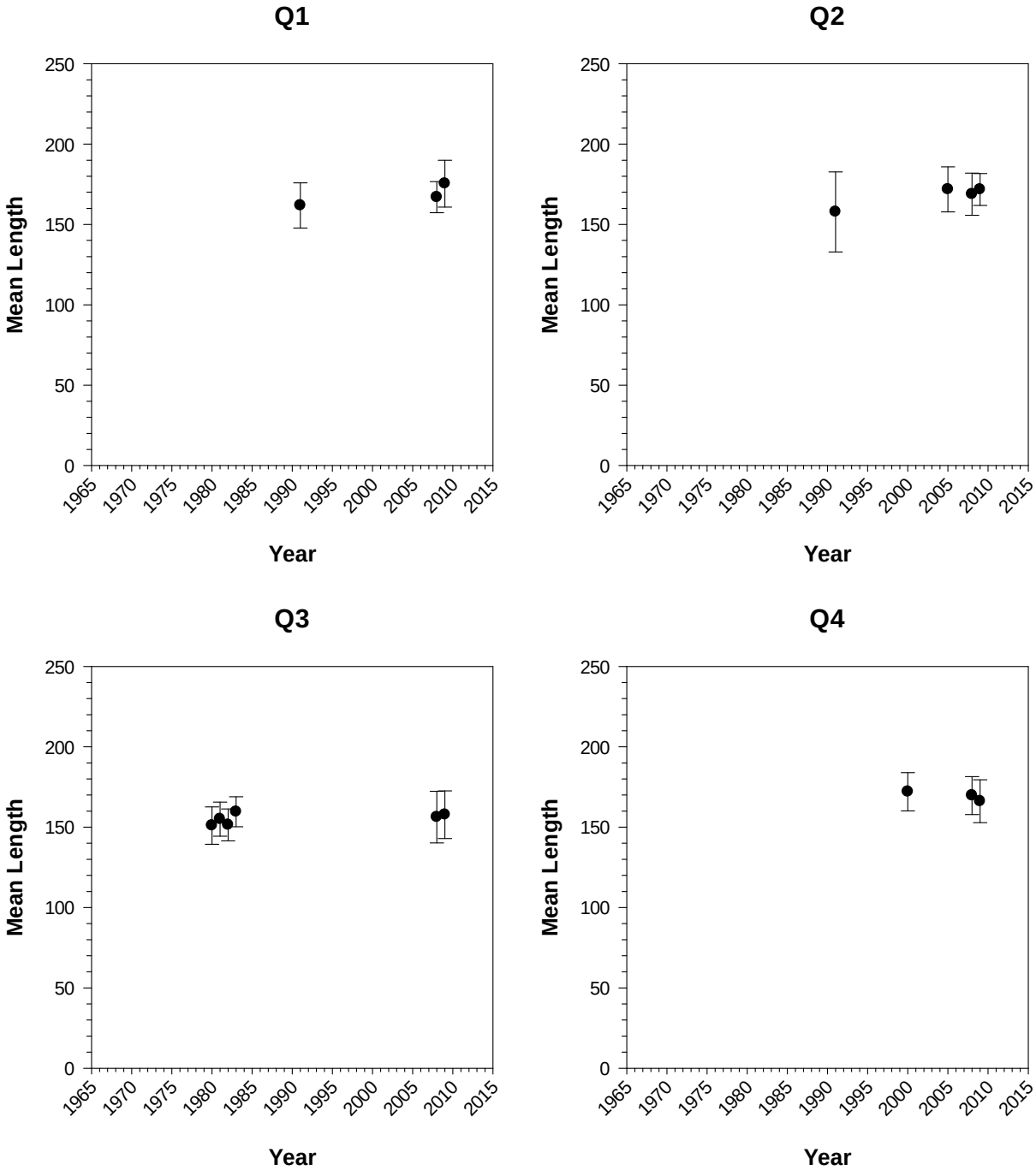

Figure 54. Quarterly mean lengths (cm) by year for Japanese drift net vessels.

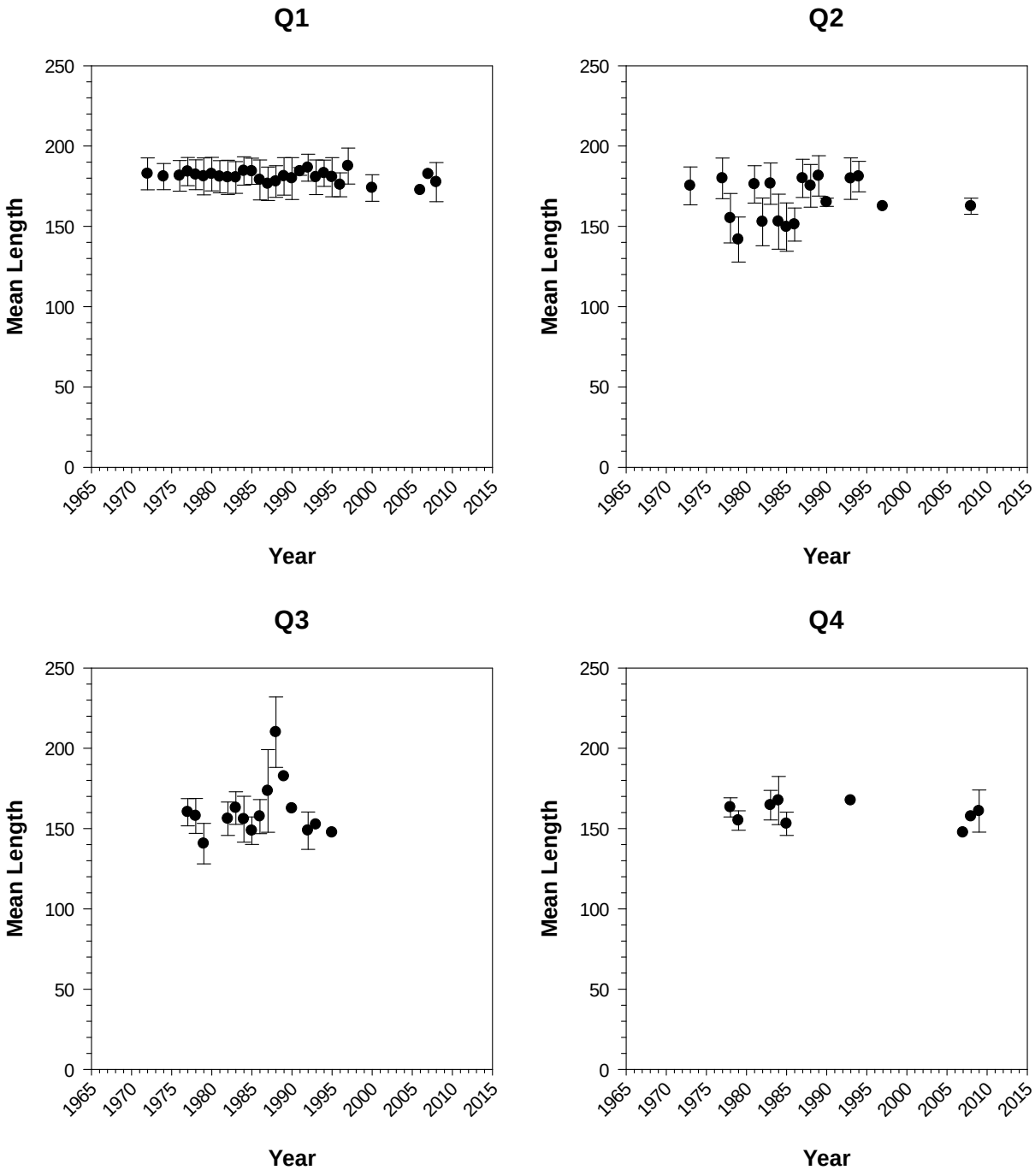

Figure 55. Quarterly mean lengths (cm) by year for Japanese other vessels.

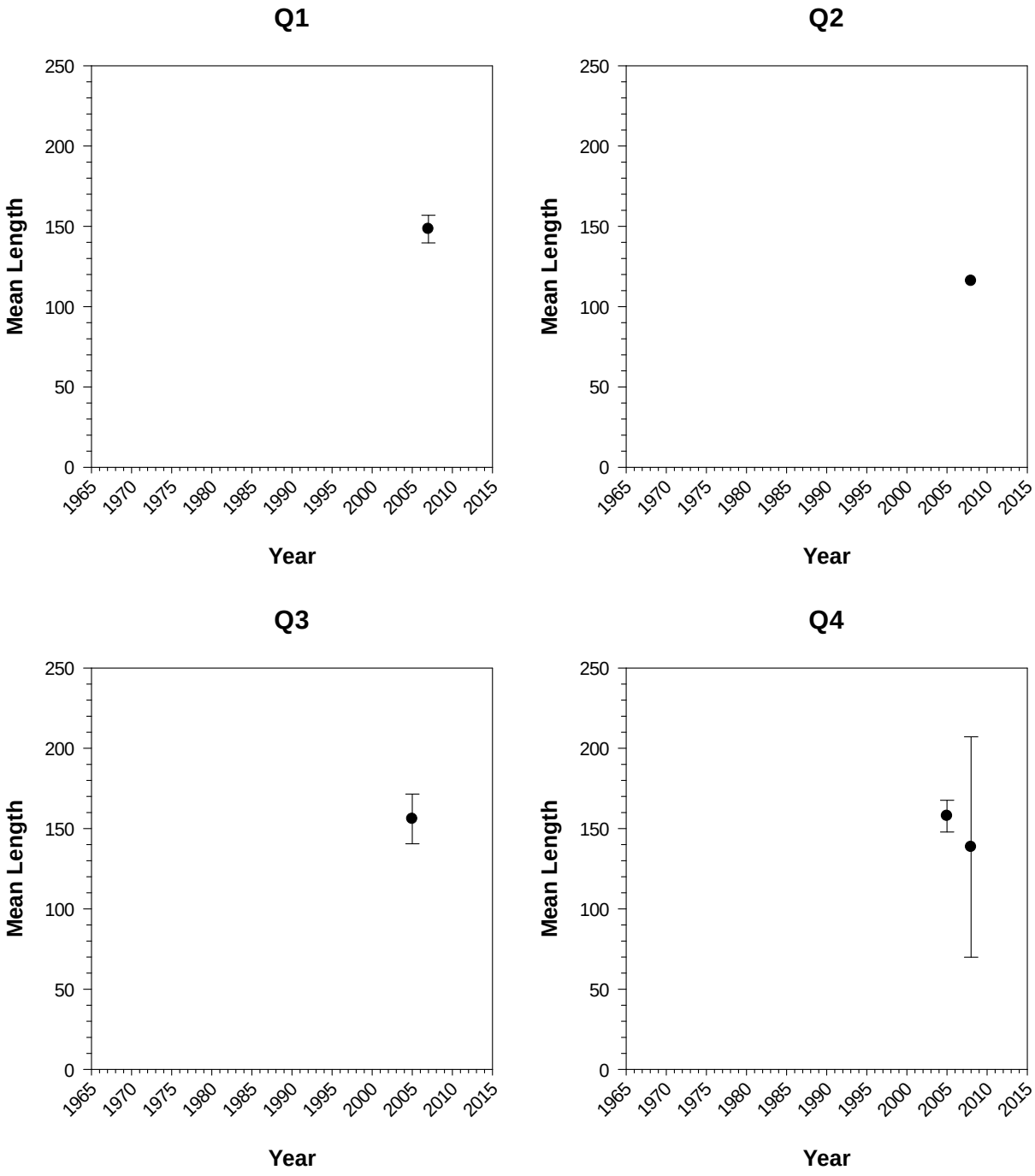

Figure 56. Quarterly mean lengths (cm) by year for Korean longline vessels.

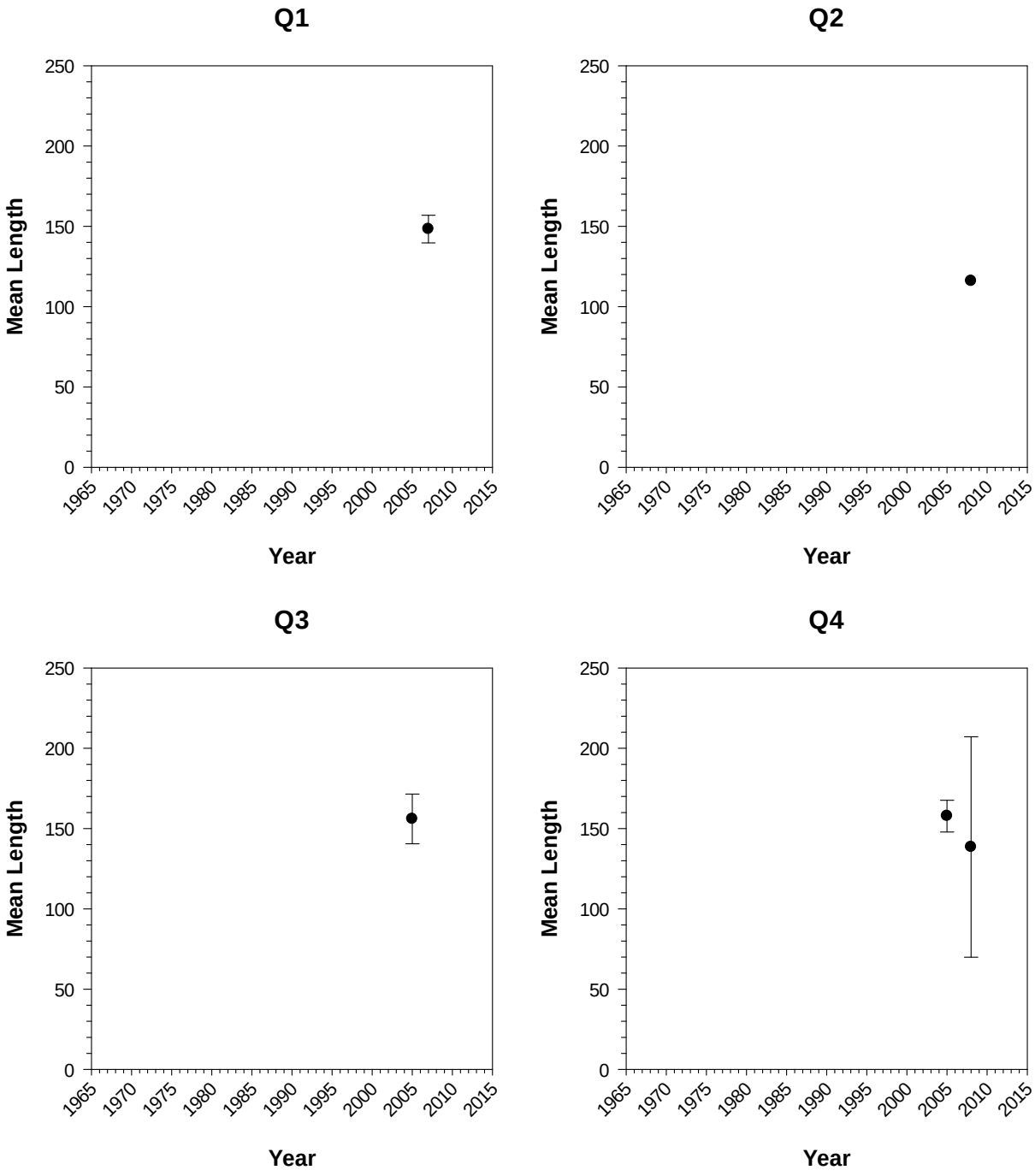

Figure 57. Quarterly mean lengths (cm) by year for WCPFC longline vessels.

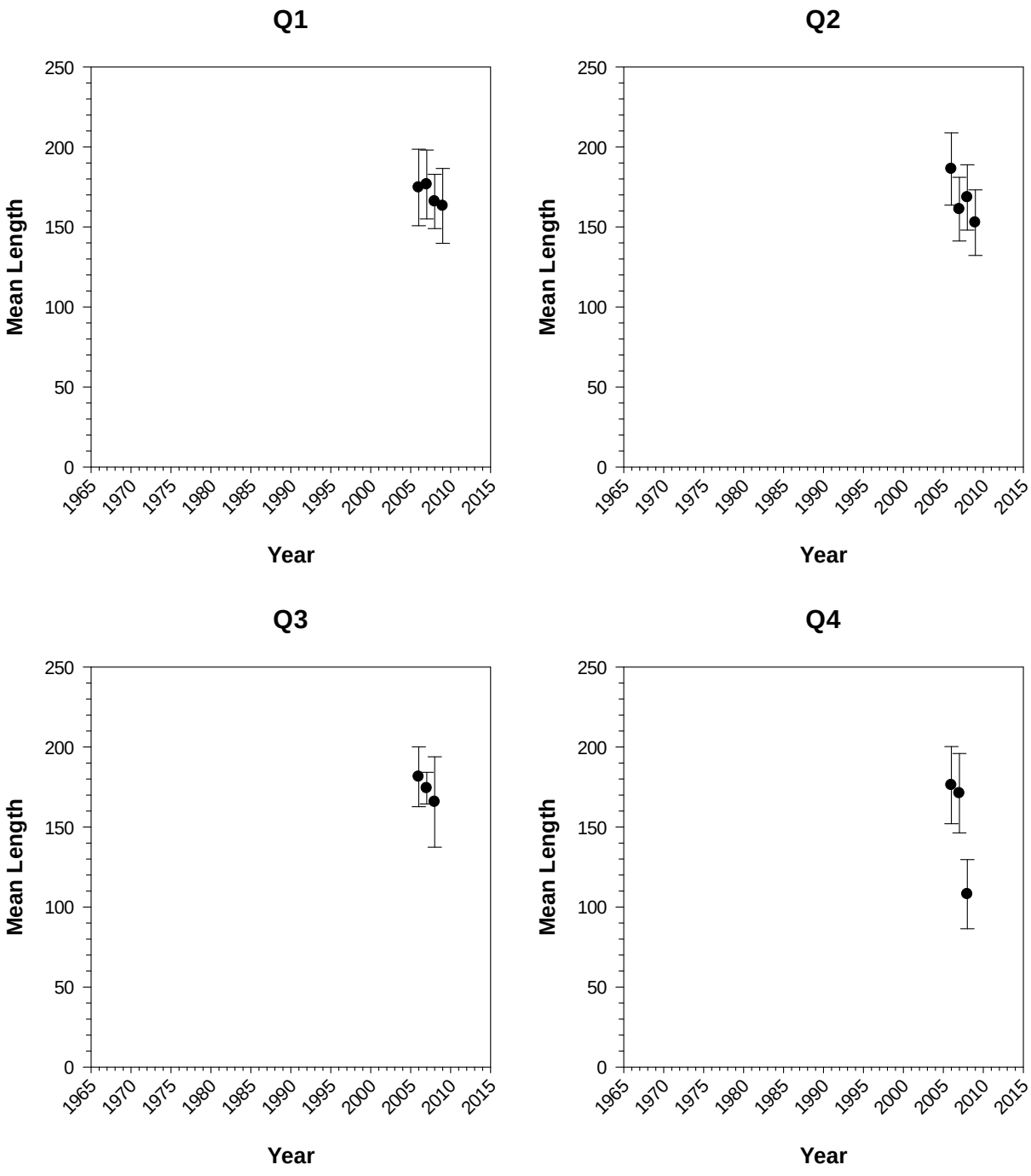

Figure 58. Quarterly mean lengths (cm) by year for Chinese Taipei longline vessels.

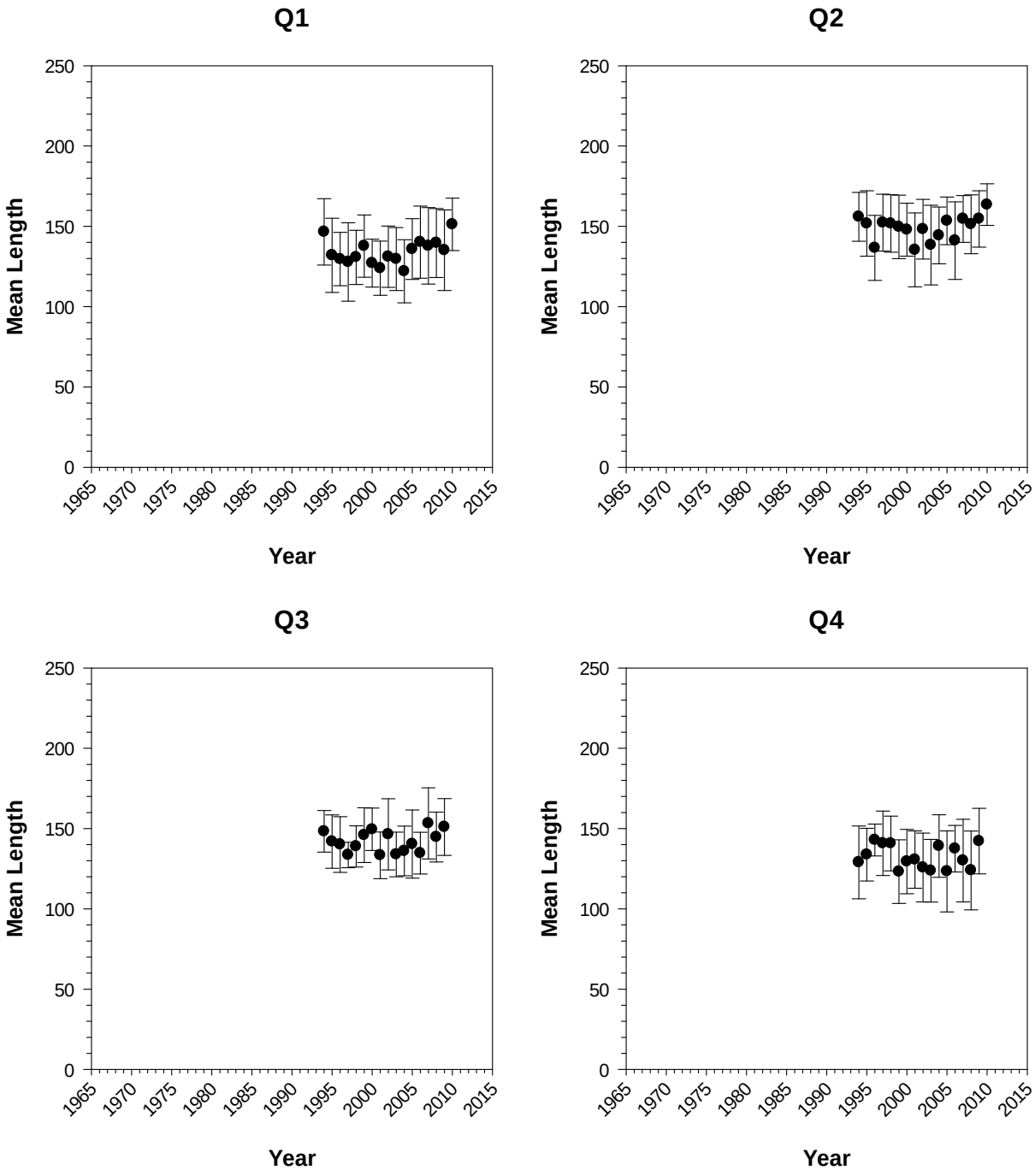

Figure 59. Quarterly mean lengths (cm) by year for U.S. longline vessels.