

**A Biological Review of the Tortugas Pink Shrimp Fishery through
December 2007**

By

**Rick A. Hart, Ph.D.
National Marine Fisheries Service
Southeast Fisheries Science Center
Galveston Laboratory**

Annual Shrimp Catch

From calendar year 1960 through 2007, the Florida pink shrimp catch averaged 11.2 million pounds (\pm 921 thousand pounds, 95% confidence interval) (Figure 1). Record numbers of pink shrimp were landed in 1996 (18.9 million pounds), yet catch subsequently declined in 1997, and have remained below or near the long term mean (Figure 1). Until the year 2004 there was a slight trend of increasing pink shrimp catch. However, since 2004 catch has declined to 8 million, 7.8 million, and 3.4 million pounds of tails in 2005, 2006 and 2007 respectively.

When pink shrimp catch is plotted separately for the nine statistical sub-areas off the Western coast of Florida, we can see that the Tortugas grounds (sub-areas 1-3) account for the majority of the shrimp caught from this region of the Gulf (Figure 2). While the volume of shrimp harvested from sub-areas 4-5 and 6-9 is less than the Tortugas grounds, the general patterns in catch are comparable. Similar to the catch of pink shrimp of the entire Western portion of Florida, the catch from the Tortugas has remained steady through the mid-1980s to the late-1990s. However, Tortugas catch for calendar year 2005, 2006, and 2007 decreased to about 5.4, 5.0, and 2.0 million pounds respectively (Figure 2).

Annual catch (*i.e.*, calendar year) on the Tortugas grounds (sub-areas 1-3) remained quite stable for 4 years (1989-1992), while catch from the other sub-areas off

of Florida decreased during this same period. During 1993, catch from sub-areas 1-3 increased, while catch from the other sub-areas remained stable. In 1994 the catch from sub-areas 1-3 remained near the 1993 level, but an increase was noted in sub-areas 6-9 (Figure 2). In 1995 catch increased in sub-areas 1-3, 4-5, and 6-9. Catch from Western Florida equaled 13.7 million pounds in 1995. This was slightly above the historical average for this statistical zone combination. In 1996 the total Florida catch was 18.9 million pounds, which is the largest harvest recorded since 1960. Similar to 1995, all statistical-areas off the Florida coast showed increases in catch during 1996. In 1997 the overall Florida catch declined to 12.2 million pounds. Only the Tortugas area experienced a decrease in catch when compared to the 1996 level, while during the same time period sub-areas 4-5 and 6-9 remained stationary. In 1998 the total Florida catch was 16.6 millions pounds, with increased catch in all areas. The most notable increase in catch for this year was from the Tortugas ground, while the other sub-areas increased slightly. In 1999 the total Florida catch was only 7.7 million pounds. This represented a dramatic decline in catch for the Florida area, with major decreases being noted in all statistical areas in Florida. The decrease of catch for Florida continued into 2000 with only 6.9 million pounds reported for the year. Only the catch levels experienced in 1991 and 1992 surpass this low value. The decrease in catch was experienced in all the statistical areas in Florida. The catch for Florida in 2001 increased to 9.2 million pounds, with most sub-areas off Florida remaining stable or recording a slight increase. However, total Florida catch decreased again beginning in 2005 and 2006 to 8.0 and 7.8 million pounds respectively, continuing to decline in 2007 to 3.4 million pounds when compared to the 2004 catch of 9.4 million pounds. As noted earlier, catch from the Tortugas fishing grounds was approximately 5.4 million pounds in 2005 and 5.0 million pounds in 2006, decreasing to only 3.4 million pounds of tails in recorded in 2007.

Biological Year Shrimp Catch

During biological year 1986 (July 1986-June 1987) an approximately 30% decrease from the long term average was observed on the Tortugas grounds, with a 25% decrease from the average of 12.2 million pounds observed for the entire pink shrimp fishery off of the west coast of Florida (Figure 3). Although an increase in catch from the Tortugas grounds was noted in biological year 1987 (7.40 million pounds), the next several fishing seasons produced very poor pink shrimp yield. Biological year 1989 produced the second lowest yield of Tortugas pink shrimp (4.3 millions pounds) since current records began in 1960, with biological year 1990 having the third lowest level at 4.6 million pounds. From 1986 through 1991, catch averaged only 5.30 million pounds \pm 1.15 million pounds; a 46% decrease in yield compared to pre-1985 conditions. Although still below the pre-1985 average, catches during 1992 (6.3 million pounds), 1993 (8.3 million pounds), and 1994 (8.0 million pounds) were better than they had been for several years. The catch of 13.2 millions pounds in biological year 1995 represented the first year since the decrease in biological year 1986 in which catch was above average. The Tortugas catch in biological year 1996 was 8.7 million pounds, while the catch in biological year 1997 was 7.9 million pounds. Both of these values were slightly below the historical average for the Tortugas area. The catch in biological year 1998 was 7.3 million pounds, with biological year 1999 producing the lowest yield on record with 4.0 million pounds caught. This was the fourth straight year recording a decrease in catch for this area. Although still below average, biological years 2000, 2001, and 2002 catches increased to 6.4, 6.8, and 6.7 million pounds respectively. However, catch from the Tortugas for biological year 2003 declined to 6.1 million pounds. Catch in the Tortugas fishing grounds declined again in 2004 to 6.0 million pounds, yet catch for the entire Western coast of Florida (statistical areas 1-9) increased to 8.9 million pounds. Tortugas pink shrimp catch in biological year 2005 remained near the 2004 level, with 5.6 million pounds being caught, while catch from statistical areas 1-9 increased slightly to 9.0 million pounds (Figure 3). Catch in biological year 2006 is the lowest level on record. The west coast of Florida, recorded a catch of only 4.1 million pounds, while Tortugas fishermen caught about 2.4 million pounds of tails during biological year 2006.

Size Distributions during Calendar Years

The size distributions of shrimp caught from the Tortugas grounds have been variable over the recorded time period. Small shrimp, *i.e.*, those greater than 67 count/pound were increasingly represented in the catch from 1994-1995 and 1998 when compared to earlier and more recent catch records (Figure 4). The increases in the 1994 and 1995 catch were primarily due to the increase in catch of the smaller size category of shrimp (Figure 5). In 1997 a general decline in shrimp harvest was noted, with the decrease in catch coming from all of the shrimp size categories (Figures 4 and 5). A small percentage of the shrimp landed in 1997 were represented by the smallest size category. The increase in shrimp catch in 1998 was primarily due to an increase in the numbers of smaller sized shrimp in the 51-67 and >67 count/pound categories. Declines in catch for the years 1999 – 2000 was primarily due to fewer small category sized shrimp being caught (Figures 4 and 5). An increase in calendar year catch was noted in 2001-04 relative to the previous two years. However, as mentioned previously, catches in 2005, 2006, and 2007 have declined. The decrease in Tortugas pink shrimp catch during 2005 was due to a lower yield of the 41-50 and >67 count shrimp and a lower catch of 51-67 and >67 sized shrimp in 2006 (Figures 4 and 5). In 2007 there was a decrease in all of the sizes of shrimp caught from the Tortugas grounds. However, within the catch, sizes 15-20 and 41-50 increased relative to the other sizes when compared to 2006 (Figures 4 and 5).

Monthly Shrimp Catch during Calendar Years

The monthly patterns of shrimp catch for sub-areas 1-3 from January 1989 through December 2007 were compared with historical monthly averages derived from the 1960-1985 catch (Figure 6). During the time period from 1989-1992 monthly catch was below the long-term average (Figure 6). Beginning in 1996 and continuing through 2005, catch fluctuated from near to slightly below the long-term average. In 1997, monthly catch was below the historical average for most of the time, while during 1998 monthly catch was usually above the historical averages. In both 1999 and 2000 catch

fell to below historical average during all months. In the years 2001-04 only a small number of monthly catches were above the historical average. In 2005, catch in all months, except for June, were below the historical average, while the catch for all months of 2006 was below the historical average (Figure 6). This pattern was again evident in 2007, when all of the months recorded catches were below the historical average (Figure 6).

Tortugas Fishing Effort during Biological Years

Following the low fishing effort values experienced during biological years 1988-1992 (July-June), fishing effort in sub-areas 1-3 during biological year 1994 was about 13 thousand days fished (Figure 7). This fishing effort was still below the 16.3 thousand days \pm 2.13 thousand days fished average (1960-1985) for the Tortugas area. Effort increased during biological year 1995 to above average levels. Fishing effort in sub-areas 1-3 during biological year 1995 was around 25 thousand days fished. Effort decreased during biological year 1996, to around 17 thousand days of fishing and remained there during 1997. Fishing effort in the Tortugas has been below the 1996 level of 17 thousand days fished ever since. The effort levels reached during the mid-1990s are all above the historical average for the area. In 1998 effort declined to about 14 thousand days of fishing, and declined again in 1999 to 11 thousand days of fishing. Effort increased in biological years 2000 and 2001 to approximately 13 and 14 thousand days fished respectively. While in 2002 and 2003 effort was about 13 thousand days fished. The decline in effort accelerated through 2004 and 2005 when only 9 and 7 thousand days respectively were fished. Effort for biological year 2006 continued to show this declining trend. Effort in biological year 2006 was only 6.0 and 3.0 thousand days fished for the western coast of Florida the Tortugas respectively (Figure 7). The decrease in catch and effort during the later years documented in this report resulted in increased catch per unit effort (CPUE) for the fishermen working Florida and the Tortugas grounds.

Biological Year Catch Per Unit Effort (CPUE)

Catch per unit effort (CPUE) is reported as pounds of shrimp caught during a 24 hour fishing day (pounds per day fished). Catch per unit effort values averaged 598 pounds per day fished \pm 81 pounds per day fished in the Tortugas area from 1960-1985. During the years between 1986 and 1994, each CPUE was below average (Figure 8, Table 1). The CPUE of 507 pounds per day fished during 1995 was still below the historical average for the area, while CPUE for 1996 decreased to 484 pounds per day fished. During biological year 1997 CPUE was the lowest value experienced during the recovery period, equaling 464 pounds per day fished. CPUE in 1999 increased to 491 pounds per day fished despite the low catch levels noted previously. Disproportional decreases in both catch and effort caused the resulting increase in CPUE. However, this CPUE was still below the 500+ pounds per day noted during the recovery period. The CPUE experienced in biological year 1999 equaled 349 pounds per day fished. The 1999 CPUE is the lowest value recorded over the entire data set. A 40% decrease in CPUE has occurred from 1994 to 1999 on the Tortugas fishing grounds. An increase in CPUE was observed in biological year 2000, with values increasing to about 467 pounds per day fished. Catch per unit effort also increased during 2001, equaling 482 pounds per day fished (Figure 8, Table 1), and increased in 2002 to 511 pounds per day fished. While catch and effort were down from previous years, CPUE increased in 2004 for both the entire Western coast of Florida and the Tortugas fishing grounds to 599 and 639 pounds per day fished respectively. Catch per unit effort for statistical zones 1-9 increased in 2005 to 691 pounds per day fished, while CPUE for the Tortugas grounds increase to 736 pounds per day fished (Table 1). Like the previous years, an increased CPUE for 2005 was the result of disproportional decreases in both catch and effort. Catch per unit effort declined again in 2006 to 627 and 615 days fished for Florida and the Tortugas respectively. While CPUE did decline in 2006, its level for both the west coast of Florida and the Tortugas grounds is still much higher than has ever been recorded for the last 20 years prior to 2005 (Figure 8 and Table 1).

Recruitment

Yield per recruit is enhanced with the presence of the Tortugas Sanctuary, since it prevents the harvest of small shrimp as they migrate from the nursery areas to the offshore fishing grounds. Overall yield is a function of number of recruits entering into the fishery each year. Low and high periods of recruitment have been experienced throughout the 46 year history of the fishery (Figure 9). A three-year period of low recruitment occurred from 1988 through 1990, while an increase in recruitment was noted for the 1991-1995 time period. Although the 1996 value dropped from the 1995 level, it was only slightly below the long-term average of 1.07 billion recruits. A slight increase in recruitment was noted in 1997, declining in 1998 and 1999. The 1998 level was slightly below average for the area, with the 1999 recruitment the lowest on record. Recruitment increased in 2000, 2001, and 2002 to about the 1998 level. Similar to the recruitment 2003, recruitment in both 2004 and 2005 declined to approximately 0.7 billion recruits. Our models still indicate that recruitment continued to decline through 2006 to about 0.3 billion recruits.

Spring recruitment (January-June) on the Tortugas fishing grounds has undergone fluctuations during the 46 year period (Figure 10). Spring recruitment showed a steady increase from 1991 through 1996, but declined sharply in 1997. Spring recruits increased during 1998, but fell again in 1999. The 2000 value was similar to the number of recruits estimated in 1999, with the 2001 value increasing to between the 1997 and 1998 levels. An increase in recruitment continued through the spring of 2003 but declined in 2004 and 2005 to 0.41 and 0.26 billion recruits respectively. Spring recruitment in 2006 declined to about 0.2 billion recruits. A general decreasing trend is visible for fall recruitment (July-December) from 1960 through about 1992. Fall recruitment was good in both 1995 and 1996, however these levels were still not above the average experienced during the early years of the fishery (Figure 10). There was a decrease in recruitment in 1997, increasing in 1998 to levels similar to those experienced in 1995 and 1996. Recruitment fell sharply in 1999, but increased slightly in 2000. A trend of increasing fall recruitment of pink shrimp has also continued through 2005. Our model estimates fall recruitment for 2004 and 2005 to be 0.47 and 0.49 billion young shrimp respectively.

From the first period of low catch in the Florida pink shrimp population (late 1980's to early 1990's), an increase in pink shrimp parent numbers was noted from 1990 through 1992 (Figure 11). During 1992, an increase in the number of recruits also occurred. Although the 1993 parent level was below the 1992 value, the recruitment level was above the 1992 value (Figure 11). In 1994 an increase in recruitment above the 1993 level occurred with only a slight increase in parent stock. In 1995 both the number of parents and the number of recruits increased above the 1994 values. This continued increase in recruitment, with an increase in parent stock levels, is an indication that improvements were beginning to occur in the pink shrimp nursery habitats in Florida. In 1996, the parent level was higher than the 1995 value, but fewer recruits were produced in the fishery. However, recruitment was still above the historical average for 1996. In 1997 a decrease in parents was again noted, but recruitment levels, although lower than 1996, were still above average. In 1998 an increase in parents was noted, but this increase produced fewer recruits than in any of the previous four years. This apparent lack of a strong relationship between the number of parents and resulting recruits indicate problems were again starting to occur in the pink shrimp habitat. The 1999 parent values and recruitment were similar to those experienced in the early 1990's. The total pink shrimp parent stock level in 1999 was at 108 million shrimp, which is near the over-fishing index level of 100 million shrimp. In 2000, 2001, and 2002 both parent stock and recruitment showed an increase above the 1999 levels (Figure 11). Parent stocks for 2003 off of the Western coast of Florida declined to numbers last observed in 1991, while recruits are estimated to be at levels last noted in 1992. However, for 2004 and 2005 we have estimated an increase in parents compared to the 2003 levels (Figure 11). Our model estimates the parent number index in 2006 to be at about one-half of that estimated in 2005.

Summary

From the currently available biological data, no causes for the recent declines in pink shrimp fishery catches along the Florida coast have been documented. Previously, problems within the habitat (i.e., freshwater flow pattern alteration, sea grass die-off, high temperatures and/or salinity in Florida Bay, etc.) are suspected as

potential reasons for declines in shrimp populations. However, recent declines in catches over the last several years are most likely purely economical, resulting in lower fishing effort, and attributed to the financial hardships currently experienced throughout the Gulf of Mexico commercial shrimp fishery. These hardships have been documented to include an increase in imported shrimp on the domestic market, and most notable a dramatic rise in fuel costs. These non-biological factors are substantiated by the decline in effort and hence lower yields. If biological factors were a large factor in these recent downturns in shrimp catch, we would be documenting a decline in catch with stable or even increasing fishing effort. This does not appear to be occurring in this as well as the larger Gulf fishery as we have recorded some of the highest CPUE levels in recent years. This increase in CPUE indicates that the shrimp are available for harvest for the fishermen who are able to target them. Therefore, the currently low yields in the pink shrimp fishery can most likely be attributed to economic and not biological conditions.

Table 1. Biological year pink shrimp catch statistics for the Tortugas fishing grounds from 1960-2006.

Year	Catch (million Lbs.)	Effort (k days fish)	CPUE	CPUE	CPUE
1960	13.2	18	725	-	725
1961	8.5	16	523	-	523
1962	8.9	15	560	-	560
1963	10.3	17	595	-	595
1964	10.4	16	620	-	620
1965	13.0	17	730	-	730
1966	10.9	18	597	-	597
1967	8.5	16	506	-	506
1968	9.1	15	602	-	602
1969	11.2	15	704	-	704
1970	9.1	15	593	-	593
1971	7.7	12	599	-	599
1972	8.5	14	596	-	596
1973	10.0	17	565	-	565
1974	8.9	15	559	-	559
1975	8.4	15	524	-	524
1976	9.7	14	656	-	656
1977	13.0	20	629	-	629
1978	9.5	16	569	-	569
1979	8.8	18	489	-	489
1980	13.6	20	677	-	677
1981	8.7	11	786	-	786
1982	7.5	16	462	-	462
1983	7.6	15	474	-	474
1984	10.2	17	592	-	592
1985	7.9	12	614	-	614
1986	5.8	13	-	417	417
1987	7.4	16	-	459	459
1988	4.9	11	-	416	416
1989	4.3	10	-	390	390
1990	4.6	10	-	428	428
1991	4.8	10	-	460	460
1992	6.3	11	-	566	566
1993	8.3	15	-	544	544
1994	8.0	13	-	579	579
1995	13.2	25	-	507	507
1996	8.7	17	-	484	484
1997	7.9	17	-	464	464
1998	7.3	14	-	492	492
1999	4.0	11	-	349	349
2000	6.4	13	-	467	467
2001	6.8	14	-	482	482
2002	6.7	13	-	511	511
2003	6.1	13	-	460	460
2004	6.0	9.0	-	639	639
2005	5.6	7.0	-	736	736
2006	2.4	3.0	-	615	615
Mean CPUE (± 1 Standard Error) =			598 (±15.8)	498(±21.5)	553 (±14.3)

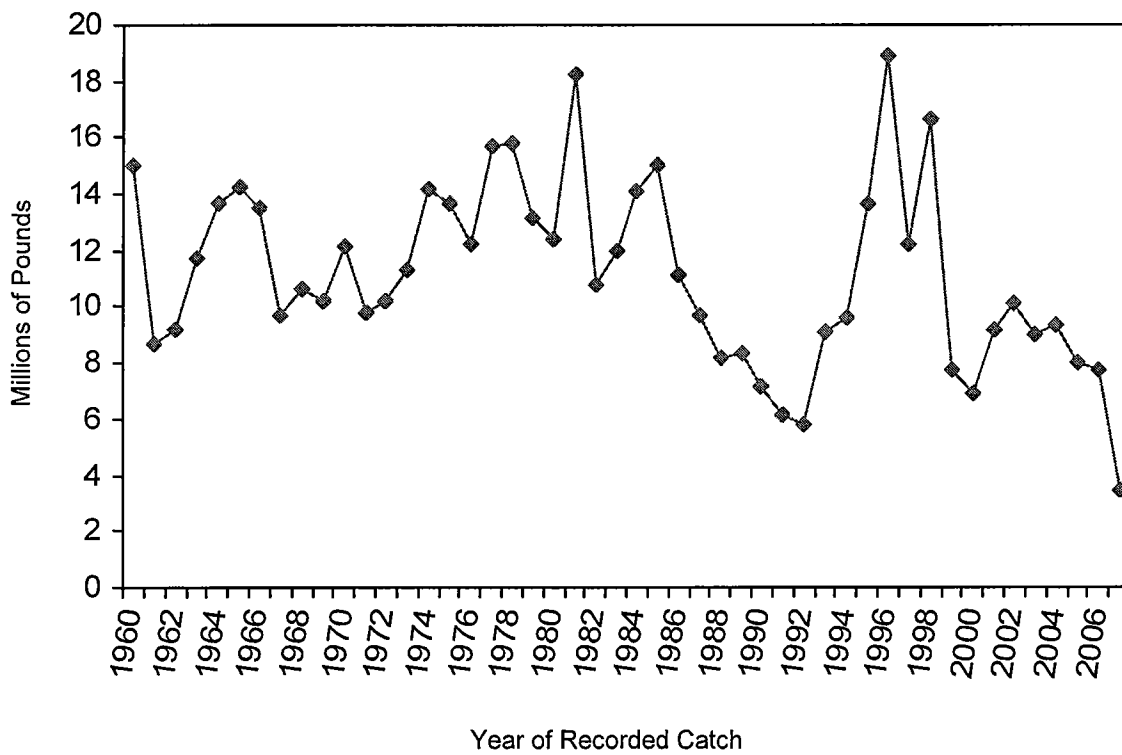


Figure 1. Annual pink shrimp catch for the West coast of Florida (1960-2007).

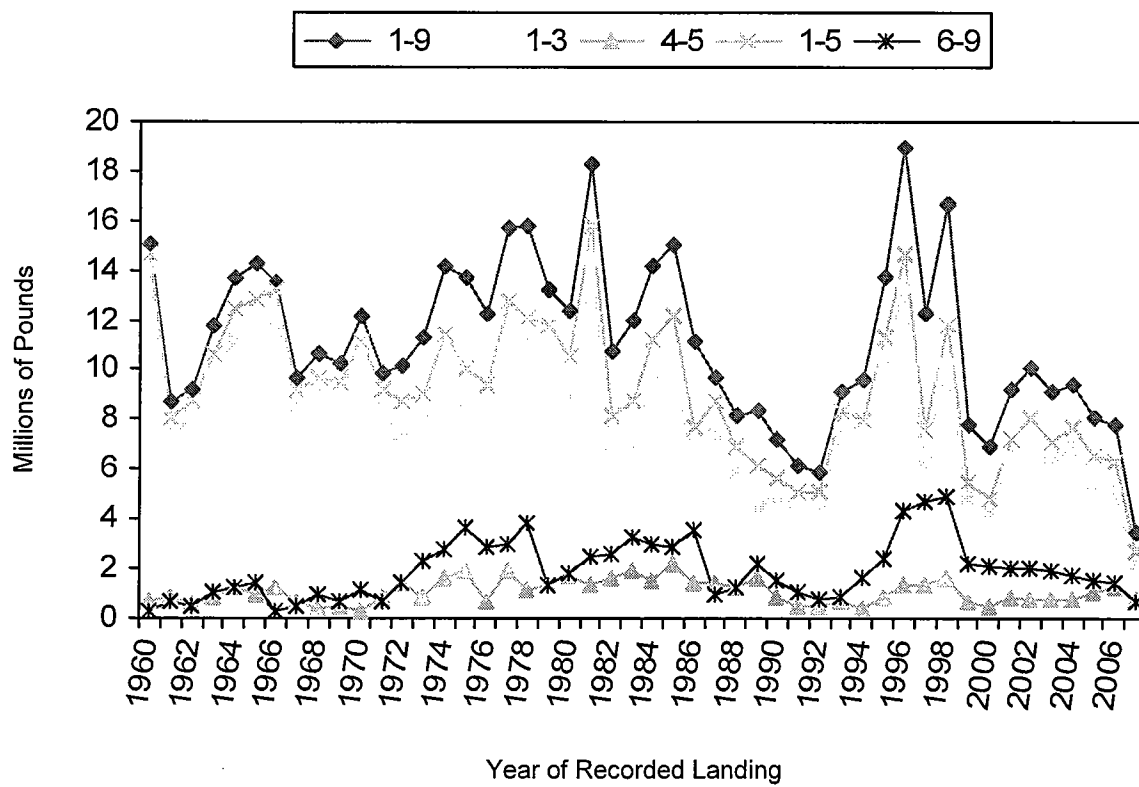


Figure 2. Annual pink shrimp catch (1960-2007) for the West Coast of Florida illustrating all of the sub-areas.

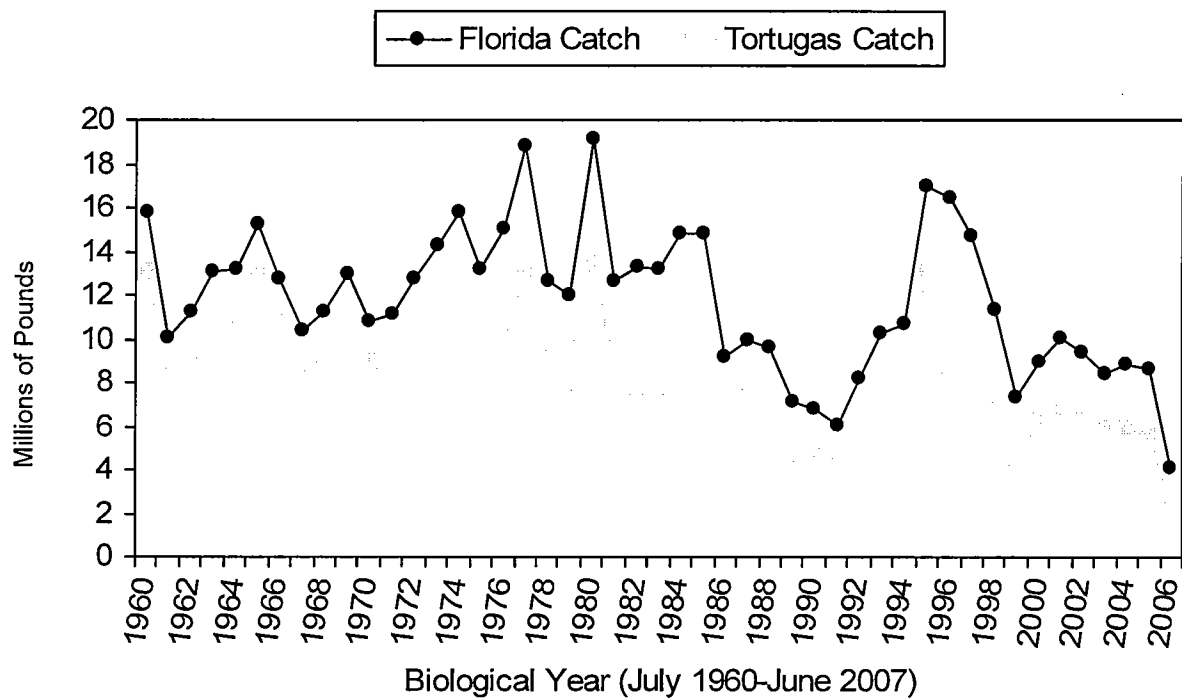


Figure 3. Pink shrimp catch for the Tortugas grounds (sub-areas 1-3) and the West coast of Florida (sub-areas 1-9) for biological years 1960-2006.

