Assessment of Georgia's Marine Fishery Resources

Patrick J. Geer and Dwayne E. Roberson

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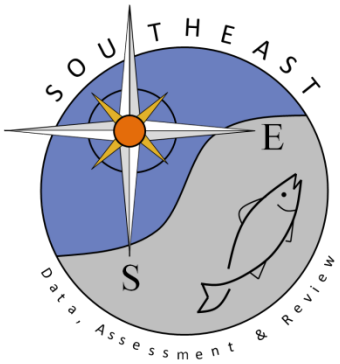

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Award No. NA06FI0081
Completion Report
Project Period: March 1, 2000 - February 28, 2003

by

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ABSTRACT

Project personnel conducted monthly coast-wide trawl assessment monitoring activities from March 2000 through February 2003, to collect fishery independent information on shrimp and crab population abundance, size and spawning activity. Data collected were used in conjunction with historical assessment records and fishery dependent data to evaluate current fishery status and to formulate management recommendations to open and close seasons and geographic areas for Georgia's shrimp and crab fisheries. Population abundance, maturities, spawning activity, and other biological and environmental data are presented by area, year and month with stock abundance comparisons from previous assessment studies. This report summarizes 2000-2003 assessment monitoring activities and reveals how these data were used in the formulation of commercial fisheries management actions. Major management actions, legislative revisions, rule changes and ongoing fishery-related activities are also included in this report.

ACKNOWLEDGEMENTS

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A very special thanks is extended to Jim Music who retired from DNR's Coastal Resources Division in December 2002 after 32 years of service. His dedication and loyalty to this program and the state of Georgia has served as a model for all those who succeed him.

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INTRODUCTION

The Georgia Department of Natural Resources (DNR), Coastal Resources Division (CRD), is charged with insuring the wise use, conservation and management of Georgia's commercially and recreationally important estuarine and marine fishery resources for the benefit of all Georgians. These common property marine fishery resources are being subjected to increased user demands making it necessary for fishery managers to routinely monitor stocks and environmental parameters that affect commercial harvests. Georgia law requires that specific criteria be addressed before management decisions are implemented. Since penaeid shrimp and blue crabs are short-lived and support annual fisheries, these decisions must be based on current analyses of stock status and fishery dependent factors such as market demand, price, and anticipated landings.

Georgia's total 2002 commercial harvest of all seafood products was valued at $14.8 million (Appendix A-1). Of this total value, commercial food shrimp (whites, browns, and pinks) accounted for 3.3 million pounds valued at $10.9 million (73.6%) with blue crabs at 2.0 million pounds valued at $1.9 million (12.8%). Penaeid shrimp and blue crabs are the most economically important commercial marine species in Georgia. Commercial landings for white shrimp were substantially higher in 2002 (2.78 million pounds of tails) as compared to 2001 (1.7 million pounds). However, the majority of these landings occurred early in the year (January) and during the spring. Fall catches of white shrimp were well below normal. Blue crab landings continue to decline with four of the worse five years occurring successively since 1999. Landings of hard crabs in 2002 were 76% below the long-term average (56-02) of 8.5 million pounds. An extended drought (four plus years) has been speculated as the cause of this continued decline in blue crabs.

Historically, white shrimp*, Litopenaeus setiferus*, annually comprise approximately 81% of Georgia's commercial shrimp harvest, while brown shrimp, *Farfantepenaeus aztecus*, constitute approximately 19%. Pink shrimp, *Farfantepenaeus duorarum*, are far less abundant in Georgia waters and typically comprise < 0.1% of the annual harvest (Appendices A-1 to A-). From 1957-1999 white shrimp landings averaged 3.7 million pounds (Appendix A-2) while brown shrimp averaged approximately 0.9 million pounds (Appendix A-3). Pink shrimp landings since 1956 have ranged from 0 to 28,000 lbs but in the past decade have averaged only 5,173 lbs. annually with catches ranging from 899 to 14,981 lbs. per year (Appendix A-4). Commercial landings for Georgia's seafood industry are presented in Appendices A1-A6.

Since 1968, Georgia's managers have conducted various shrimp and crab assessment and monitoring studies, several of which have also included finfish. In recent years, there has been a need to repeat the work of these previous studies because of strong concerns from recreational fishermen and environmentalists about by-catch from all trawl fisheries. Work done by Mahood et al., (1974) originally inventoried the distribution, seasonal abundance and size composition of shrimp, crab and finfish and began Georgia's current resource database for fishery independent comparative trends. Harris (1974) expanded analyses of the shrimp database by reporting on growth rates, sex ratios, maturity and size composition, and found little variation from earlier findings by Lindner and Anderson (1956). Likewise, Palmer (1974) expanded blue crab data analyses and reported on life history aspects including size composition, maturity, sex ratios and distribution.

Music (1979) continued shrimp and crab population assessments along the Georgia coast and documented the impacts of the disastrous 1977 winter "shrimp kill", resulting in recommendations that altered traditional commercial harvesting seasons and areas. Recommendations from this work included closure of the sounds and delaying the annual opening date for Georgia's territorial waters (from the beaches seaward to three miles) to allow "roe white shrimp" the opportunity for adequate spawning. Rogers (1990) collated data from historical blue crab assessment studies with meteorological data, river discharge and major environmental events to shed light on recent declines in commercial crab landings.

From 1977 through 1981, life history information was collected on population dynamics of penaeid shrimp, blue crab, and selected coastal finfish (Shipman, et al., 1983). Stevens, et al., (1984) continued this work by documenting recruitment, distribution, relative abundance, size, and reproduction of penaeid shrimp and blue crabs, and also included recruitment and seasonal abundance of juvenile finfish. Since 1983, shrimp and crab resource assessment monitoring activities have been designed to maintain continuity of these historical data for properly evaluating the principles of wildlife research and management mandated by Georgia law O.C.G.A. 27-4-130 (Appendix B). Recent studies continue this historical database and allow analyses and interpretation for timely management recommendations. This long-term database has allowed managers to approach optimum yield without adversely impacting other important fishery resources.

Music and Pafford (1984) investigated life history aspects of Georgia's most popular inshore marine sportfish including: age, growth, seasonal abundance, maturity, size composition, and feeding habits. Recent finfish studies have included marine recreational fishery surveys, a finfish assessment monitoring study, and a red drum and spotted seatrout assessment and tagging study funded by the Federal Aid Sportfish Restoration Act.

In April 1995, a three-year shrimp trawl fishery bycatch study began to characterize and quantify the finfish bycatch associated with Georgia's shrimp trawl fishery. Department staff participated monthly as bycatch observers aboard commercial shrimp trawlers and collected monthly fishery independent bycatch information aboard the state's research vessel, *ANNA*. This study and other previous assessment studies above were designed to document relative abundance, distribution, size, reproduction, and recruitment of penaeid shrimp and blue crabs for real time management decisions. This particular study augments the historical database while maintaining a 27-year continuous database for these important resource stocks. Since May of 1997 the shrimp and crab assessment study has been the main focus of the Commercial Fisheries Program. This report, details the assessment monitoring study, and how the data from the present three-year project were used in making management recommendations and seasonal decisions for Georgia’s shrimp and blue crab fisheries.

METHODS

Trawl sampling was conducted monthly from February 2000 through March 2003 in six of Georgia's commercially important estuarine systems: Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrew and Cumberland (Figure 1). Each system was divided into three separate sectors: 1) large creeks and rivers; 2) open sounds; and 3) nearshore ocean waters associated with the state's territorial waters from the beaches to three miles offshore. Two fixed trawl stations were established in each sector providing six stations per estuarine system, or 36 stations coast-wide (Figure 1 and Table 1).

Cruises were typically scheduled and conducted during the first half of the month on neap tides whn possible for standardization purposes. Although some deviation occasionally occurred due to inclement weather, mechanical problems, and other unforeseen events, field sampling was typically completed within this two-week window.

Standard trawl duration was 15 minutes calculated as bottom time from end of deployment until haul back. All sampling was conducted aboard the Department of Natural Resources' (DNR) 18.3 m (60 ft.) research vessel *ANNA*. The gear consisted of a 12.2 m (40 ft.) flat otter trawl with 4.8 cm (1 7/8 inch) stretch-mesh webbing for the body and bag, with attached tickler chain and 60”x 28” trawl doors. Catches were deposited in a large culling table where shrimp and blue crabs were sorted by species and quantitative measurements taken.

At each station, a representative subsample of 30 shrimp of each species was measured. Individual lengths were recorded in millimeters with weights recorded to the nearest tenth of a pound. Records were maintained for each commercially important penaeid shrimp species on datasheets providing for sex, total length (mm) (tip of rostrum to tip of telson), state of ovarian development, the occurrence of diseased individuals, and the total weight and number of individuals per pound (heads-on). Number per pound count size was determined by obtaining the average number of whole individuals in a random three-pound subsample. In small samples where less than three pounds of a particular species were collected, number per pound values were calculated by dividing the total number of individuals collected by the total weight of the sample. In samples where only one specimen was collected, or when total weights represented one ounce or less, a length/weight conversion table, prepared from previous commercial fisheries investigations, was used to obtain heads-on counts (Appendix C). Ovarian development was classified and recorded in five distinct stages of maturity (King, 1948): UN = undeveloped; D = developing; Y = yellow; R = ripe; and S = spent. The presence or absence of spermatophores was also recorded.

A similar protocol was established for blue crabs with sex, carapace width (distance in mm between tips of the major spines), ecdysis stage, maturity, total number, and total weight collected. Ecdysis stages were recorded in five classifications: hard, pre-molt, peeler, soft, and paper. The shape of the abdominal apron, with triangular aprons indicating immature or virgin females and rounded aprons indicating mature females, determined female maturity. Development or maturation of the "sponge", or egg mass, was classified by color with yellow, orange, and dark brown denoting successive stages of egg development.

Weight in pounds has traditionally been the mass unit used for consistency with industry standards. Efforts are underway to convert these values to kilograms in the historic datasets with the understanding the imperial system data will be available for the industry and other lay persons. Count size (represented as number per pound) will continue to be recorded since it represents more of a marketing unit (grade) than landings measure. In past reports, catch per unit effort was presented as pounds per hour of trawling. Both this measure of effort and kilograms per standard 15-minute trawl are used in this report. However, there is a potential source of bias in the pounds per hour effort measure. Expanding the standard tow durations of 15 minutes to one hour would be an extrapolation of the data with the assumption of a linear relationship of catch to tow duration. Many studies have reported the contrary with catches reaching an asymptotic with increasing tow duration (Geer et al, 1995; Hata 1997).

Environmental information recorded at each trawl sample station included: station location, tide stage, wind direction and speed, surface air and water temperatures (^{o}C), dissolved oxygen in mg/l, and surface water salinity in parts per thousand (ppt). Moon phase was also recorded, but is not included the analyses in this report.

Spot check sampling was also conducted as needed to obtain supplemental data critical to the formulation of management recommendations or to evaluate the impacts of unusual environmental events such a severe winters. Spot checks were made in the same manner as normally scheduled trawl sampling but were not necessarily made at established stations. Therefore, supplemental spot check sampling was not included as part of regular analyses, but rather served as supplemental information for management decisions.

Trawl assessment monitoring, including station locations, equipment, and data gathering criteria were closely aligned with the methodology of previous studies (Music, 1979; Shipman, et al., 1983; Music, et al., 1987; Music. et al.1991; and Music, 1994); serving as the comparative historical database so these current findings could be compared directly with long term records. Georgia's historical trawl assessment studies date back to 1970, but sampling regimes have varied slightly between individual studies. Consequently, those particular data are not included in historical comparisons (Table 2).

RESULTS

Environmental Parameters

Georgia has experienced drought conditions since the fall of 1998. The Palmer Drought Index, a measure of relative wetness or dryness ranging from 4 to -4, has consistently been below –2.0 in climatic division 9 (coastal counties) since June of 1998 (NOAA 2003). The drought has produced higher than normal salinity in the estuaries, a condition that can have adverse affects on shrimp and crab populations. Although there has been no period when salinity measures were significantly above the long-term average, values at creek sites were as much as 17% above normal during the summer of 2003 (Table 3, Figures 2-5). The impact this drought may have had on crabs and shrimp is not completely understood. However, both assessment and commercial landings data for blue

crabs have shown a significant decline during each of the past four years. Loss of habitat, increased disease occurrence, and failed recruitment may all be possible under such adverse conditions. Large rain events occurring in March and April of 2003 may have brought the drought to an end (Figure 5). Many rivers and creeks in Georgia remain near or above flood stage, bringing coast-wide salinity levels to 8% below normal (Table 3).

Estuarine water temperature during the period covered by this report was generally above normal. December 2001 was exceptionally warm – over 5^{o}C above average. The mild winter of 2002 (Table 3 and Figure 4) is believed to have resulted in earlier than normal maturation of white shrimp during April 2002. With the exception of February 2000 (overall 9.64^{o} C, 2.5^{o} C below normal) and the winter of 2000-01 (January and February, 2 ^{o} C and 3 ^{o} C below normal respectively), all other months during this period were at or above the long-term monthly averages (Table 3 and Figures 2-5).

Dissolved oxygen (D.O.) levels did not vary significantly between sectors during any given month. As expected, D.O. has an inverse relationship with temperature, reaching a minimum in July (long-term mean 4.79 mg/l) as water temperatures peak (long-term mean 30.14) (Table 3 and Figure 6). Overall for this three-year period, D.O. concentrations were below average nearly all of 2000 and most of 2002, while at or above average for the entire 2001 sampling year (Figure 6). Interestingly, these years of lower than normal D.O. also correspond to years when black gill disease occurred in white shrimp (Geer 2003).

Abundance Estimates

Catch per unit of effort (CPUE) is used as a proxy measurement of abundance. Two methods have been used to calculate CPUE for each of the four species and for all shrimp species combined. In the past, CPUE in pounds per hour was calculated by multiplying the standard tow duration (15 minutes) by four and dividing by the total number of trawls. Even though this method is routinely used in the commercial sector, these results should be used with the caveat that they are calculated from an extrapolation of the survey data. The second method of calculating CPUE as kilograms per standard 15 minute trawl provides a more realistic measure of abundance since it does not assume linearity between catch and trawl duration (Hata 1997).

Some discrepancies have been found with the historic data. The station and individual specimen information (size, sex, etc) are available for all of 1979, but the catch information (total numbers and weight) are missing for all but the December survey. This fact makes all the annual abundance estimates for 1979 erroneous and results for that year should be considered provisional. Efforts are presently underway to re-enter these data and thoroughly examine all historical data for accuracy and completeness.

Tables 4-6 show the annual catch rates and count size for each species as well as for all shrimp species combined, by sound and sector. Table 7 presents the annual catch values for each of these species with the associated 95% confidence intervals. Unfortunately, due to the small monthly

sampling size (n=36) and expected high variability in trawl catches, it is difficult to identify any significant difference in catch rates.

Shrimp Species Combined

Catches in St. Simons Sound typically were observed to be higher than all other sound systems in each of the three years, ranging from 2.51 kg/trawl in 2000 to 3.58 kg/trawl in 2002 (Tables 4-6). Conversely, Cumberland Sound usually had the lowest catch rates ranging from 0.64 to 2.24 kg/trawl.

The sounds and creeks had similar overall catch rates during the three year period with the creek stations ranging from 20.43 (2000) to 32.63 kg/trawl (2002), and the sounds from 17.11 (2000) to 36.79 kg/trawl (2002) (Tables 4-6). Catch rates in offshore sampling were nearly an order of magnitude lower than catches from other sectors, with annual catch rates between 3.14 and 4.45 kg/trawl (Tables 4-6).

White Shrimp

White shrimp were the most abundant shrimp species in assessment trawls, ranging from 78.5% of the total catch in 2001 to 93% in 2000 (Tables 4-6). Coastwide, catch rates typically peak during the fall with the long-term monthly averages (1976-2002) highest in November (6.29 kg/trawl) followed by September (5.85) and December (5.22) (Figure 7). Abundance usually declines prior to spring spawning with the lowest values observed in June and July (0.33 and 0.23 kg/trawl respectively). Catches for the past three years have generally been below these long-term averages (Figures 7 & 8). With the exception of March and April 2002, and May 2003, the catch rates for the first half of the year have all been below normal (Figures 7 and 8). Catch rates for the second half of the year appear to be declining when compared against the long-term average. Both 2000 and 2001 were below the norm. Early fall results in 2002 reflected high abundance (August and September), however, catches rates rapidly declined in October through December possibly due to impacts associated with black gill disease (Figure 7 & 8) (Geer 2003).

On a geographic basis, the St. Simons Sound System has the highest and most consistent catch rates followed by St. Andrews and Sapelo (Figure 9). Monthly fall catch rates in these sound systems routinely exceeded 5 kg/trawl. Although Wassaw, Ossabaw, and Cumberland Sounds often had isolated catches approaching this value, they were neither consistent between months, nor between years.

Estimates of annual abundance for the sound systems presently sampled (Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrews, and Cumberland), indicate the past three years to be below the long-term average of 3.05 kg/trawl (Table 7 and Figure 10). Catches in 2000 and 2001 were comparable at 1.47 and 1.50 kg/trawl, with 2002 results a kilogram greater (Table 7). Catch rates have shown a general downward trend since the “average” year in 1993. Although catch rates are below normal, the size of white shrimp are larger. Count size (in number per pound) has been lower than the 33.2/lb average each of the last four years. (Table 7, and Figures 10-11). The average size

(total length measured from rostrum to telson) has been significantly larger each of the past six years than the overall average of 126.26 mm (Figure 11).

Brown Shrimp

Brown shrimp typically first appear in trawl catches in May, and by June comprise the bulk of the assessment trawl shrimp catch. By volume this species averages 6.8% of the total shrimp catch, but its contribution is highly variable with annual catch rates from 0 to 19.3% (Table 7). Brown shrimp are only in the sampling area during the summer months (June to August) after which they migrate offshore to spawn (Figures 8 & 12). Distributional data from the last three years indicates similar catch rates between sound and creek stations, with catches at offshore sites being appreciably less (Tables 4-6, and Figure 13). Monthly catch rates for both 2001 and 2002 were well above normal for both June and July (mean = 1.84 and 3.01 kg/trawl, respectively) (Figures 12 and 13). However, catches for 2000 were well below the average (June = 1.35, July = 1.32 kg/trawl) (Table 4 and Figure 12). As with white shrimp, brown shrimp were most abundant in St. Simons Sound with catch rates during these summer months routinely above 1.5 kg/trawl (Tables 4-6 and Figure 13).

Annual estimates of abundance are highly variable (Table 7 and Figure 14). The overall mean (1976 through 2002) was 0.22 kg/trawl, $\pm$ 2.19 kg. Catches in 2000 were 50% below this average, with those in 2001 and 2002 68% and 32% above average, respectively. No apparent trend is evident in these estimates with large fluctuations from year to year. Count size has fluctuated closely around the long-term average of 31.0/lb, ranging from 23.4 (1978) to 39.1/lb (1980) (Table 7). In the most recent years, sizes have been above this long-term average (Table 7, Figures 14 & 15).

Pink Shrimp

Pink shrimp are a minor but regularly occurring component of the overall shrimp catch, ranging from 0.1% of catch (2000) to 2.1% in 2001 (Tables 4-6). Catches are typically highest in the spring, peaking in May (Figure 16). Catches in May 2001 and 2002 were above the long-term mean for the month (0.08 kg/trawl). The highest catches during this reporting period occurred in August 2001, primarily due to higher than normal catches in Cumberland Sound (Figure 17). Catch distribution between the estuaries varies between years, with Sapelo Sound consistently near the highest catch rates and Wassaw near the low end. As with the other shrimp species, abundance is comparable between the creek and sound stations with offshore stations nearly an order of magnitude lower (Tables 4-6). Annual estimates of abundance seemed to be higher than normal through the early 1980s and below normal the entire 1990s (Figure 18). There were below average catches in 2000, near record highs in 2001, and average catches in 2002 (Table 7 and Figure 18). Count size has fluctuated around a long-term mean of 45.3/lb, ranging from 31.6 to 65.7, excluding the anomalous year of 1979 when only 53 specimens from December's sampling were used for the calculations (Table 7 and Figure 18). The average size has ranged from 77.14 mm TL (1980) to 110.59 (1999) (Figure 19) with a long-term mean of 101.19 mm.

Blue Crabs

The four-plus years of drought have been blamed for a severe decline in blue crab harvest and assessment abundance estimates during the study period. (Table 7 and Figure 20). However, CPUE values have indicated a downward trend since 1993. The largest impact has been seen on Wassaw and Ossabaw Sounds where catch rates have declined to near zero (Figure 21). There has been a dramatic coast-wide decline in abundance unprecedented in the 28 years of the survey (Figure 8 & 21). Typically blue crabs show a bimodal pattern of abundance in both the harvest and assessment trawl catches. Numbers increase during the spring, decline during the summer months, and increase again during the fall (Figures 21 & 22). The long-term monthly mean number of crabs per trawl has only been surpassed three months in the last three and a half years (Feb 2001, Apr 2001, and Oct 2000) (Figure 22). April is typically the month of highest catch rates, however, with the exception of 2001, assessment trawl catches have all been well below normal. April 2003 estimates were 92.4% below the long-term average (Figure 22). Although the drought may be causing a reduction in abundance and catches , the average size of blue crabs has increased in recent years. In 2000 the average crab was 136.52 mm (carapace width). The average size declined significantly from this value during 2001 and 2002, but was still greater than the long-term average of 115.76 mm) (Figure 23). Dwindling sample sizes is responsible for increased variance in lengths the last few years.

The decline in catches is not limited to any one-life stage. Females typically make up the bulk of assessment catches with adults averaging 32.3% and juveniles 30.5% of the total catch (Figure 24). The proportion of adult and juvenile males is somewhat equal, with adults averaging 11.3% of the catch and juveniles 13.1%. With the increased salinity associated with drought conditions, the percentage of males has been declining since 1998. There has been a corresponding increase in the proportion of females in assessment catches (Figure 24).

If catches are used as an indicator of abundance, then the size of the Georgia blue crab stock has declined precipitously since the early 1990's. However, again because natural variability and small monthly sample size introduce considerable variance in summary statistics the differences between annual catches and long-term arithmetic means are not statistically significant. The decline in the blue crab population seems to be most pronounced in the spawning stock (adult females). Catches in 2002 were 90.2% below the long-term average of 2.54 crabs per trawl (Figure 25). Catches were down over 92% since the last "normal" year in 1993. These estimates for 2002 are the lowest recorded in the history of the assessment survey. Juvenile catches can provide a measure of recruitment success and have shown similar but sometimes less dramatic declines. Catches in 2000 were 72.5% below the historical average of 3.79 crabs/trawl. In 2001, the catch of juveniles was slightly better at 1.75 crabs/trawl (53.8% below average). However, the low average catch of 0.24 crabs/trawl (93.7% below the long-term average) suggests that there may have been a complete recruitment failure in 2002 (Figure 25).

SHRIMP OVARIAN DEVELOPMENT

White Shrimp

Historically, there has been very little ovarian development observed during the first quarter of the year (< 5%). Development generally begins in April and peaks during May and June, when, on average, 50% of all females are developing eggs (Figure 26). Spawning is generally restricted to water temperatures above 21^{o} C which are typically first observed in May (Figures 2 to 5). Spawning is usually completed by August with less than 10% of all females showing signs of development during that month. The spawning season can generally be defined as the period from March to August. This is the period when assessment trawl catches are lowest, a situation likely due to shrimp migration beyond the sampling area. (Figure 27).

On an annual basis, 2000 was very similar to the long-term trends. Developing and yellow ovaries were observed in all sound systems in April with 81% of all females examined possessing maturing ovaries. By June, 36% were in advanced stages of development (Figure 28). In 2001, the situation was much different. Shrimp numbers were very low in the northern sounds through July of 2001 with only one shrimp observed showing signs of development (Figure 29). The cause of this may be mortality associated with cooler than normal winter temperatures (Figures 2,3, and 29). Female shrimp collected from the southern sounds exhibited little ovarian development in April (< 20%) (Figures 29 and 30), but by May, 81.4% of females exhibited development and data indicated that spawning was complete by August (Figure 29). In 2002, spawning occurred earlier than normal due to April temperatures that were 4^{o} C above normal (Table 3, Figures 30 & 31). A total of 55.4% of the shrimp had developing ovaries as compared to the long-term average for that month of 22.1% (Figure 31).

Brown Shrimp

Brown shrimp spawn well offshore and few specimens are captured possessing ovarian development. Historically, ovigerous females never comprise more than 3% of the catch, with the highest percentages in May (2.2%) and October (1.5%) (Figure 26). However, during May 2002, 16 out of 68 females collected from the St. Andrews estuary (23.5%) exhibited development (4 developing, 11 yellow, and 1 spent) (Figure 27).

Pink Shrimp

Ovigerous pink shrimp never exceed 5% of the catch. Similar to the brown shrimp, pink shrimp reproductive activity peaks in May and October with percentages of 4.5 and 3.2, respectively (Figure 26). In recent years, only one specimen has been observed with developing ovaries and that specimen was captured during May 2000 (Figure 27).

FEMALE BLUE CRAB MATURITIES

Information on the maturity state of female blue crabs collected in assessment trawls is presented in Figure 24. Adults comprised 56.9% of the catch in 2000 with juveniles at only 23.7% (nearly 7% above the long-term average). Catches of adult and juvenile females in 2001 and 2002 were above the long-term averages (Figure 24). The spatial distribution of crabs is thought to have changed as a result of the alteration of the longitudinal salinity profile of the estuary. Males were possibly displaced further upstream beyond the survey's sampling area.

The catch of egg-bearing (sponge) female blue crabs typically peaks in March and April, (22.8% and 35.9%, respectively)(Figure 26). Typically, the percent of ovigerous females in assessment catches remains above 10% through August. In 2000, the pattern changed slightly and few adult ovigerous females were collected after May. (Figure 27). It appears the spawning period was even more truncated in 2001 and 2002. Egg-bearing females were only caught during March and April of 2001 and only in March of 2002. (Figure 27).

The majority of egg-bearing females caught during assessment trawls are classified as having an orange sponge mass. Since this is the stage of egg maturity with the longest duration (Anderson 1982), there is a greater likelihood of catching reproductively active females in this condition. Over 90% of all sponge females collected during the 2000-2002 sampling season were in this condition. Samples from Ossabaw, Sapelo, and St. Andrews Sounds contained the highest percentage of sponge females during this three-year period (Figure 32). Most of the Wassaw Sound individuals were captured in 2001 with no sponge crabs observed in either Wassaw or Sapelo in 2002 (Figure 32). Ovigerous as well as all adult females were nearly absent in the northern sounds with only low numbers seen in the southern sounds since early 2001 (Figure 32 and 33).

ENVIRONMENTAL IMPACTS

Disease

In the case of short-lived crustaceans such as shrimp and blue crabs, environmental factors can have a great influence on stock size. Likewise, these same factors can greatly influence the spatial and temporal distribution of animals within estuaries and nearshore ocean waters. Management strategies applied to crustacean fisheries must be developed in consideration of these environmental factors. During the study period, Georgia's shrimp stock experienced two infestations by an opportunistic parasite which caused a condition commonly known as "black gill". Black gill results from a heavy infestation of the gill filaments by the ciliated protozoan apostome (Ascophrys sp.) that adheres to the cuticle of shrimp resulting in moderate to sever levels of melanization (blackened gills). It was first observed in Georgia waters in 1996. That year, severe flooding impacted the lower portion of the coast and may have contributed to these first observations where infection rates were moderate at only 6.5% over the year. In 1999, extensive and continued drought associated with the tropical phenomenon La Nina was thought to be linked to the second occurrence of the disease (infection rate 7.3%). In both cases the disease was reported in live bait shrimp captured in inshore creeks and rivers, in commercial food shrimp landings from the open Atlantic Ocean , and in biological samples collected for this study all along the coast of Georgia. The disease

occurred again in the drought year 2001 (rate = 25%), with the highest infection rates yet observed occuring in 2002 (33.6%). The infection seems to initially impact the northern estuaries (Wassaw and Ossabaw) in August, spreads coast-wide by September and October, and disappears by December (Figures 34 and 35).

There are strong concerns about black gill disease within the commercial shrimp industry in both South Carolina and Georgia. Specifically, harvesters are concerned that the disease is lethal and is reducing the size of the shrimp stock. They are also concerned about the marketability of shrimp affected by the disease. A cursory experiment by South Carolina researchers in a closed system suggested the shrimp recover completely from the disease (D. Whitaker, per. comm.). However, the acute decline in shrimp abundance between the spring and fall of 2002 suggest that black gill disease may be the source of increased natural mortality. Assessment catches in August and September indicated that the shrimp stock size was larger than average, and that the fall harvest would remain above average. However, after the appearance of the disease, commercial landings for the latter part of the year fell to 50% the historic average. Assessment trawl catches likewise declined to 25% below the long-term average by December (Figure 36). The disease appears at a time when white shrimp catches should be increasing, but often with the onset of the disease catch rates appear to decline (Figure 37). An initial examination of environmental parameters suggests a relationship between water temperature and the rate of disease occurrence. With all areas and years combined, 35.4% of diseased animals occurred in waters of 28 to 30^{o} C. The disease is significantly correlated with water temperatures (positive) and dissolved oxygen (negative) from each of the two previous months, rainfall from the preceding month (positive), and abundance (positive) ($p < 0.001$). This may suggest a density dependent relationship in which animals regularly challenged by high temperatures and low dissolved oxygen become stressed by what would otherwise be a benign ectoparasite. (Geer 2003).

Winter Kills

Increased natural mortality due to cold stress and premature emigration of small shrimp from closed areas to commercial fishing grounds are two factors that can drastically alter the desired consequences of management. Although the shrimp season is routinely extended into January each year (Appendix D), it was not extended the full two-month maximum extension time frame in any of the three years of the study. Low stock abundance and/or small size resulted in the early closure of the trawling seasons. During the study period, estuarine water temperatures never fell below the known 5^{o} C mortality threshold for shrimp (Table 3). However, surface water temperatures did approach this value during the winter of 2001.

COMMERCIAL LANDINGS AND MANAGEMENT ACTIONS

2000 Commercial Fishing Season

The commercial shrimp trawling season began on May 24 and closed December 31 (Appendix D). During that season there were 534 commercial food shrimp trawlers and 166 cast-netters licensed to fish in Georgia waters. Calendar year 2000 produced 3,516,895 pounds of total

food shrimp worth $17,205,600(Appendix A-1). White shrimp comprised 84.9% of the harvest weight and value. The dominant count sizes (tails) for white shrimp were valuable 21/25 to 26/30 count. During that year, total white shrimp landings ranked 34 among the 40+ years since 1957,. Total annual landings of white shrimp were 16.8% below the long-term average and 14.5% below the running 10-year average (Figure 38 and Appendix A-2). The roe season (Apr-Jun) (847,417 lbs) was 190.3% above the running 10-year average with the fall harvest (Aug-Dec) (1,889,941 lbs) 20.0% below the running 10-year average. Brown shrimp landings totaled only 480,084 pounds, a value 44.3% below the long-term average since 1957, and 33.6% below the running 10-year average (Figure 38 and Appendix A-3). There were no pink shrimp landings (Figure 39, Appendix A-4) reported in 2000, and rock shrimp landings were 60.1% below the running 10-year average (Figure 39, Appendix A-5). Blue crab landings were at or above the 20-year average for the first quarter of the year but harvest decline through the remainder of the year. None of the monthly harvest during the rest of 2000 met or exceeded the long-term or decadal averages (Figure 40, Appendix A-6). Annual landings declined some 700,000 pounds (17.9%) compared to 1999, and were 42.5% of the running 10-year average.

2001 Commercial Fishing Season

The 2001 shrimp season began on June 25 and closed on February 22 (Appendix D). The Altamaha Channel was closed slightly earlier due to the increased abundance of small shrimp in that area (January 11, 2002). Landings in Georgia's territorial sea and the Exclusive Economic Zone (EEZ) were very low through June 2001, with only 59,728 lbs reported. This value is 91.6% below the long-term average of 713,064 lbs for that period (Figure 38 and Appendix A-2). Although the roe season was an abysmal failure, the fall season was relatively successful. Landings from the latter part of the year comprised 90.3% of the annual catch of 1,797,654 lbs. However, this catch was still 31.3% below the running 10-year average for this time period. Fortunately, the brown shrimp season was successful with 889,728 lbs (23.0% above the running 10-year average) and increased profitability for those adversely impacted by the low catches of white shrimp. (Figure 38 and Appendix A-3). Only 4,295 lbs of pink shrimp were reported (26.5% below long-term average) with rock shrimp landings sporadic at only 15,363 lbs (Appendices A-4 and A-5). Blue crabs continued to decline (Figure 40 and Appendix A-6) to new record lows. Annual harvest fell below 3 million pounds for the first time indicating a statistically significant decline from the long-term mean (Figure 40).

2002 Commercial Fishing Season

The 2002 shrimp season was delayed several weeks due to a record number of turtle strandings appearing on Georgia's beaches in mid-May. A record number of strandings (n=95) resulted in delaying the opening of state waters until June 12 (Appendix D), and the requirement of a leatherback TED opening for trawlers operating in both state and federal waters. The January commercial harvest of white shrimp was the third highest on record, almost three times greater than the long-term average (Appendix A-2, Figures 26 and 38). Higher than normal harvest occurred throughout the roe shrimp season. However, commercial landings during the last quarter of the year were 48.4% below the 20-year average. The industry relies heavily on this fall harvest of white

shrimp with 71.8% of the annual catch typically coming in those three months. Brown shrimp harvest in June was nearly double the 20-year average but the annual catch was slightly below average (-13.4% of 20-year average) (Appendix A-3, Figure 38). There were no reported landings of either pink or rock shrimp in 2002. State waters were closed to food shrimp harvest on January 18 2002. Blue crab harvest continued to decline in 2002 with the fifth consecutive low year, making 2002 the worse year ever recorded at 2.0 million pounds (76.3% below the long-term average) (Appendix A-6 and Figure 40).

A chronological list of all management actions performed from January 2000 to May 2003 is shown in Appendix E.

DISCUSSION

The four plus years of drought have greatly impacted the coastal waters of Georgia (Figure 41). Even when precipitation did occur, it was usually short in duration and intense, not allowing the dry soil time to absorb the water. The result being infrequent but intense run-off events into the estuaries. The obvious impact of this drought on the estuary was higher salinity (17% above average in the creeks). The impact to marine organisms wasn't always as obvious. Higher salinities may force organisms further upriver to areas of lower quantity and quality habitat. The lack of stream flow could impact recruitment processes by creating a situation that is unfavorable for the transportation of eggs and larvae to suitable nursery areas. The stress of higher salinity could make organisms vulnerable to disease, or the higher salinities may increase the range and abundance of certain diseases/parasites.

All these factors have been discussed concerning the decapod species of concern. Blue crab abundance and harvest declined precipitously during the study period. The parasitic dinoflagellate, *Hematodinium*, is known to prefer high saline waters and is thought to be 100% lethal. A longitudinal shift in the estuarine salinity profile may allow the organism to increase its range and potential infect more crabs. Black gill disease in white and brown shrimp is associated with a ciliated protozoa and affects the respiratory system (gills) at a time when dissolved oxygen levels are typically at their lowest. Intense, but infrequent rain events, may cause run-off, which produce conditions that allow this organism to proliferate. If so, the density of the protozoan increases and more shrimp are exposed. Higher salinity may mean a reduction in the quantity of optimal habitat for juveniles crabs and shrimp Additionally, these higher salinities may have been the cause for the massive *Spartina alterniflora* die-offs which occurred during the study period (primarily 2002), a situation that also resulted in less available habitat for estuarine-dependent species. Recruitment processes may be impacted by the higher salinity as well. Female crabs may be releasing their larvae further up the estuary where proper development is impossible. Climatic conditions that produce a drought can also affect wind patterns that drive larval transport processes. Typical summer-time weather patterns produce southwest winds bringing moisture from the Gulf of Mexico which produce regularly occurring thundershowers. This southwest wind also produces upwelling along the coast supplying food for decapod larvae and ultimately becomes the process that entrains the larval back into the estuary. If this pattern is disrupted, the lack of precipitation, upwelling, and wind patterns all will impact recruitment of not only decapods but many marine organisms as well.

The shrimp species discussed here are all short-lived with commercial fisheries based on one-year life cycles. Poor conditions one season may not necessary correspond to the next. Both the landings data and estimates of abundance from assessment surveys have been fairly resilient, with long-term (30 plus years) and decadal averages showing only slight differences from each other. With the protection of estuarine waters (sounds and creeks) from intense commercial fishing, it will be difficult to overexploit these populations unless natural phenomena reduce spawning stock far below a required and still unknown minimum quantity.

The biggest obstacle facing the shrimp industry today is the on-going battle over imports. Inexpensive and readily available farm raised shrimp from Asia and South America are shipped to the United States in great quantities. This influx of imported shrimp results in a reduction in the ex-vessel price of domestic shrimp . While this is good for the consumer, the domestic shrimp harvester struggles to maintain profitability. Unfortunately, the average consumer is not aware these imported shrimp are not fresh and are often laden with chemicals such as the antibiotic, chloramphenicol. The national wild shrimp harvest makes up only 12% of all shrimp consumed in this country. The industry as a whole does not expect to reverse this trend in imports; however, they are determined to hold onto their small market share. As a result of these imports, and several less than average harvest years, Congress allocated $35 million dollars to the Southeast shrimp industry for financial assistance and marketing, (United States FY03 Omnibus Appropriations Bill, Title V: Fisheries Disasters). Georgia's allocation (based on landings 1999 to 2001) is $3.3 million dollars of the South Atlantic's apportionment of $17.5 million. Of the $3.3 million, a total of 67% was allocated for direct assistance to the harvesters and dealers, while 33% is to be used for marketing, research, and special programs (R. Vendetti, per. comm.). It is hoped the large marketing budget will educate the general public to discern the difference between a fresh local product and imports.

The declines in blue crab abundance and harvest have also been observed in other Atlantic coast states, albeit not to the extent of Georgia's decline (-76.3%). A blue crab reaches maturity after 12 to 18 months of life compared to shrimp which are mature after only 6 months. Therefore, any possible recovery will take at least two to three years. In 2002, the Georgia General Assembly passed a bill banning the harvest of all sponge crabs (O.C.G.A. 27-4-150 (2)). It is hoped by protecting the spawning stock the population may be able to recover. However, thus far in 2003, neither commercial harvest or assessment catches indicate that the blue crab stock is returning to its former size. On May 8, 2003, the Governor of Georgia received a letter from Dr. Bill Hogarth (Director of NMFS) declaring a commercial fishery failure due to a fishery resource disaster had occurred in Georgia's blue crab fishery (pursuant to Section 312(a) of the Magnuson-Stevens Sustainable Fisheries Act). GADNR is in the process of requesting a congressional appropriation for funds which will be used both for direct assistance to the industry and for a comprehensive five-year blue crab research and surveys plan.

LITERATURE CITED

Anderson, D.T. 1982. Embryology. Pages 1-41 *in* S. Abele, ed. The biology of Crustacea, Vol. 2. Academic Press, New York.

Geer, P.J. 2003. Black gill disease in the Georgia Shrimp Fishery. Summer Meeting of The Crustacean Society. June 1-5, 2003. Williamsburg, VA.

Geer, P.J., H.M. Austin, and D.N. Hata. 1995. Estimation of relative abundance of recreationally important finfish in the Virginia portion of Chesapeake Bay. Annual report to VMRC/USFWS Sportfish Restoration Project F104-R5. July 1994-June 1995. Virginia Institute of Marine Science, Gloucester Pt. VA, 23602. 171 p.

Harris, C.D. 1974. Observations on the white shrimp (Penaeus setiferus) in Georgia. Ga. Dept. Nat. Res., Contrib. Ser. No. 27. 54 p.

Hata, D.N. 1997. Comparison of gears and vessels used by the Virginia Institute of Marine Science juvenile finfish trawl survey. Special Report in Applied Marine Science and Ocean Engineering No. 343. Virginia Institute of Marine Science, Gloucester Pt, VA 23602. 244 p.

Georgia Department of Natural Resources. 1999. Georgia Landings Annual Summary, 2000.

King, E. 1948. A study of the reproductive organs of the common marine shrimp, Penaeus setiferus (Linnaeus). Biol. Bull. (Woods Hole), 94(3):244-262.

Lindner, M.J. and W.W. Anderson. 1956. Growth, migrations, spawning and sex distribution of shrimp *Penaeus setiferus*. U.S. Fish and Wildl. Serv., Vol. 56, Fish Bull. 106:555-645.

Mahood, R. K., C.D. Harris, J. L. Music and B.A. Palmer. 1974. Survey of the fisheries resource in Georgia's estuarine and inshore ocean waters, Part IV. Ga. Dept. Nat. Res., Game and Fish Div., Coast. Fish. Office, Brunswick. Contrib. Ser. No. 25. 201 pp.

Music, J. L. Jr. 1979. Assessment of Georgia's shrimp and crab resources. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Contrib. Ser. No. 30. 75 pp.

Music, J.L. 1987. Studies and assessment of Georgia's marine fisheries resources. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. No. 2-424-R-1.

Music, J.L. 1994. Assessment of Georgia's shrimp and crab resources. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. No. NA16F10020-03.

Music, J.L. and J.M. Pafford. 1984. Population dynamics and life history aspects of major marine sportfishes in Georgia's coastal waters. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Contrib. Ser. No. 38. 382 p.

Music, J.L., D. Roberson. 1997. Assessment of Georgia's shrimp and crab resources. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. Rep. to NMFS, NOAA. P.L. 99-659, Proj. No. NA46FI0063.

Music, J. L., S. G. Rogers and B. C. Williams. 1991. Studies and assessment of Georgia's marine fisheries resources, January 1986 - January 1991. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. Rep. to NMFS, NOAA. 270 pp.

Music, J. L. B. C. Williams and A. G. Woodward. 1988. Studies and assessment of Georgia's major marine fisheries resources 1986-1987. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. Rep. to NMFS, NOAA. 232 pp.

NOAA. 2003. National Climatic Data Center. http://lwf.ncdc.noaa.gov/oa/ncdc.html. May 6, 2003.

Palmer, B.A. 1974. Studies on the blue crab, (Callinectes sapidus) in Georgia. Ga. Dept. Nat. Res., Game and Fish Div., Coast. Fish. Office, Brunswick. Contrib. Ser. No. 30. 29 pp.

Rogers, S.G. 1990. Assessment of the effects of the environment on the Georgia blue crab stock. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Final report to NOAA and Saltonstall-Kennedy (S-K), Grant No. NA90AA-H-SK018. 69 pp.

Shipman, S., V. Baisden and H. Ansley. 1983. Studies and assessment of Georgia's marine fisheries resources, 1977-1981. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. Rep. to NMFS, NOAA. 287-455.

Stevens, S., V. Baisden and S. Shipman. 1984. Studies and assessment of Georgia's marine fisheries resources, 1982. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. Proj. 2-379-R Compl. Rep. to NMFS, NOAA. 149 pp..

TABLES

Table 1. Georgia DNR's Shrimp Assessment Survey Sites. Coordinates from NOAA charts.

Estuary	Sector	Station Description	Station Number	Midpoint Location (Deg Min)		Average Depth	
				Latitude	Longitude	Feet	Meters
Wassaw	Creek	Halfmoon River	111	3158.20	8057.60	17	5.18
		Wilmington River at Sister Island	112	3159.80	8100.20	22	6.71
	Sound	Mouth of Bull River	121	3157.00	8056.00	23	7.01
		Wassaw Sound at Saltpond	122	3155.60	8058.30	22	6.71
	Offshore	North Channel off Little Tybee Island	131	3154.90	8054.90	25	7.62
		South Channel off Wassaw Island	132	3154.60	8055.00	24	7.32
Ossabaw	Creek	Vernon River at Burnside River	211	3155.40	8105.50	17	5.18
		Florida Passage at Cane Path Creek	212	3149.60	8109.50	13	3.96
	Sound	North side of Racoon Key	221	3151.70	8104.10	14	4.27
		South side of Racoon Key	222	3150.20	8103.00	24	7.32
	Offshore	Channel East of Racoon Key	231	3148.10	8059.50	21	6.40
		Channel East of Ossabaw Island	232	3147.40	8100.00	14	4.27
Sapelo	Creek	Wahoo River near mouth	411	3135.50	8112.50	9	2.74
		Mud River at Intracoastal Waterway	412	3129.00	8118.20	7	2.13
	Sound	North side of Dog Hammock	421	3131.60	8117.00	16	4.88
		Lower sound north of High Point	422	3131.50	8114.80	11	3.35
	Offshore	Channel near north end of Blackbeard	431	3132.00	8109.50	29	8.84
		Channel east of Blackbeard Beach	432	3131.50	8110.50	16	4.88
St. Simons	Creek	Frederica River at Mackay River	711	3111.80	8125.00	13	3.96
		Back River at Little River	712	3109.30	8126.80	24	7.32
	Sound	St. Simons Range Towers at Federica River	721	3108.90	8125.20	9	2.74
		Lower Jekyll Cove at Dubignion	722	3106.20	8125.80	22	6.71
	Offshore	Offshore of St. Simons Sound Entrance	731	3106.50	8121.50	19	5.79
		Channel East of North Jekyll Island	732	3106.00	8120.50	15	4.57
St. Andrews	Creek	Jointer Creek near mouth	811	3102.80	8128.20	24	7.32
		Floyd Creek near mouth	812	3056.30	8126.20	23	7.01
	Sound	Satilla River at Todd Creek	821	3055.80	8129.30	19	5.79
		Cumberland River at Cumberland Wharf	822	3058.40	8130.50	26	7.92
	Offshore	Channel north of St. Andrew Sea Buoy	831	3059.60	8125.00	17	5.18
		Channel Southwest of north breakers	832	3057.00	8119.00	26	7.92
Cumberland	Creek	Brickhill River below Power Cable	911	3051.80	8128.30	13	3.96
		Crooked River South Branch	912	3049.30	8130.00	15	4.57
	Sound	Cumberland Sound at Seacamp Dock	921	3045.00	8128.60	23	7.01
		Cumberland Sound at Dungeness Dock	922	3046.00	8128.40	14	4.27
	Offshore	Offshore from mid-Cumberland Beach	931	3053.30	8123.00	14	4.27
		Cumberland Beach (Lake Whitney/Stafford Shoals)	932	3052.70	8123.50	13	3.96

Table 2. Sampling summary of Georgia DNR's Shrimp Assessment Survey.

		Month												Sound System									Sector			Duration(min)	
Year	Total	J	F	M	A	M	J	J	A	S	O	N	D	WA	OS	SC	SP	DB	AL	SS	SA	CU	Creek	Sound	Offsh.	15	Other
1975	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0
1976	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
1977	433	37	36	36	37	36	36	35	36	36	36	36	36	72	72	0	73	0	0	72	72	72	144	145	144	433	0
1978	647	54	54	54	54	54	54	54	54	54	54	53	54	73	70	72	72	72	72	72	72	72	215	216	215	647	0
1979	516	54	60	83	21	66	43	57	50	53	0	0	29	62	54	55	60	54	60	59	60	52	174	173	169	516	0
1980	150	0	0	32	0	29	0	0	0	29	0	30	30	30	0	0	30	0	30	30	30	0	50	50	50	150	0
1981	271	0	18	0	34	40	36	0	34	0	36	37	36	42	0	0	46	0	46	47	46	44	95	94	82	271	0
1982	203	1	29	0	36	36	0	36	0	0	0	32	33	31	0	0	35	0	36	34	35	32	70	72	61	203	0
1983	255	22	36	0	36	34	36	19	36	36	0	0	0	43	1	1	42	1	41	45	45	36	87	90	78	255	0
1984	377	16	0	36	36	36	36	36	36	36	36	36	37	60	0	1	62	0	59	66	65	64	125	127	124	377	0
1985	432	37	35	36	36	36	35	37	36	36	36	36	36	71	0	2	72	0	72	72	72	71	144	144	143	432	0
1986	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	431	1
1987	433	36	36	36	37	36	36	36	36	36	36	36	36	72	72	0	73	0	0	72	72	72	144	144	145	433	0
1988	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	429	3
1989	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
1990	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	430	2
1991	433	36	37	36	36	36	36	36	36	36	36	36	36	73	72	0	72	0	0	72	72	72	145	144	144	433	0
1992	433	36	36	36	36	36	36	36	36	36	36	36	37	72	72	0	72	0	0	72	73	72	145	144	144	431	2
1993	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	428	4
1994	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	73	71	144	144	144	431	1
1995	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	431	1
1996	433	37	36	36	36	36	36	36	36	36	36	36	36	72	73	0	72	0	0	72	72	72	144	145	144	433	0
1997	431	35	36	36	36	36	36	36	36	36	36	36	36	72	71	0	72	0	0	72	72	72	144	143	144	431	0
1998	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
1999	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
2000	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
2001	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
2002	432	36	36	36	36	36	36	36	36	36	36	36	36	72	72	0	72	0	0	72	72	72	144	144	144	432	0
2003	144	36	36	36	36	0	0	0	0	0	0	0	0	24	24	0	24	0	0	24	24	24	48	48	48	141	3
Total	11208	905	953	961	975	1015	924	922	930	928	846	908	941	1805	1517	131	1813	127	416	1818	1819	1762	3746	3751	3708	11191	17

Key: Sound System: WA-Wassaw; OS-Ossabaw; SC-St. Catherines; SP-Sapelo; DB-Doughboy; AL-Altamaha; SS-St. Simons; SA-St. Andrews; CU-Cumberland

Table 3. Monthly surface salinity and water temperature statistics (Jan 2000 – Apr 2003) for each sector and overall as compared to the long-term mean and 95% confidence intervals (1986-2002).

		Salinity (ppt)							Water Temperature (C)						
		Sector				Statistics (86-02)			Sector				Statistics (86-02)		
Month	Year	Creek	Sound	Offshore	Overall	Mean	Lower	Upper	Creek	Sound	Offshore	Overall	Mean	Lower	Upper
1	2000	28.58	29.83	31.17	29.86	27.25	16.09	38.41	13.83	14.33	14.75	14.31	11.40	6.45	16.35
2	2000	27.08	28.67	30.50	28.75	24.91	11.24	38.59	9.58	10.00	9.33	9.64	12.14	7.02	17.27
3	2000	25.08	26.50	29.17	26.92	23.93	10.20	37.67	18.75	18.58	17.67	18.33	15.35	10.49	20.20
4	2000	24.92	27.00	28.58	26.83	24.81	12.43	37.20	18.92	19.08	19.58	19.19	19.22	14.22	24.22
5	2000	26.58	28.00	30.75	28.44	27.27	16.13	38.41	23.58	23.58	22.92	23.36	23.15	19.58	26.71
6	2000	31.67	32.58	33.42	32.56	29.61	20.80	38.41	27.58	27.83	27.25	27.56	26.82	23.33	30.32
7	2000	34.25	34.50	35.17	34.64	30.24	21.54	38.93	30.42	30.67	29.33	30.14	29.22	26.58	31.86
8	2000	34.00	34.58	35.25	34.61	30.86	21.02	40.70	30.33	30.50	30.17	30.33	29.20	26.67	31.74
9	2000	31.00	31.75	33.25	32.00	29.06	18.55	39.58	27.42	27.58	27.25	27.42	27.58	24.16	31.00
10	2000	28.25	28.17	32.25	29.56	28.40	17.76	39.03	22.33	22.50	20.33	21.72	23.50	17.81	29.20
11	2000	30.17	31.75	33.08	31.67	28.62	20.05	37.19	18.67	19.00	16.92	18.19	18.87	13.76	23.97
12	2000	30.67	31.50	32.50	31.56	28.51	19.12	37.89	13.08	13.08	12.50	12.89	14.93	9.50	20.37
1	2001	27.42	30.25	31.25	29.64	27.25	16.09	38.41	8.67	8.83	7.00	8.17	11.40	6.45	16.35
2	2001	27.58	30.08	31.75	29.81	24.91	11.24	38.59	12.58	12.50	11.67	12.25	12.14	7.02	17.27
3	2001	25.92	28.42	31.42	28.58	23.93	10.20	37.67	16.33	16.33	15.83	16.17	15.35	10.49	20.20
4	2001	22.33	25.42	29.50	25.75	24.81	12.43	37.20	18.50	18.33	18.00	18.28	19.22	14.22	24.22
5	2001	26.08	29.25	31.58	28.97	27.27	16.13	38.41	22.58	22.92	23.75	23.08	23.15	19.58	26.71
6	2001	29.42	31.50	33.42	31.44	29.61	20.80	38.41	28.17	28.08	28.42	28.22	26.82	23.33	30.32
7	2001	27.75	31.17	33.17	30.69	30.24	21.54	38.93	30.00	30.08	30.58	30.22	29.22	26.58	31.86
8	2001	27.92	29.75	33.17	30.28	30.86	21.02	40.70	29.83	29.92	29.50	29.75	29.20	26.67	31.74
9	2001	28.50	31.00	32.50	30.67	29.06	18.55	39.58	27.67	28.08	29.00	28.25	27.58	24.16	31.00
10	2001	30.67	31.25	33.08	31.67	28.40	17.76	39.03	23.25	23.42	23.75	23.47	23.50	17.81	29.20
11	2001	30.25	32.25	33.67	32.06	28.62	20.05	37.19	18.83	18.92	18.33	18.69	18.87	13.76	23.97
12	2001	31.58	33.00	34.25	32.94	28.51	19.12	37.89	20.25	20.08	19.83	20.06	14.93	9.50	20.37

continued

Table 3. Continued.

		Salinity (ppt)							Water Temperature (C)						
		Sector				Statistics (86-02)			Sector				Statistics (86-02)		
Month	Year	Creek	Sound	Offshore	Overall	Mean	Lower	Upper	Creek	Sound	Offshore	Overall	Mean	Lower	Upper
1	2002	32.42	33.08	34.00	33.17	27.25	16.09	38.41	11.08	11.42	10.83	11.11	11.40	6.45	16.35
2	2002	30.83	31.00	32.92	31.58	24.91	11.24	38.59	14.92	15.25	14.00	14.72	12.14	7.02	17.27
3	2002	26.42	28.00	31.50	28.64	23.93	10.20	37.67	18.25	18.17	14.25	16.89	15.35	10.49	20.20
4	2002	27.67	29.83	31.67	29.72	24.81	12.43	37.20	23.25	22.83	23.83	23.31	19.22	14.22	24.22
5	2002	30.17	32.00	33.17	31.78	27.27	16.13	38.41	25.67	25.42	25.08	25.39	23.15	19.58	26.71
6	2002	30.83	32.00	33.33	32.06	29.61	20.80	38.41	27.67	28.00	27.75	27.81	26.82	23.33	30.32
7	2002	29.00	30.92	32.67	30.86	30.24	21.54	38.93	30.00	30.33	29.50	29.94	29.22	26.58	31.86
8	2002	32.00	33.58	34.58	33.39	30.86	21.02	40.70	30.00	30.00	29.17	29.72	29.20	26.67	31.74
9	2002	29.33	30.33	32.08	30.58	29.06	18.55	39.58	28.58	28.67	28.17	28.47	27.58	24.16	31.00
10	2002	26.92	29.00	30.92	28.94	28.40	17.76	39.03	26.42	26.42	26.42	26.42	23.50	17.81	29.20
11	2002	26.42	28.08	30.67	28.39	28.62	20.05	37.19	19.08	19.00	19.33	19.14	18.87	13.76	23.97
12	2002	26.00	28.08	29.50	27.86	28.51	19.12	37.89	13.00	13.08	13.50	13.19	14.93	9.50	20.37
1	2003	22.17	23.67	29.75	25.19	27.25	16.09	38.41	10.58	10.67	11.42	10.89	11.40	6.45	16.35
2	2003	24.67	27.00	29.83	27.17	24.91	11.24	38.59	12.83	12.25	11.25	12.11	12.14	7.02	17.27
3	2003	17.67	20.58	25.75	21.33	23.93	10.20	37.67	16.67	16.92	15.17	16.25	15.35	10.49	20.20
4	2003	14.92	18.58	25.17	19.56	24.81	12.43	37.20	19.50	19.83	18.17	19.17	19.22	14.22	24.22

Table 4. Catch per unit effort (measured as lbs/hr and kg/trawl) and count size by sound and sector for each species in 2000.

Esturary	Sector	White Shrimp			Brown Shrimp			Pink Shrimp			Combined Totals			Blue Crabs			Trawls
		Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	CPUE (kg/trawl)	CPUE (#/trawl)	
Wassaw	Creek	2.59	33.2	0.29	0.47	45.4	0.05	0.15	47.6	0.02	3.21	35.6	0.36	1.70	0.19	1.29	24
	Sound	5.41	30.4	0.61	1.57	41.8	0.18	0.02	35.1	0.00	7.00	33.0	0.79	1.64	0.19	0.92	24
	Offshore	8.62	27.0	0.98	1.23	34.6	0.14	0.00	50.0	0.00	9.85	28.0	1.12	1.68	0.19	1.00	24
	Total	5.54	29.1	0.63	1.09	39.6	0.12	0.06	46.2	0.01	6.69	30.9	0.76	1.67	0.19	1.07	72
Ossabaw	Creek	19.71	38.8	2.24	0.48	36.4	0.05	0.13	39.7	0.01	20.32	38.7	2.30	4.80	0.54	4.79	24
	Sound	14.18	27.9	1.61	0.14	38.8	0.02	0.04	50.0	0.00	14.36	28.1	1.63	3.42	0.39	2.58	24
	Offshore	2.42	19.0	0.27	0.23	37.7	0.03	0.03	18.8	0.00	2.67	20.6	0.30	0.52	0.06	0.29	24
	Total	12.10	33.2	1.37	0.28	37.1	0.03	0.07	39.2	0.01	12.45	33.3	1.41	2.92	0.33	2.56	72
Sapelo	Creek	14.69	24.6	1.67	0.24	35.5	0.03	0.03	70.0	0.00	14.97	24.9	1.70	2.59	0.29	2.13	24
	Sound	22.86	26.5	2.59	1.80	40.1	0.20	0.25	48.3	0.03	24.90	27.7	2.82	6.75	0.77	5.42	24
	Offshore	4.87	23.5	0.55	0.19	30.4	0.02	0.01	80.0	0.00	5.07	23.9	0.57	0.30	0.03	0.21	24
	Total	14.14	25.5	1.60	0.74	38.8	0.08	0.10	51.7	0.01	14.98	26.3	1.70	3.21	0.36	2.58	72
St. Simons	Creek	34.40	30.2	3.90	2.46	24.3	0.28	0.06	51.4	0.01	36.92	29.8	4.19	11.82	1.34	8.63	24
	Sound	22.99	21.7	2.61	3.98	25.6	0.45	0.20	45.5	0.02	27.18	22.5	3.08	22.50	2.55	17.29	24
	Offshore	1.54	19.8	0.17	0.66	20.4	0.07	0.01	85.7	0.00	2.21	20.4	0.25	1.90	0.21	1.13	24
	Total	19.64	26.6	2.23	2.37	24.6	0.27	0.09	48.5	0.01	22.10	26.5	2.51	12.07	1.37	9.01	72
St. Andrew	Creek	34.46	27.6	3.91	2.03	23.8	0.23	0.34	49.8	0.04	36.83	27.6	4.18	4.02	0.46	3.63	24
	Sound	25.57	22.5	2.90	0.22	26.4	0.03	0.08	51.1	0.01	25.87	22.6	2.93	2.41	0.27	1.79	24
	Offshore	3.17	16.4	0.36	0.07	31.7	0.01	0.01	100.0	0.00	3.24	16.8	0.37	0.58	0.07	0.33	24
	Total	21.07	25.0	2.39	0.77	24.3	0.09	0.14	50.6	0.02	21.98	25.1	2.49	2.34	0.27	1.92	72
Cumberland	Creek	9.96	26.9	1.13	0.81	22.0	0.09	0.17	56.2	0.02	10.94	27.0	1.24	8.66	0.98	6.46	24
	Sound	3.03	28.2	0.34	0.24	37.0	0.03	0.10	51.7	0.01	3.38	29.6	0.38	2.28	0.26	1.67	24
	Offshore	2.45	14.1	0.28	0.03	38.9	0.00	0.00.		0.00	2.48	14.4	0.28	0.34	0.04	0.17	24
	Total	5.15	25.1	0.58	0.36	25.9	0.04	0.09	54.5	0.01	5.60	25.6	0.64	3.76	0.43	2.76	72
All Estuaries	Creek	19.30	29.9	2.19	1.08	26.7	0.12	0.15	50.0	0.02	20.53	29.9	2.33	5.60	0.63	4.49	144
	Sound	15.67	24.7	1.78	1.33	32.6	0.15	0.11	48.0	0.01	17.11	25.5	1.94	6.50	0.74	4.94	144
	Offshore	3.84	22.1	0.44	0.40	30.6	0.05	0.01	51.5	0.00	4.25	23	0.48	0.89	0.10	0.52	144
	Total	12.94	27.1	1.47	0.94	30.1	0.11	0.09	49.2	0.01	13.97	27.4	1.58	4.33	0.49	3.32	432

Table 5. Catch per unit effort (measured as lbs/hr and kg/trawl) and count size by sound and sector for each species in 2001.

Esturary	Sector	White Shrimp			Brown Shrimp			Pink Shrimp			Combined Totals			Blue Crabs			Trawls
		Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	CPUE (kg/trawl)	CPUE (#/trawl)	
Wassaw	Creek	6.72	36.3	0.76	2.89	39.8	0.33	0.28	33.3	0.03	9.89	37.2	1.12	3.76	0.43	3.46	24
	Sound	27.92	25.3	3.17	1.78	30.4	0.20	0.07	29.3	0.01	29.77	25.6	3.38	4.75	0.54	3.17	24
	Offshore	1.68	19.3	0.19	1.28	45.9	0.15	0.05	26.7	0.01	3.01	30.7	0.34	1.01	0.11	0.50	24
	Total	12.11	27.1	1.37	1.98	38.3	0.22	0.13	31.8	0.02	14.22	28.7	1.61	3.17	0.36	2.38	72
Ossabaw	Creek	19.91	28.6	2.26	5.11	33.8	0.58	0.24	43.2	0.03	25.25	29.8	2.86	9.32	1.06	9.67	24
	Sound	20.12	20.3	2.28	4.83	27.8	0.55	0.15	33.9	0.02	25.10	21.9	2.85	5.46	0.62	3.71	24
	Offshore	2.52	18.0	0.29	0.93	22.9	0.10	0.01	33.3	0.00	3.46	19.4	0.39	0.29	0.03	0.21	24
	Total	14.18	24.1	1.61	3.62	30.2	0.41	0.13	39.4	0.02	17.94	25.4	2.03	5.02	0.57	4.53	72
Sapelo	Creek	23.90	28.1	2.71	2.01	35.3	0.23	0.47	34.4	0.05	26.38	28.8	2.99	4.68	0.53	4.92	24
	Sound	15.56	23.6	1.76	4.84	25.2	0.55	0.89	30.8	0.10	21.29	24.2	2.41	8.44	0.96	6.67	24
	Offshore	2.33	17.0	0.26	0.48	22.8	0.05	0.03	40.0	0.00	2.84	18.3	0.32	0.60	0.07	0.46	24
	Total	13.93	25.8	1.58	2.45	27.8	0.28	0.46	32.2	0.05	16.84	26.3	1.91	4.57	0.52	4.01	72
St. Simons	Creek	27.43	36.0	3.11	6.19	26.8	0.70	0.52	40.2	0.06	34.14	34.4	3.87	11.44	1.30	9.92	24
	Sound	30.30	28.0	3.44	8.70	29.5	0.99	0.42	40.6	0.05	39.42	28.5	4.47	8.18	0.93	7.71	24
	Offshore	1.07	19.8	0.12	1.61	23.9	0.18	0.01	42.9	0.00	2.69	22.4	0.31	0.00	0.00	0.00	24
	Total	19.60	31.6	2.22	5.50	27.9	0.62	0.32	40.4	0.04	25.42	30.9	2.88	6.54	0.74	5.88	72
St. Andrew	Creek	11.86	30.8	1.34	2.34	22.8	0.27	0.76	38.5	0.09	14.96	29.9	1.70	10.64	1.21	8.33	24
	Sound	20.71	30.7	2.35	2.22	25.9	0.25	0.36	42.2	0.04	23.29	30.4	2.64	2.97	0.34	2.42	24
	Offshore	3.20	20.5	0.36	1.18	21.4	0.13	0.01	28.6	0.00	4.39	20.8	0.50	0.00	0.00	0.00	24
	Total	11.92	29.8	1.35	1.92	23.7	0.22	0.38	39.6	0.04	14.21	29.3	1.61	4.53	0.51	3.58	72
Cumberland	Creek	11.04	33.0	1.25	6.56	25.4	0.74	0.45	55.1	0.05	18.05	30.7	2.05	4.30	0.49	4.58	24
	Sound	10.48	26.8	1.19	4.21	28.3	0.48	1.56	66.6	0.18	16.25	31.0	1.84	2.54	0.29	2.13	24
	Offshore	1.26	19.1	0.14	1.21	18.2	0.14	0.00	100.0	0.00	2.47	18.7	0.28	0.00	0.00	0.00	24
	Total	7.59	29.4	0.86	3.99	25.7	0.45	0.67	64.1	0.08	12.26	30.1	1.39	2.28	0.26	2.24	72
All Estuaries	Creek	16.81	31.7	1.91	4.18	29.7	0.47	0.45	40.7	0.05	21.45	31.5	2.43	7.36	0.83	6.81	144
	Sound	20.85	26.0	2.36	4.43	28.0	0.50	0.58	49.5	0.07	25.85	26.8	2.93	5.39	0.61	4.30	144
	Offshore	2.01	19.0	0.23	1.12	26.4	0.13	0.02	33.8	0.00	3.14	21.7	0.36	0.32	0.04	0.19	144
	Total	13.22	28.1	1.50	3.24	28.5	0.37	0.35	45.4	0.04	16.81	28.5	1.91	4.35	0.49	3.77	432

Table 6. Catch per unit effort (measured as lbs/hr and kg/trawl) and count size by sound and sector for each species in 2002.

Estuary	Sector	White Shrimp			Brown Shrimp			Pink Shrimp			Shrimp Combined			Blue Crab			Trawls
		Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	Count (#/lb)	CPUE (kg/trawl)	Mean (lb/hr)	CPUE (kg/trawl)	CPUE (#/trawl)	
Wassaw	Creek	19.49	31.0	2.21	3.37	30.2	0.38	0.23	41.5	0.03	23.09	31.0	2.62	0.42	0.05	0.21	24
	Sound	29.02	22.0	3.29	8.36	28.3	0.95	0.11	27.4	0.01	37.49	23.4	4.25	0.07	0.01	0.04	24
	Offshore	3.32	15.8	0.38	1.71	30.8	0.19	0.06	32.4	0.01	5.09	21.0	0.58	0.00	0.00	0.00	24
	Total	17.28	25.0	1.96	4.48	29.1	0.51	0.13	36.2	0.01	21.89	25.9	2.48	0.16	0.02	0.08	72
Ossabaw	Creek	19.84	32.2	2.25	7.15	27.8	0.81	0.41	31.0	0.05	27.39	31.0	3.11	0.17	0.02	0.13	24
	Sound	10.98	27.9	1.25	3.21	33.1	0.36	0.08	33.3	0.01	14.27	29.1	1.62	0.53	0.06	0.33	24
	Offshore	7.38	20.9	0.84	2.16	29.5	0.24	0.15	23.7	0.02	9.68	22.8	1.10	0.00	0.00	0.00	24
	Total	12.73	28.8	1.44	4.17	29.4	0.47	0.21	29.6	0.02	17.11	29.0	1.94	0.23	0.03	0.15	72
Sapelo	Creek	39.07	36.2	4.43	0.90	30.2	0.10	0.33	55.7	0.04	40.30	36.2	4.57	0.79	0.09	0.79	24
	Sound	45.67	29.4	5.18	4.09	24.6	0.46	0.27	31.0	0.03	50.20	29.0	5.69	0.58	0.07	0.46	24
	Offshore	2.90	22.2	0.33	0.30	24.0	0.03	0.00.		0.00	3.19	22.3	0.36	0.08	0.01	0.04	24
	Total	29.21	32.2	3.31	1.79	25.5	0.20	0.20	44.5	0.02	31.23	31.9	3.54	0.49	0.06	0.43	72
St. Simons	Creek	46.74	29.1	5.30	5.27	28.1	0.60	0.20	44.0	0.02	52.21	29.1	5.92	2.71	0.31	1.96	24
	Sound	35.09	23.6	3.98	3.70	26.7	0.42	0.38	39.9	0.04	39.16	24.1	4.44	1.62	0.18	1.17	24
	Offshore	2.64	17.8	0.30	0.63	22.9	0.07	0.01	75.0	0.00	3.28	18.9	0.37	0.00	0.00	0.00	24
	Total	28.16	26.5	3.19	3.20	27.2	0.36	0.19	41.7	0.02	31.55	26.7	3.58	1.44	0.16	1.04	72
St. Andrew	Creek	31.47	30.5	3.57	4.42	21.8	0.50	0.20	39.9	0.02	36.09	29.5	4.09	0.75	0.09	0.46	24
	Sound	40.53	25.6	4.60	0.80	22.3	0.09	0.05	44.4	0.01	39.72	25.6	4.50	0.40	0.04	0.25	24
	Offshore	2.68	17.2	0.30	0.10	25.6	0.01	0.01	66.7	0.00	2.78	17.6	0.32	0.28	0.03	0.17	24
	Total	24.67	27.4	2.80	1.76	22.0	0.20	0.08	41.2	0.01	26.20	27.1	2.97	0.48	0.05	0.29	72
Cumberland	Creek	16.43	41.2	1.86	0.19	42.0	0.02	0.08	60.0	0.01	16.69	41.3	1.89	0.76	0.09	1.08	24
	Sound	39.46	35.4	4.47	0.31	45.7	0.04	0.11	42.2	0.01	39.88	35.5	4.52	2.55	0.29	2.67	24
	Offshore	2.65	14.1	0.30	0.02	27.3	0.00	0.00.		0.00	2.67	14.2	0.30	0.00	0.00	0.00	24
	Total	19.51	36.0	2.21	0.17	43.7	0.02	0.06	49.9	0.01	19.75	36.1	2.24	1.10	0.13	1.25	72
All Estuaries	Creek	28.84	32.7	3.27	3.55	27.2	0.40	0.24	42.9	0.03	32.63	32.2	3.7	0.93	0.11	0.77	144
	Sound	33.41	27.7	3.79	3.40	28.0	0.39	0.16	36.0	0.02	36.79	27.7	4.17	0.96	0.11	0.82	144
	Offshore	3.59	18.6	0.41	0.82	28.7	0.09	0.04	28.5	0.00	4.45	20.5	0.5	0.06	0.01	0.03	144
	Total	21.92	29.4	2.49	2.59	27.7	0.29	0.15	39.1	0.02	24.62	29.3	2.79	0.65	0.07	0.54	432

Table 7. Annual estimates of abundance with associated 95% confidence intervals (±) and count size (1976-2002).

Year	White Shrimp				Brown Shrimp				Pink Shrimp				Blue Crabs				Trawls
	Mean (lb/hr)	Count (# / lb)	CPUE (kg/trawl)	C.I.'s (95%)	Mean (lb/hr)	Count (# / lb)	CPUE (kg/trawl	C.I.'s (95%)	Mean (lb/hr)	Count (# / lb)	CPUE (kg/trawl)	C.I.'s (95%)	Mean (lb/hr)	CPUE (kg/tow)	C.I.'s (95%)	CPUE (# / tow)	
1976	57.27	42.2	6.49	33.37	3.68	36.7	0.42	4.34	0.10	38.2	0.01	0.08	10.30	1.17	4.90	8.6	427
1977	73.33	25.6	8.32	134.68	2.55	24.4	0.29	2.19	0.28	38.7	0.03	0.23	7.00	0.79	3.12	6.9	433
1978	33.22	24.0	3.77	21.50	2.18	23.4	0.25	1.65	0.26	36.3	0.03	0.32	12.10	1.37	4.99	10.4	420
1979**	3.69	32.9	0.42	5.54	0.06	26.2	0.01	0.05	0.05	194.1	0.01	0.02	5.29	0.60	1.08	6.0	**24
1980	27.69	28.7	3.14	9.71	0.04	39.1	0.00	0.05	0.29	42.0	0.03	0.27	10.21	1.16	5.71	9.5	123
1981	10.35	25.5	1.17	5.96	0.24	27.4	0.03	0.25	0.23	41.7	0.03	0.15	14.81	1.68	10.78	11.8	222
1982	21.63	24.0	2.45	8.64	2.63	25.0	0.30	2.95	0.27	49.1	0.03	0.16	8.97	1.02	2.56	7.3	168
1983	28.70	34.3	3.25	16.93	1.35	36.3	0.15	0.91	0.23	58.5	0.03	0.17	6.59	0.75	2.55	5.4	209
1984	8.63	26.9	0.98	5.62	1.26	30.8	0.14	1.01	0.38	65.7	0.04	0.23	12.02	1.36	7.12	12.0	324
1985	23.82	30.2	2.70	17.83	3.36	30.6	0.38	3.09	0.39	41.4	0.04	0.24	9.52	1.08	6.90	12.9	353
1986	35.00	29.9	3.97	22.35	1.29	32.4	0.15	1.03	0.41	31.6	0.05	0.34	10.18	1.15	6.22	13.1	432
1987	36.31	36.9	4.12	17.76	1.79	32.6	0.20	1.91	0.14	61.1	0.02	0.11	9.26	1.05	4.96	10.1	431
1988	21.26	32.6	2.41	12.26	1.11	25.3	0.13	1.22	0.17	42.1	0.02	0.14	15.06	1.71	8.01	14.9	432
1989	28.43	37.2	3.22	19.78	2.16	30.0	0.24	3.08	0.18	50.8	0.02	0.17	7.48	0.85	4.09	7.9	432
1990	15.05	31.8	1.71	8.44	2.16	26.0	0.25	2.26	0.25	42.4	0.03	0.28	9.84	1.12	6.52	10.4	432
1991	32.88	34.1	3.73	15.29	2.99	37.4	0.34	2.48	0.23	45.3	0.03	0.21	9.36	1.06	5.44	8.4	433
1992	28.50	36.7	3.23	13.52	1.33	29.3	0.15	1.20	0.08	44.3	0.01	0.08	14.64	1.66	7.04	15.5	433
1993	32.64	36.1	3.70	19.65	2.76	35.8	0.31	3.57	0.05	52.5	0.01	0.05	7.79	0.88	3.50	7.7	432
1994	28.30	45.6	3.21	25.73	1.65	30.7	0.19	1.55	0.15	57.8	0.02	0.11	7.36	0.83	3.57	8.2	432
1995	23.12	42.2	2.62	11.80	1.48	38.9	0.17	2.10	0.10	49.9	0.01	0.16	6.52	0.74	4.48	7.6	431
1996	20.10	36.3	2.28	11.93	1.50	30.1	0.17	1.33	0.05	57.6	0.01	0.05	6.69	0.76	3.10	7.2	433
1997	21.82	31.3	2.47	13.20	1.22	31.6	0.14	1.25	0.13	42.0	0.01	0.11	5.57	0.63	2.34	5.5	431
1998	23.71	36.1	2.69	12.08	1.71	29.2	0.19	1.80	0.04	62.0	0.00	0.03	4.08	0.46	1.87	3.8	431
1999	21.06	28.7	2.39	11.86	2.01	35.2	0.23	2.27	0.08	37.2	0.01	0.07	4.33	0.49	2.20	3.8	431
2000	12.94	27.1	1.47	7.14	0.94	30.1	0.11	0.96	0.09	49.2	0.01	0.07	4.33	0.49	2.55	3.3	432
2001	13.22	28.1	1.50	6.73	3.24	28.5	0.37	2.25	0.35	45.4	0.04	0.31	4.35	0.49	2.70	3.8	432
2002	21.92	29.4	2.49	12.08	2.59	27.7	0.29	2.48	0.15	39.1	0.02	0.13	0.65	0.07	0.61	0.5	432
Mean	26.86	33.2	3.05	32.05	1.97	31.0	0.22	2.19	0.19	45.3	0.02	0.19	8.20	0.93	4.96	8.23	10,045

FIGURES

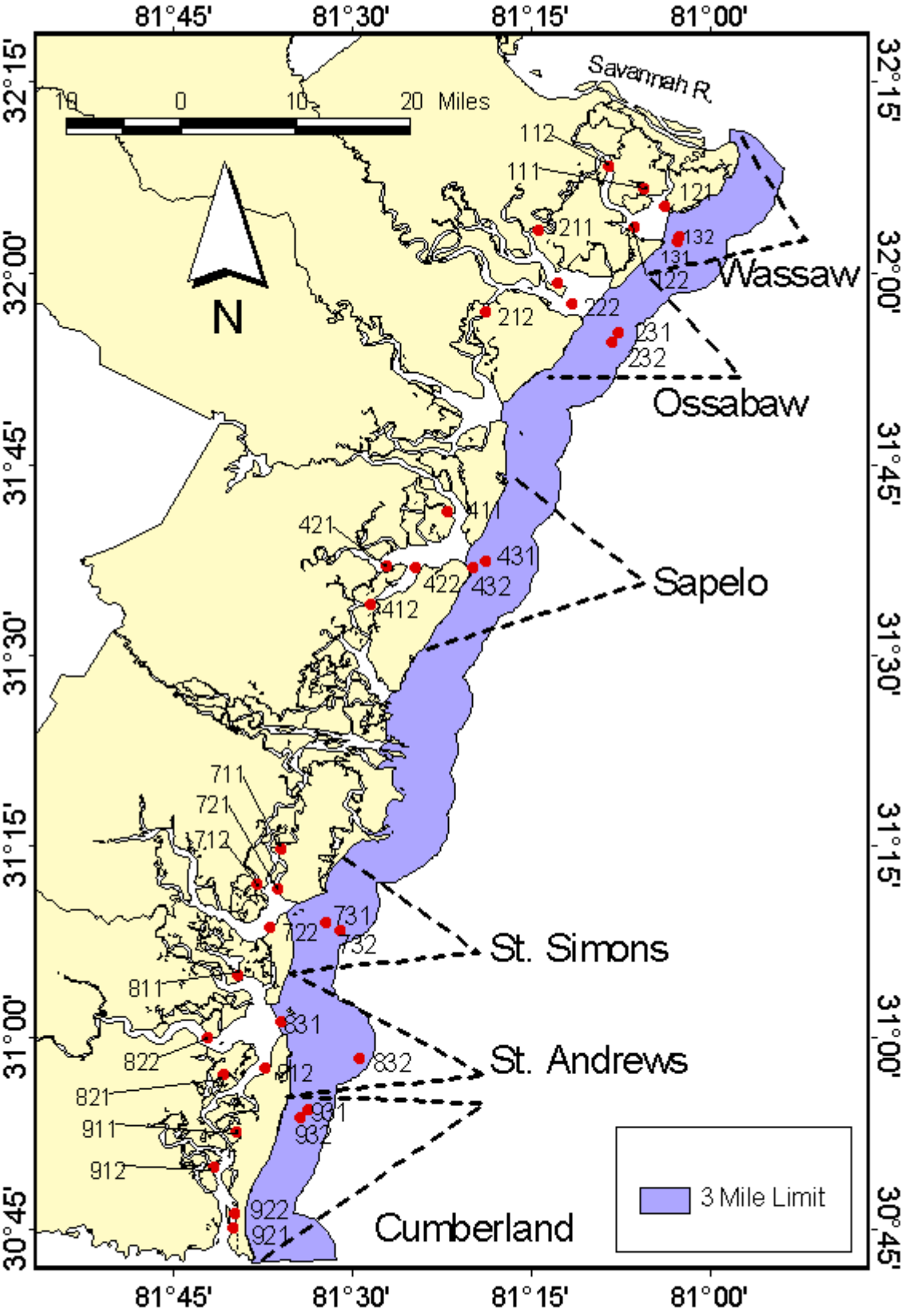


Figure 1. Shrimp Assessment Survey sampling sites. See Table 1 for details.

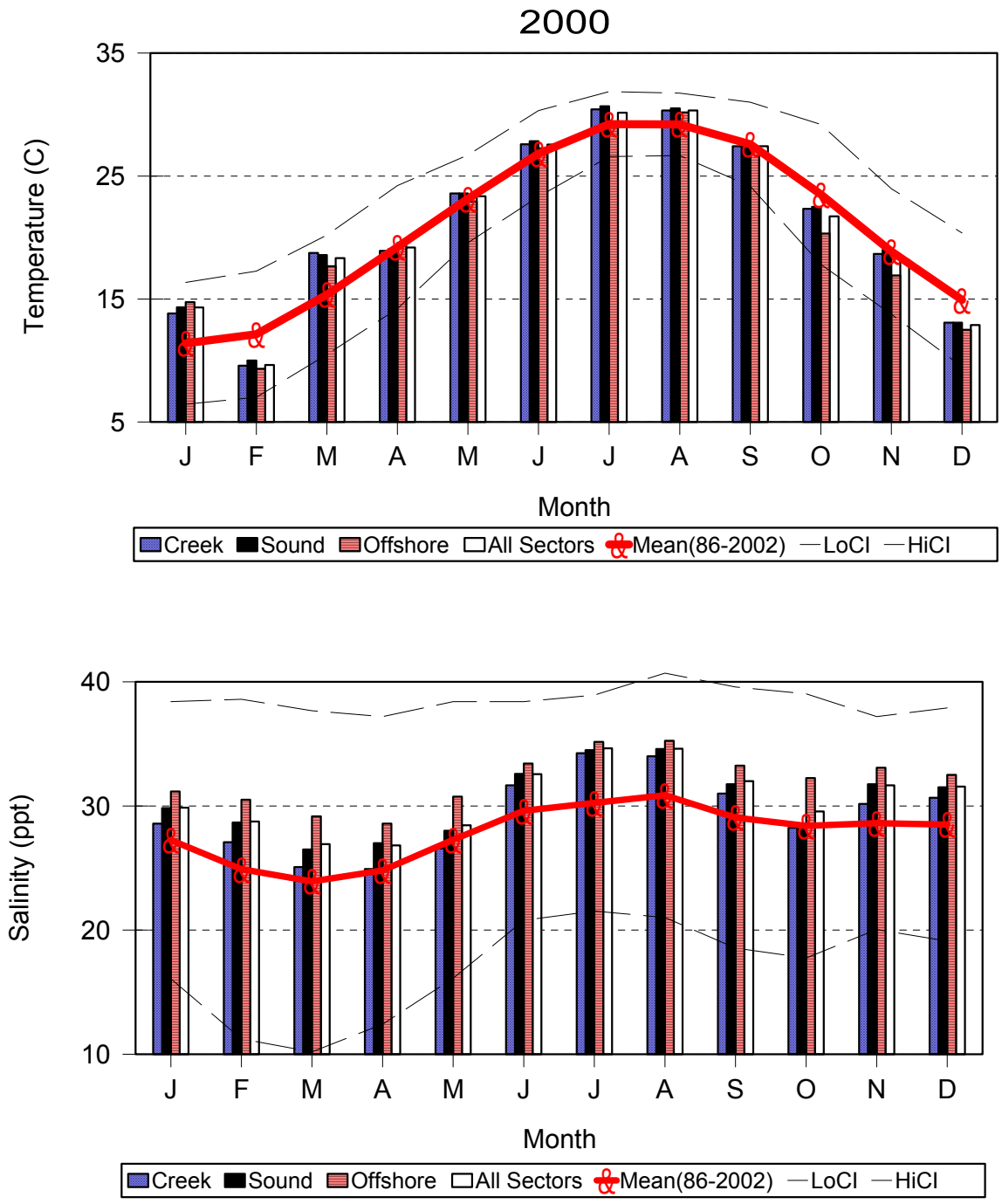


Figure 2. Mean surface temperature and salinity for 2000 by sector as compared to the long-term mean (86-02) and 95% confidence intervals.

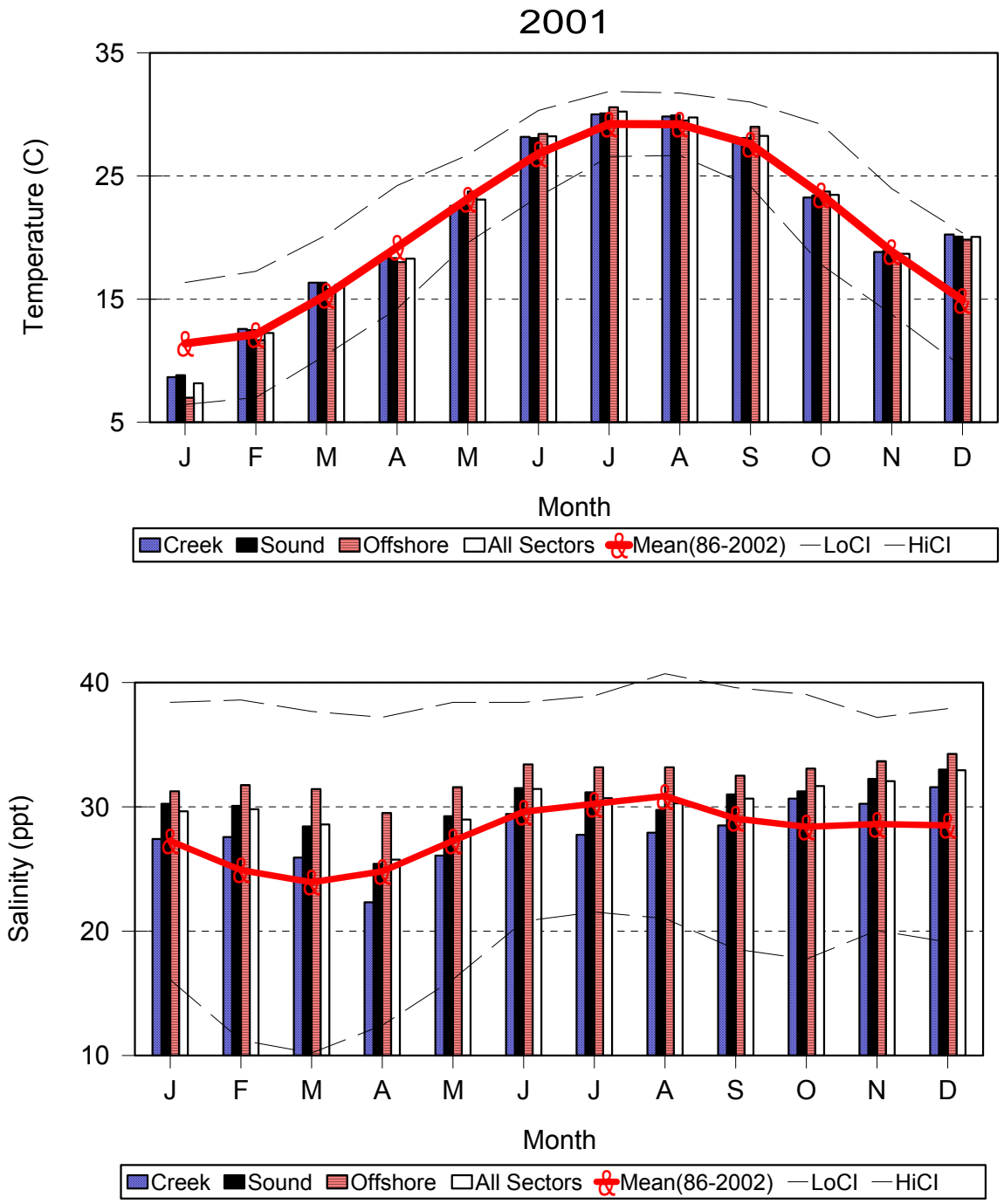


Figure 3. Mean surface temperature and salinity for 2001 by sector as compared to the long-term mean (86-02) and 95% confidence intervals.

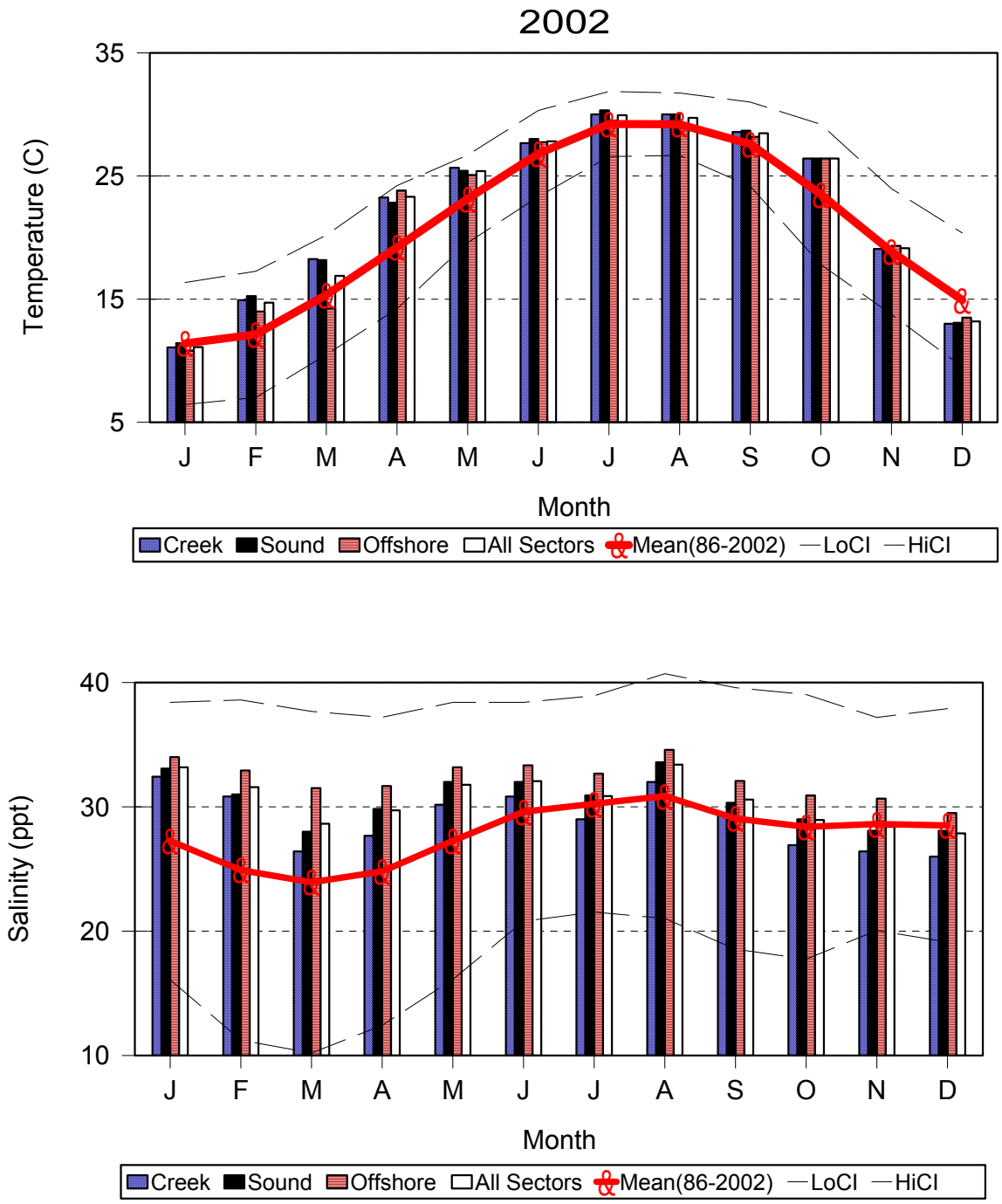


Figure 4. Mean surface temperature and salinity for 2002 by sector as compared to the long-term mean (86-02) and 95% confidence intervals.

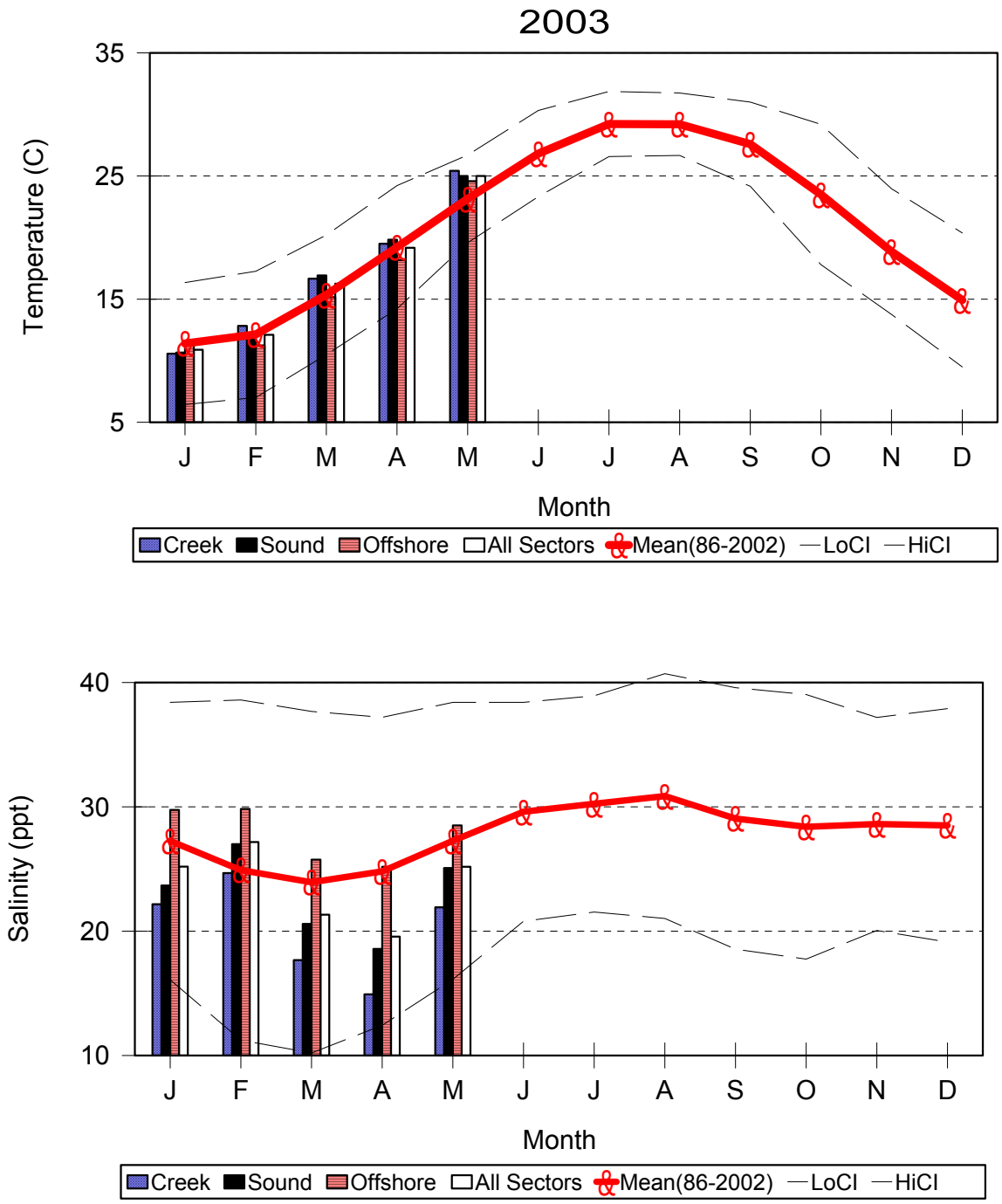


Figure 5. Mean surface temperature and salinity for 2003 by sector as compared to the long-term mean (86-02) and 95% confidence intervals.

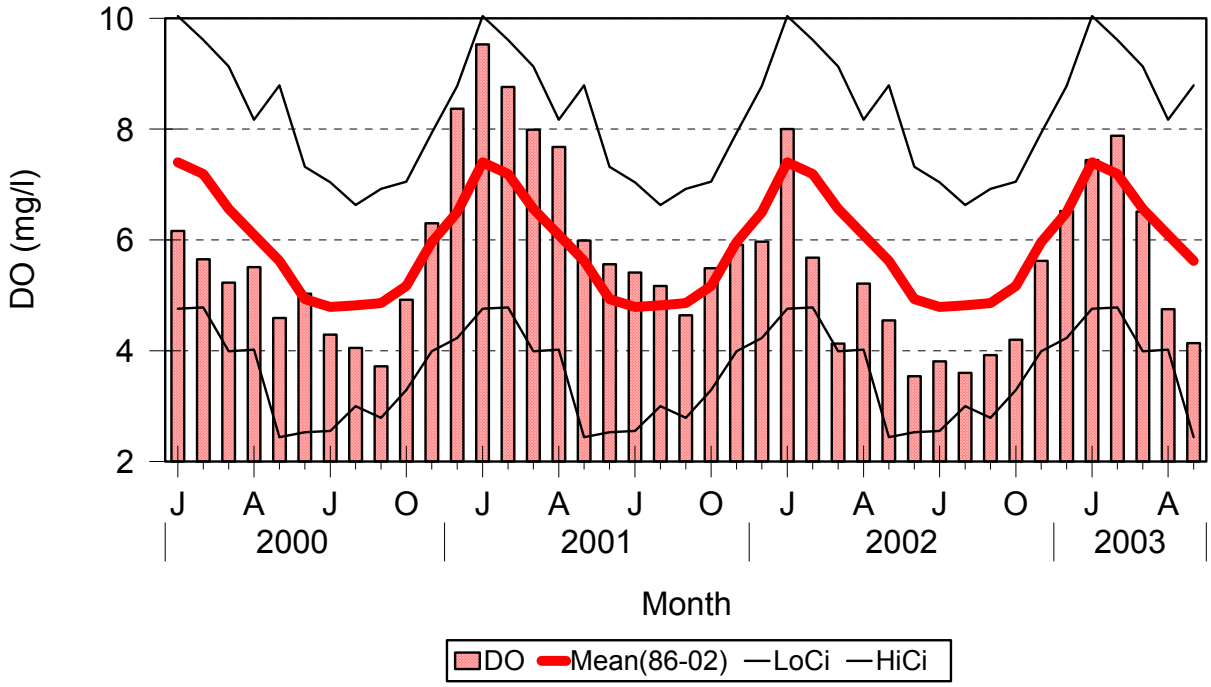
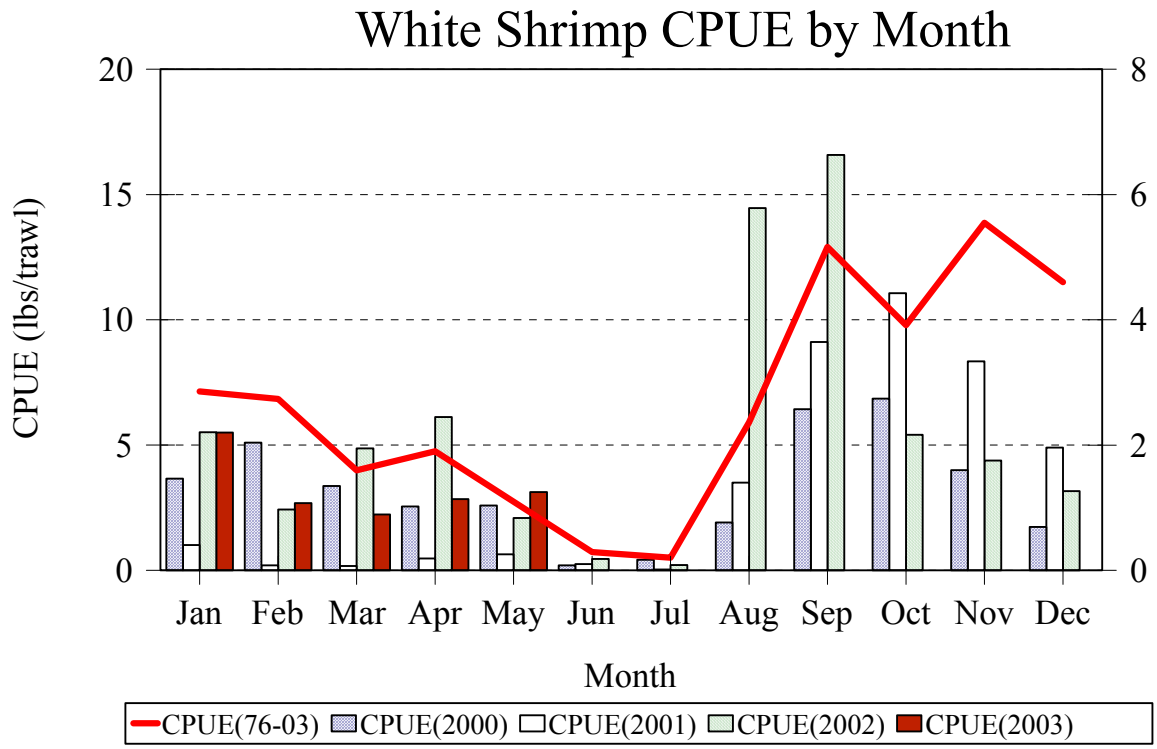


Figure 6. Monthly mean surface dissolved oxygen as compared to the long-term mean (86-02) and 95% confidence intervals.



Catch Per Unit Effort in weight per 15 minute trawl

Figure 7. Monthly catch per unit effort (2000 to 2003) compared to the long-term average (1976-2003) for white shrimp.. CPUE is shown as weight per 15 minute trawl.
These graphics are typically used to provide a real-time graphical comparison to historical catch rates for industry inquiries.

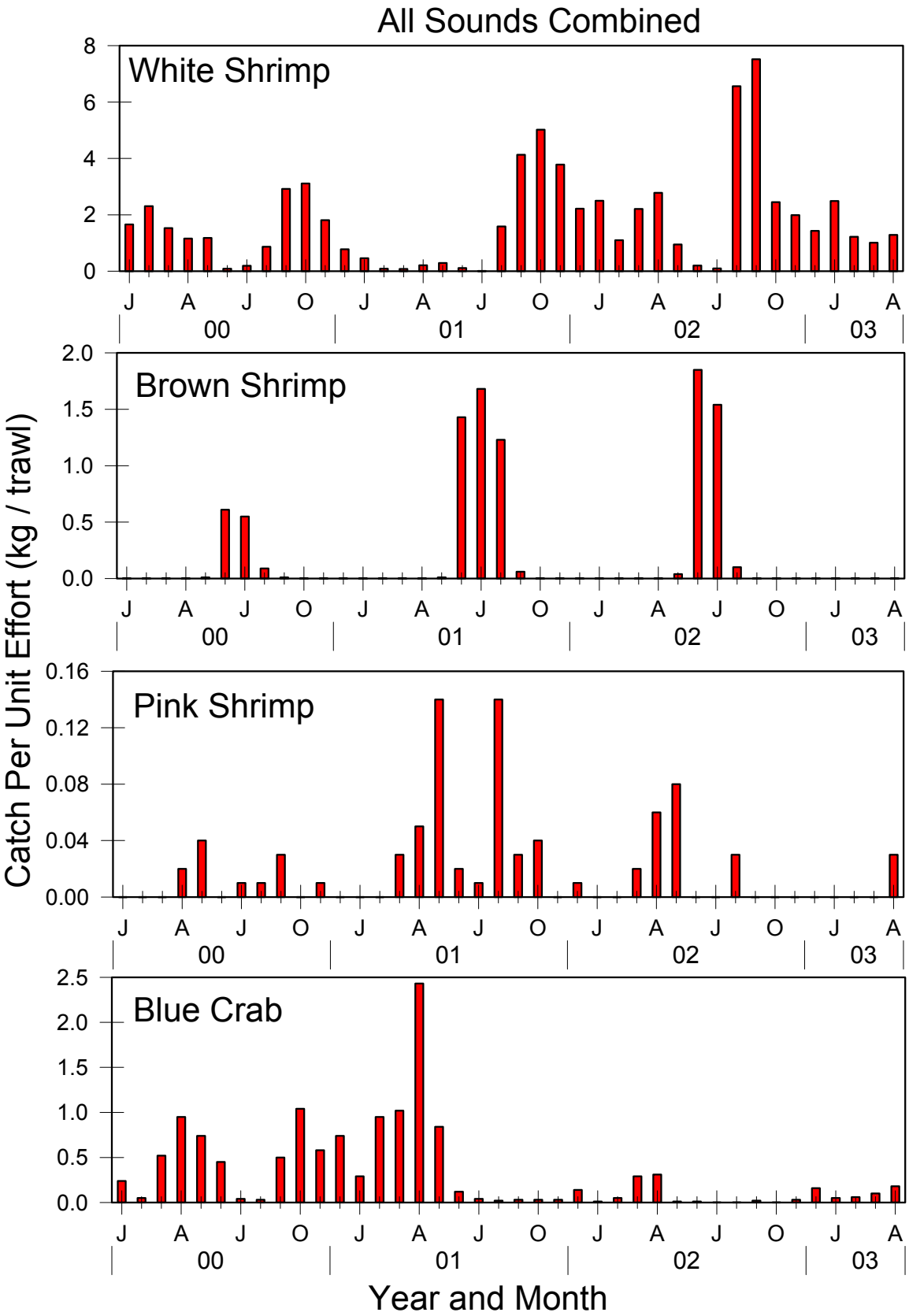


Figure 8. Monthly catch rates for white, brown, pink shrimp, and blue crabs from January 2000 to April 2003.

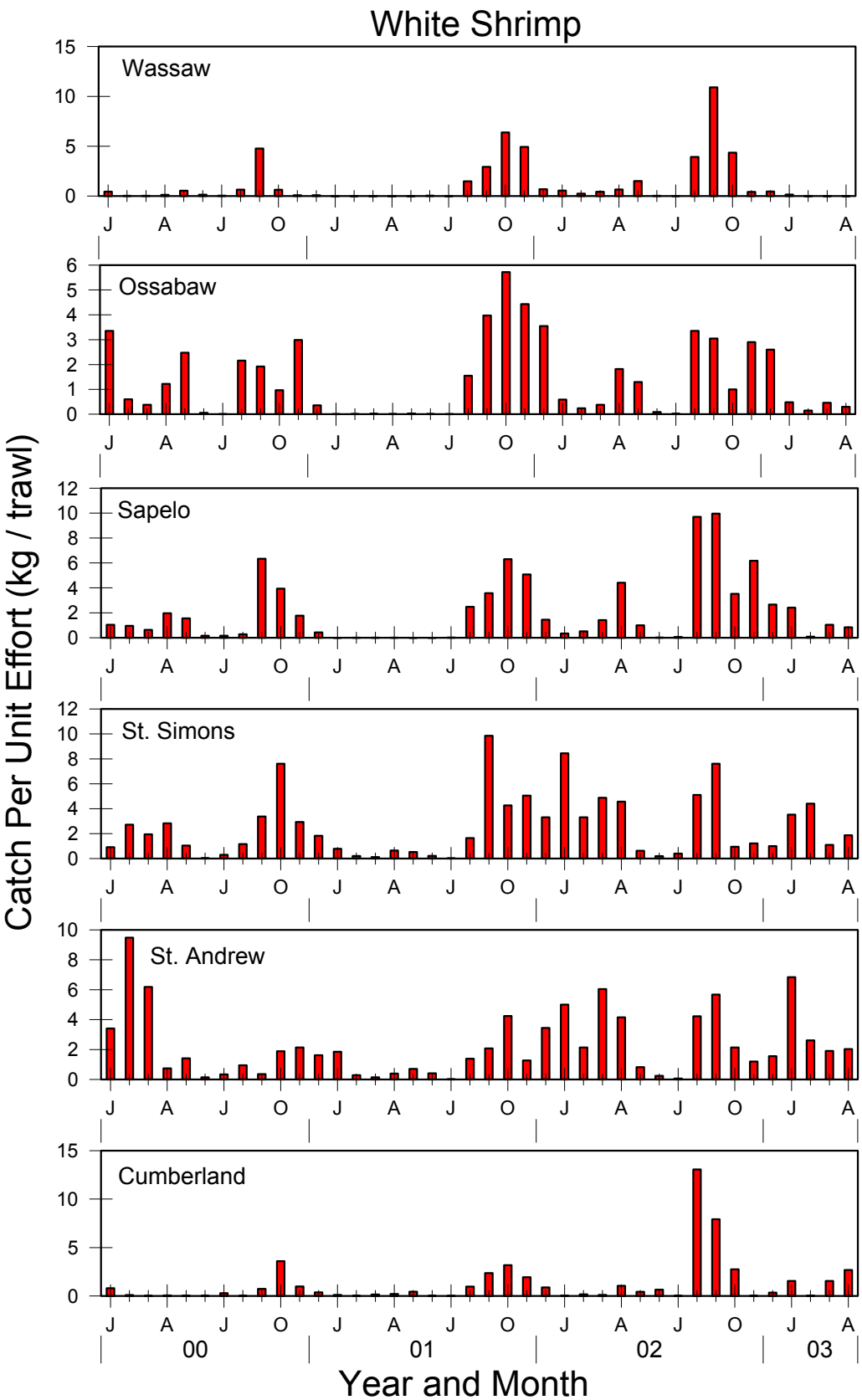


Figure 9. White shrimp monthly abundance by sound system, January 2000 to April 2003.

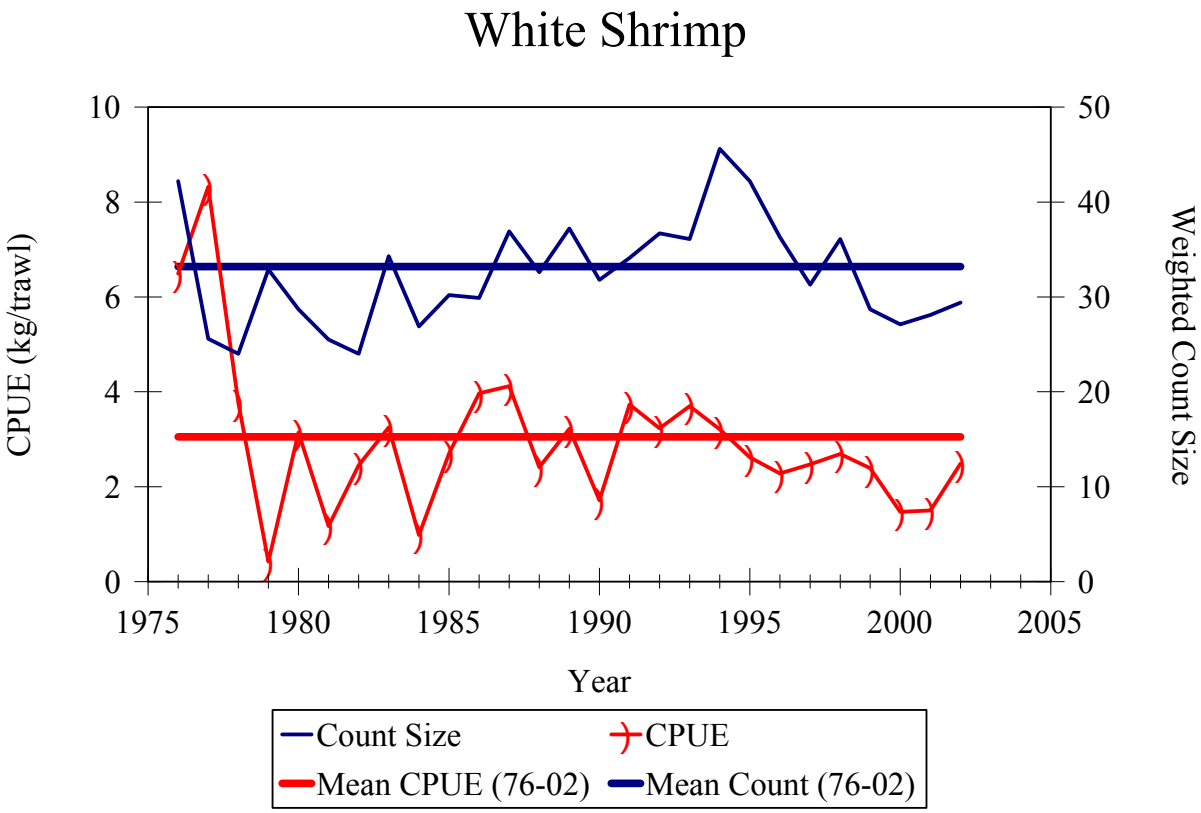


Figure 10. Annual abundance estimates and weighted count size for white shrimp, 1976 – 2002.
Please note data is missing for much of 1979 which may cause erroneous results.

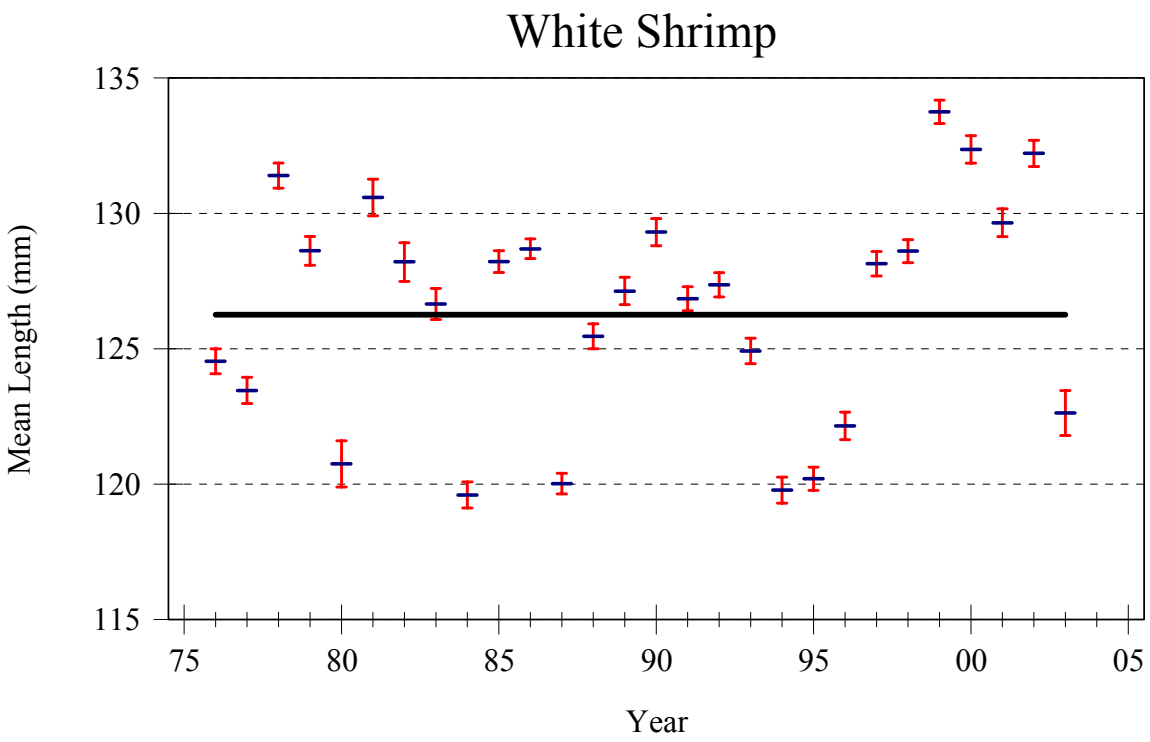
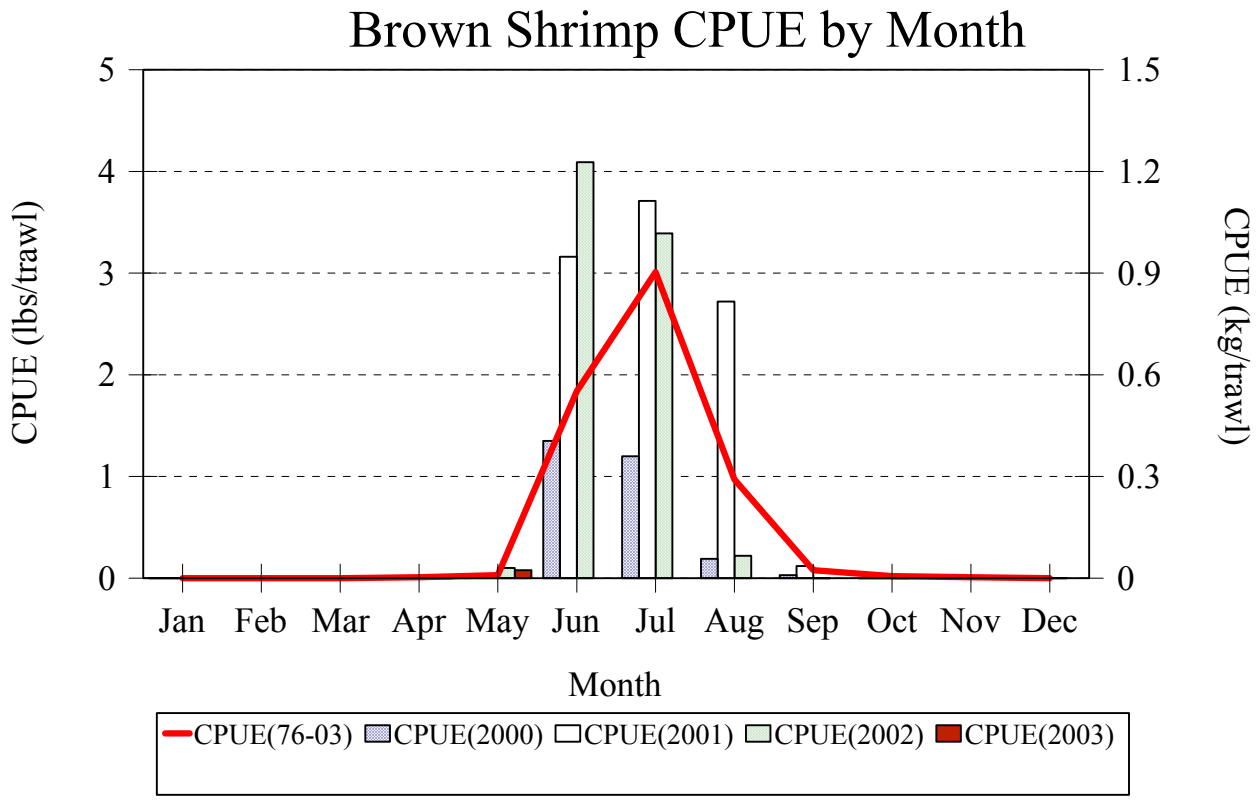


Figure 11. Size statistics by year for white shrimp relative to the long-term average.



Catch Per Unit Effort in weight per 15 minute trawl

Figure 12. Brown shrimp monthly catch per unit effort (2000 to 2003) compared to the long-term average (1976-2003). CPUE is shown as weight per 15 minute trawl.
These graphics are typically used to provide a real-time graphical comparison to historical catch rates for industry inquiries.

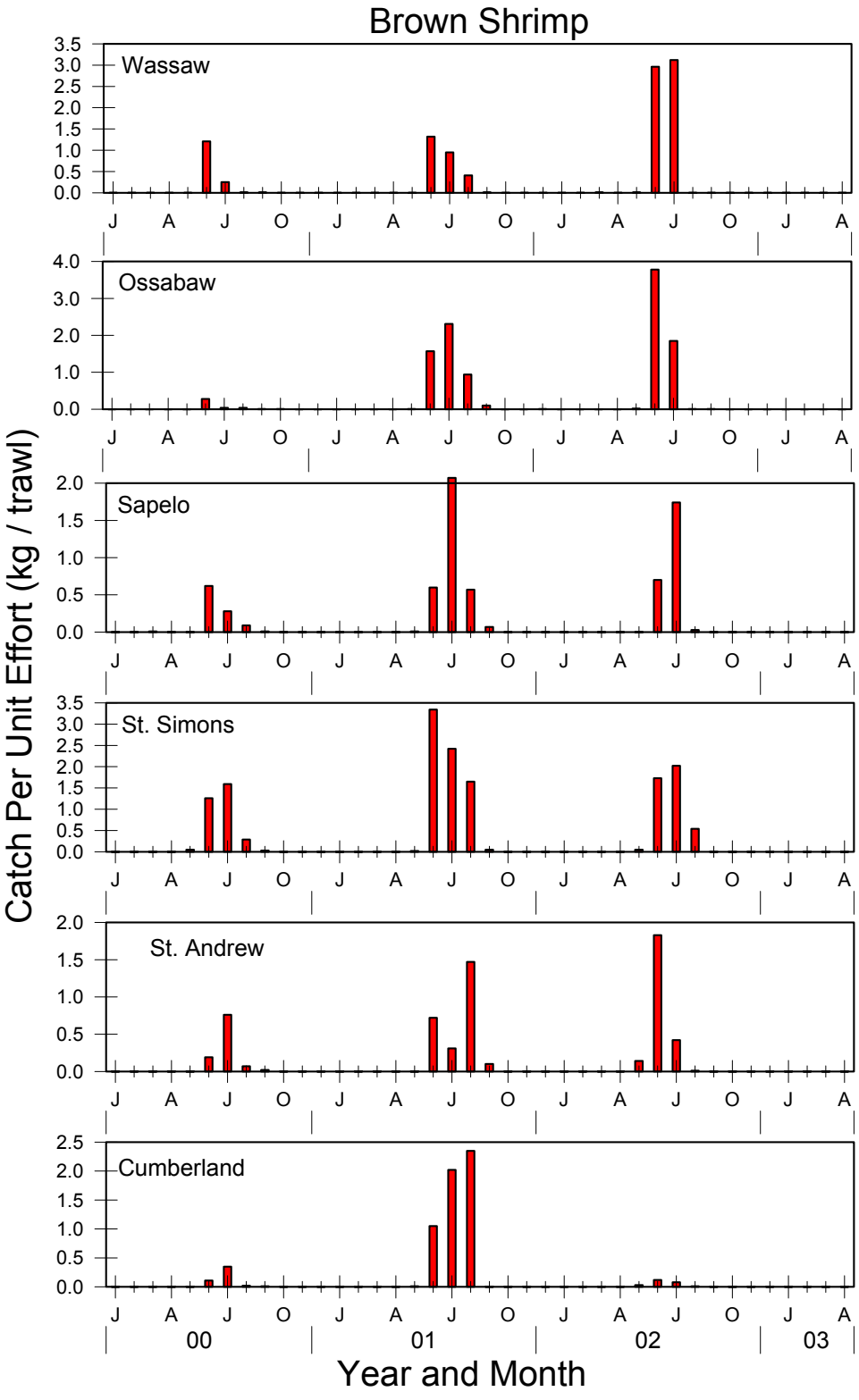


Figure 13. Brown shrimp monthly abundance by sound system, January 2000 to April 2003.

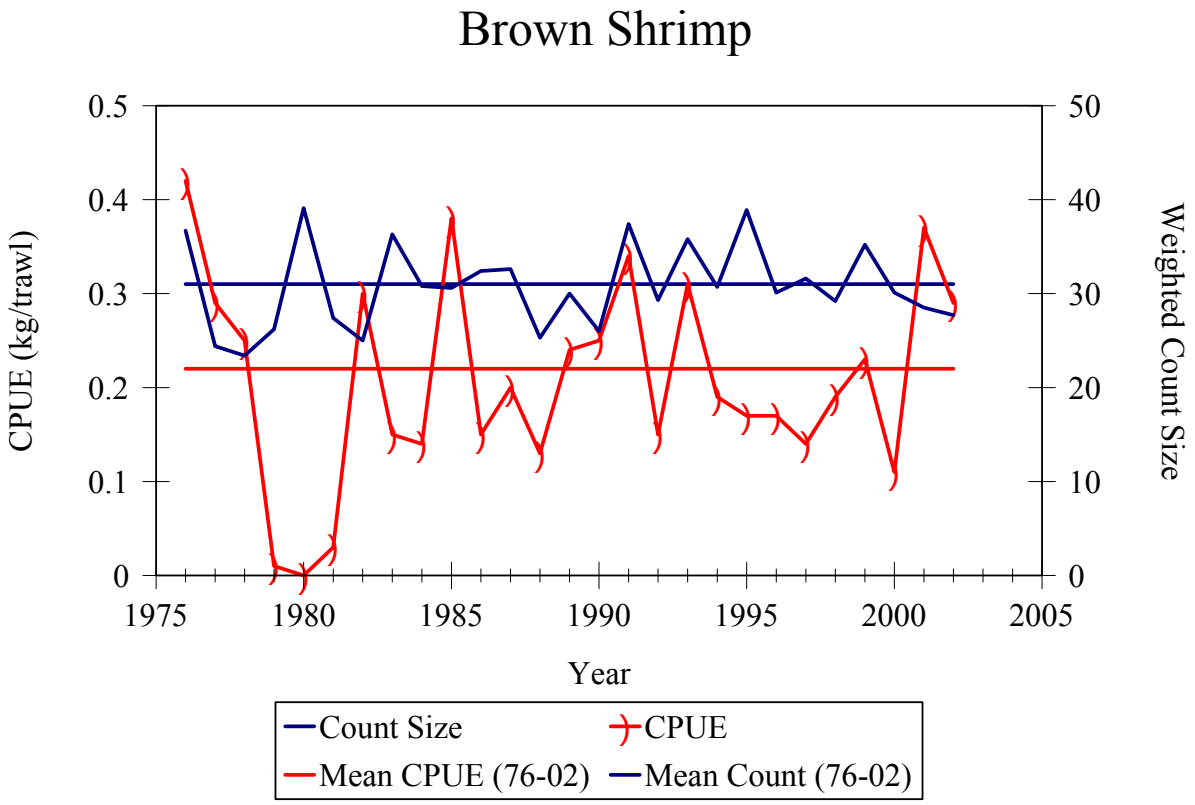


Figure 14. Annual abundance estimates and weighted count size for brown shrimp, 1976 – 2002.
Please note data is missing for much of 1979 which may cause erroneous results.

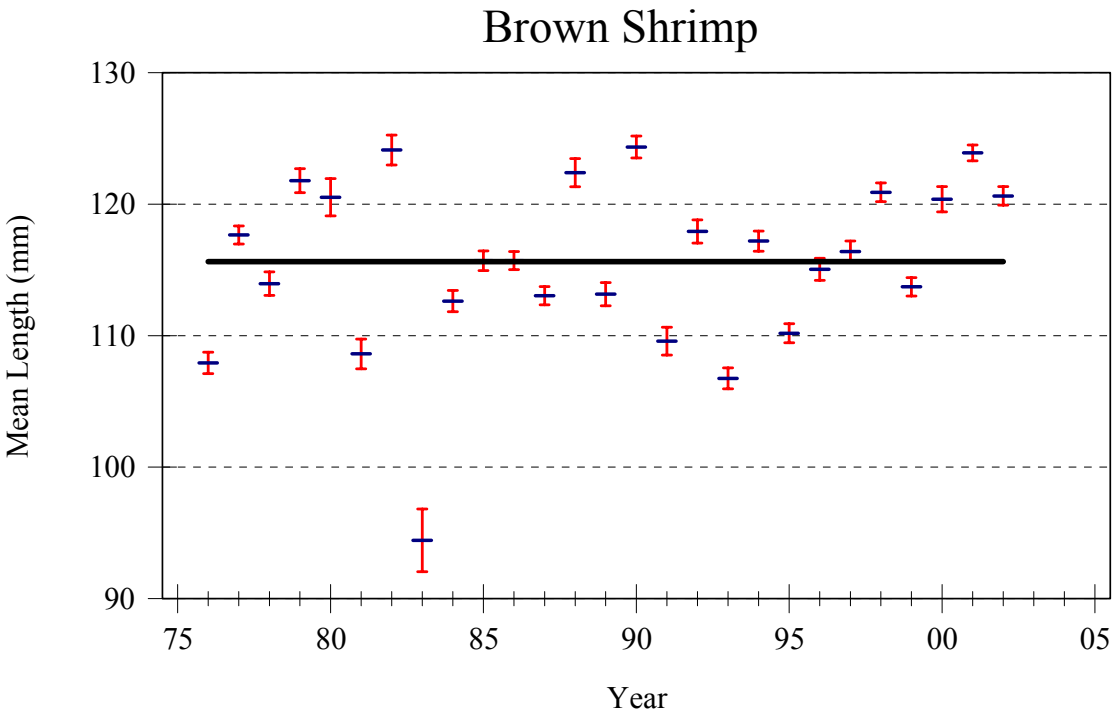
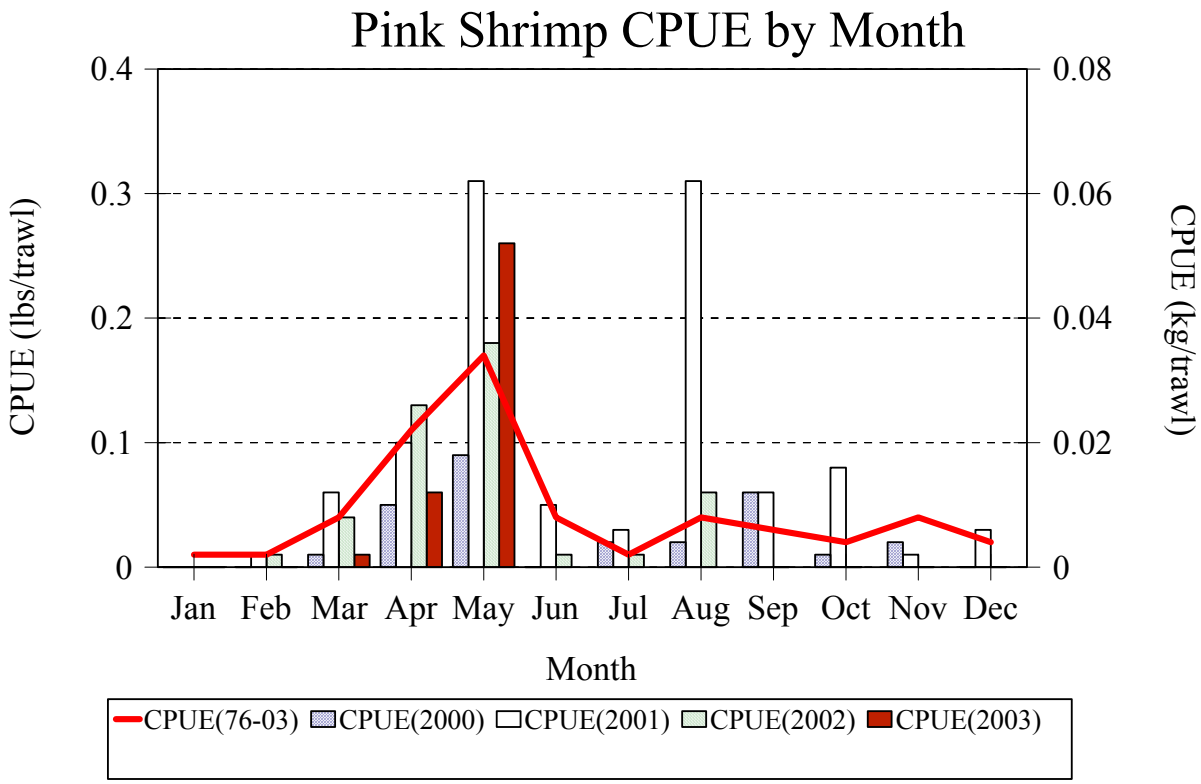


Figure 15. Size statistics by year for brown shrimp relative to the long-term average.



Catch Per Unit Effort in weight per 15 minute trawl

Figure 16. Pink shrimp monthly catch per unit effort (2000 to 2003) compared to the long-term average (1976-2003). CPUE is shown as weight per 15 minute trawl.
These graphics are typically used to provide a real-time graphical comparison to historical catch rates for industry inquiries.

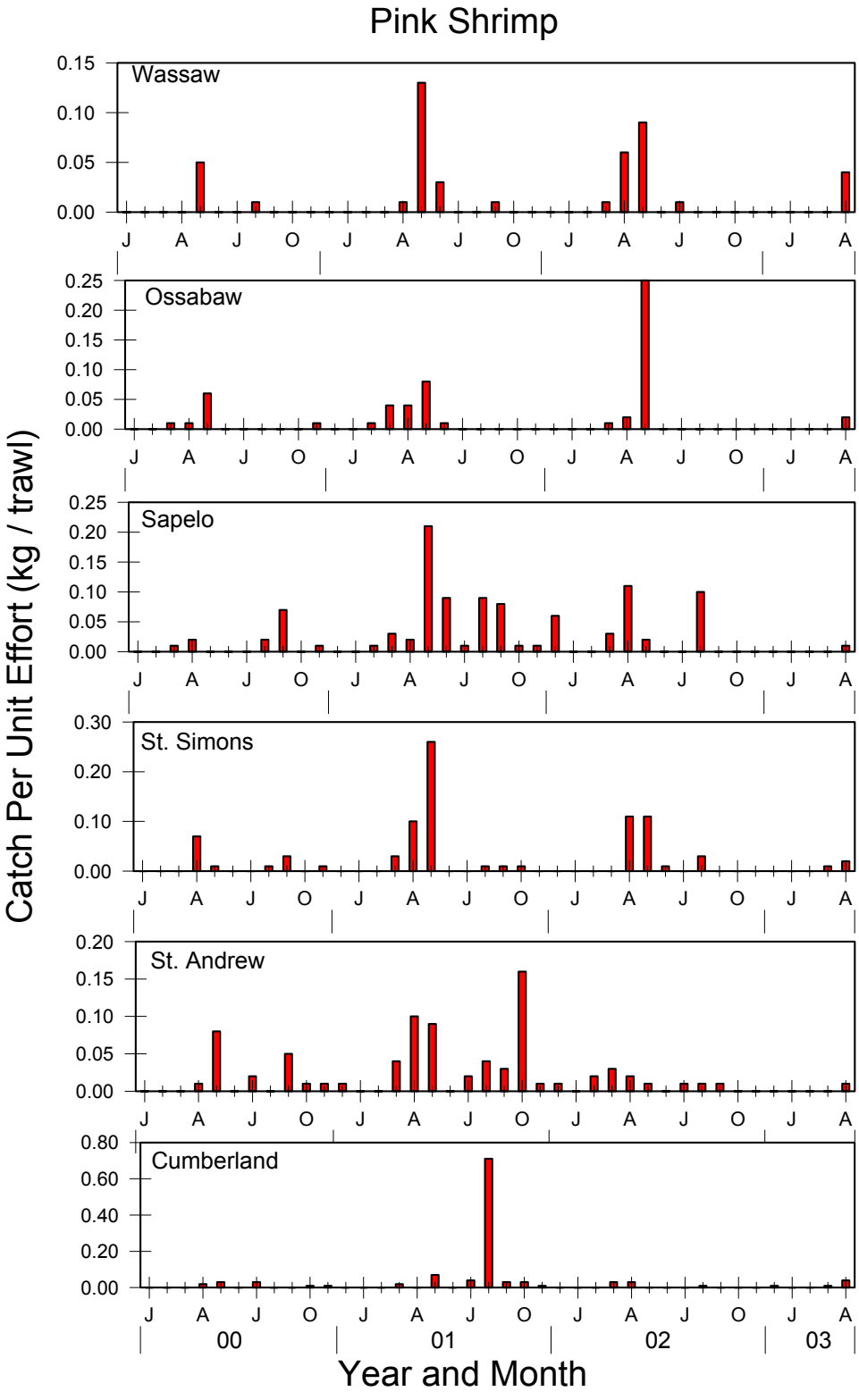


Figure 17. Pink shrimp monthly abundance by sound system, January 2000 to April 2003.

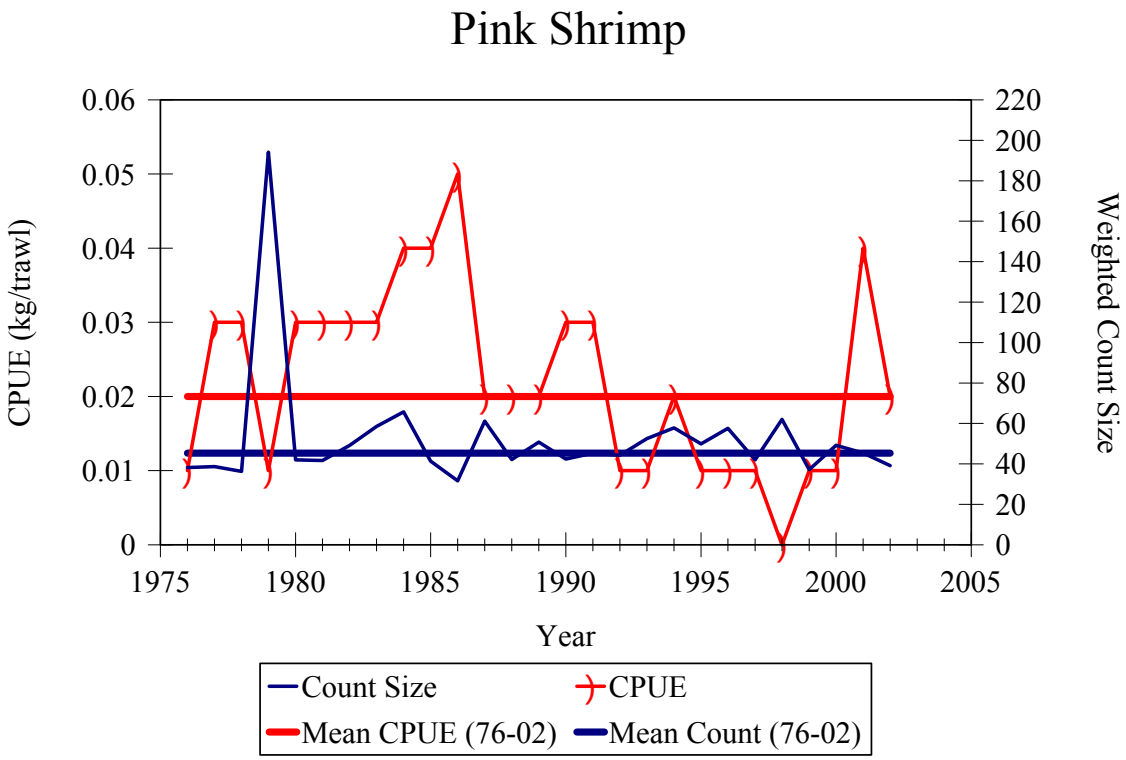


Figure 18. Annual abundance estimates and weighted count size for pink shrimp, 1976 – 2002.
Please note data is missing for much of 1979 which may cause erroneous results.

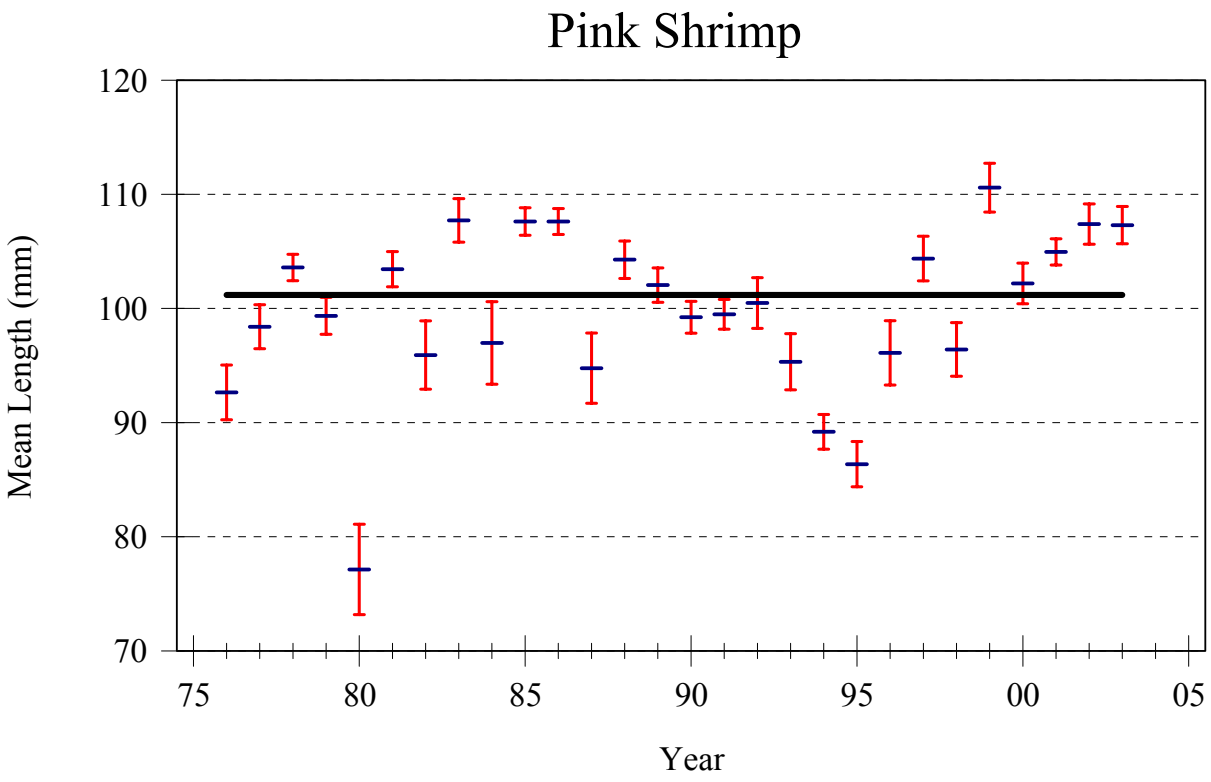


Figure19. Size statistics by year for pink shrimp relative to the long-tem average.

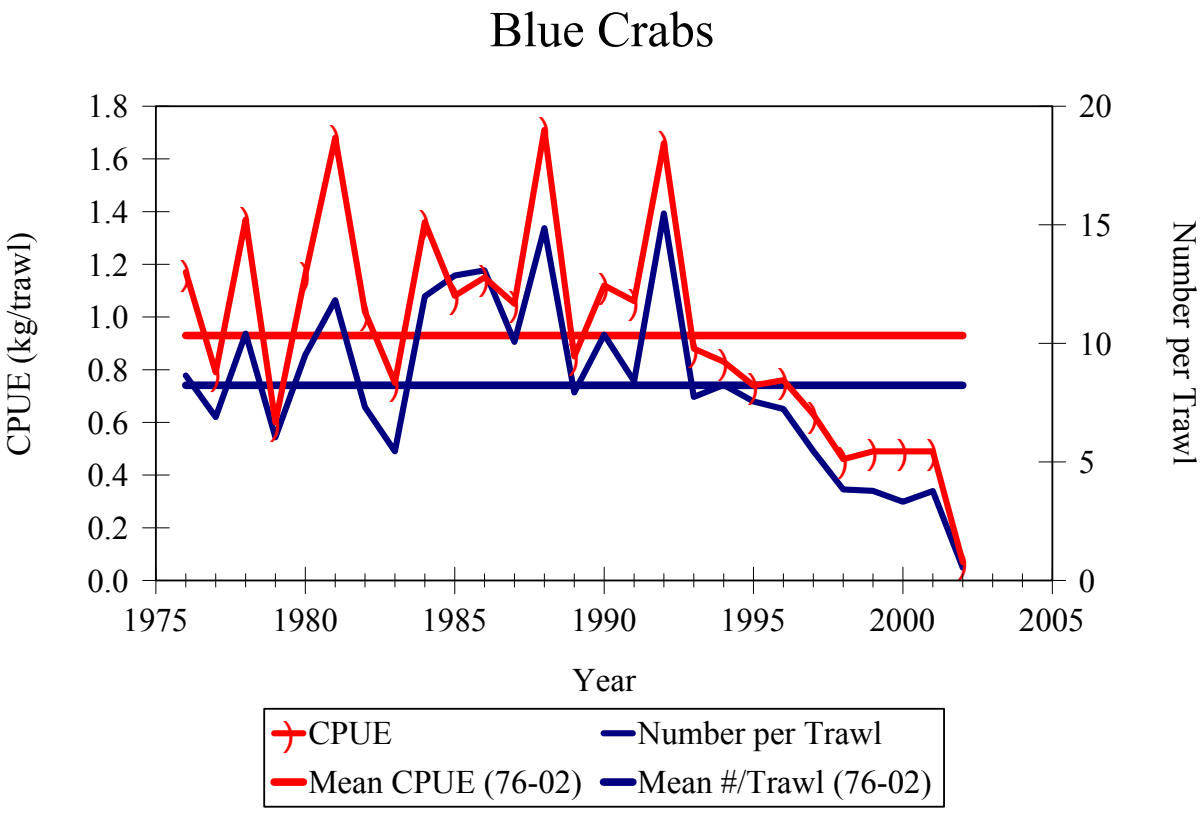


Figure 20. Annual abundance estimates by weight and total numbers for blue crabs, 1976 – 2002.
Please note data is missing for much of 1979 which may cause erroneous results.

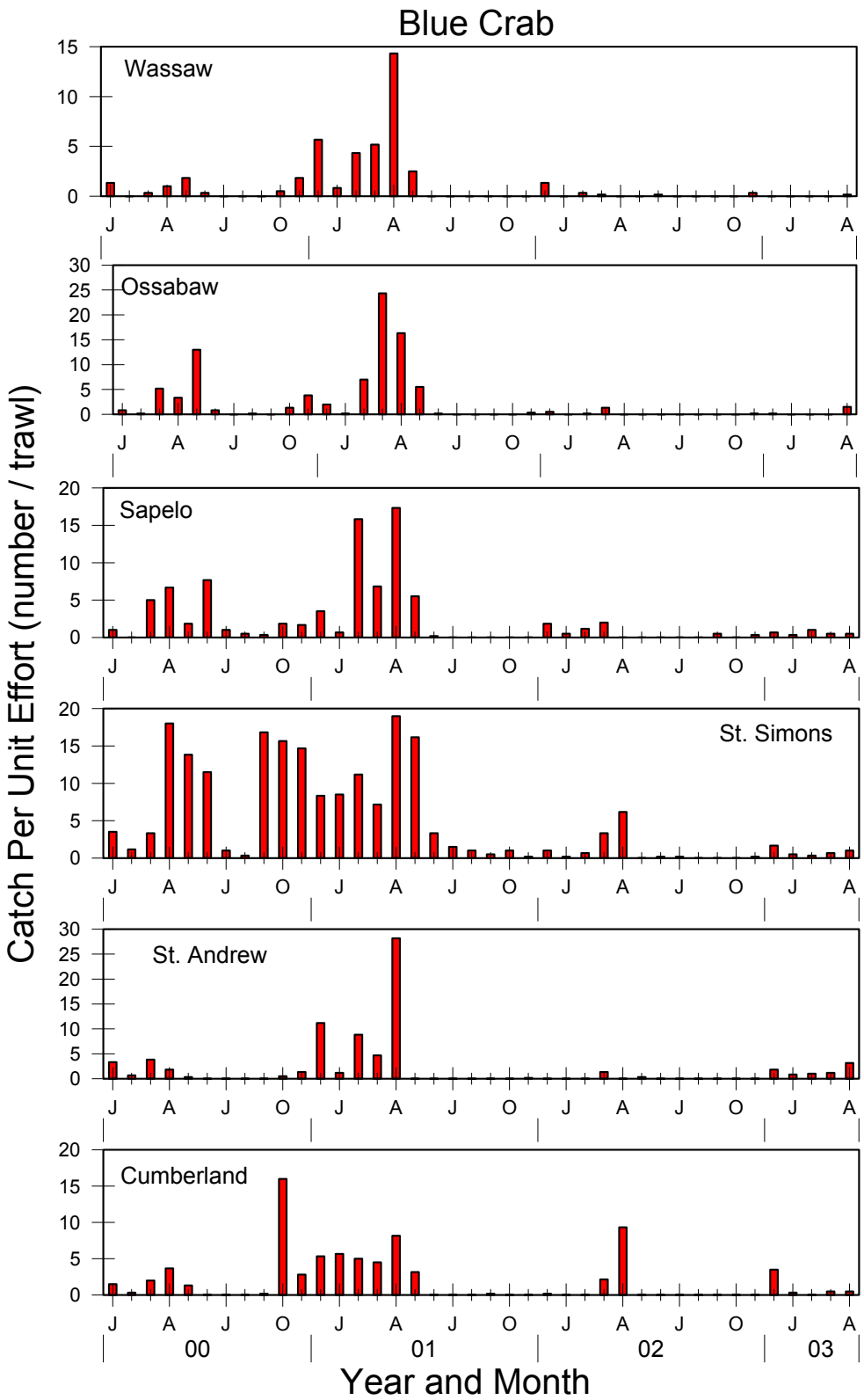
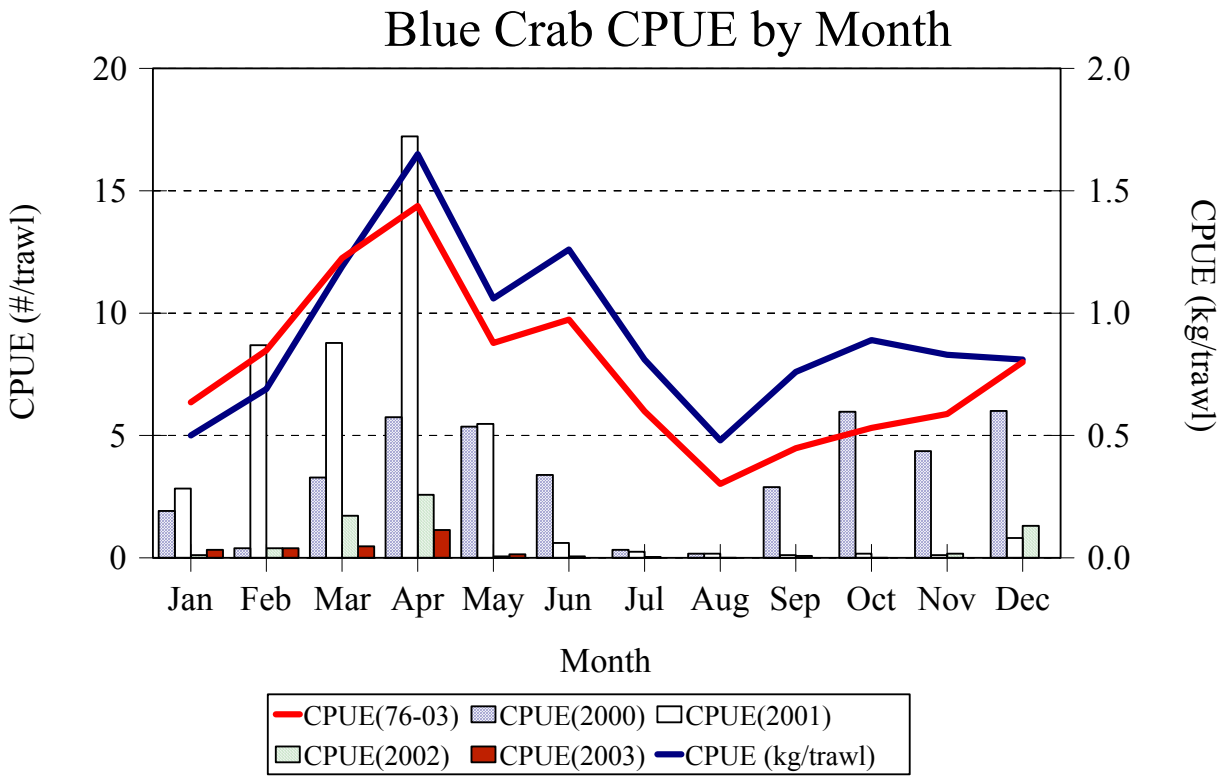


Figure 21. Blue crab monthly abundance by sound system, January 2000 to April 2003.



Catch Per Unit Effort based on standard 15 minute trawl

Figure 22. Blue crab monthly catch per unit effort (2000 to 2003) compared to the long-term average (1976-2003).

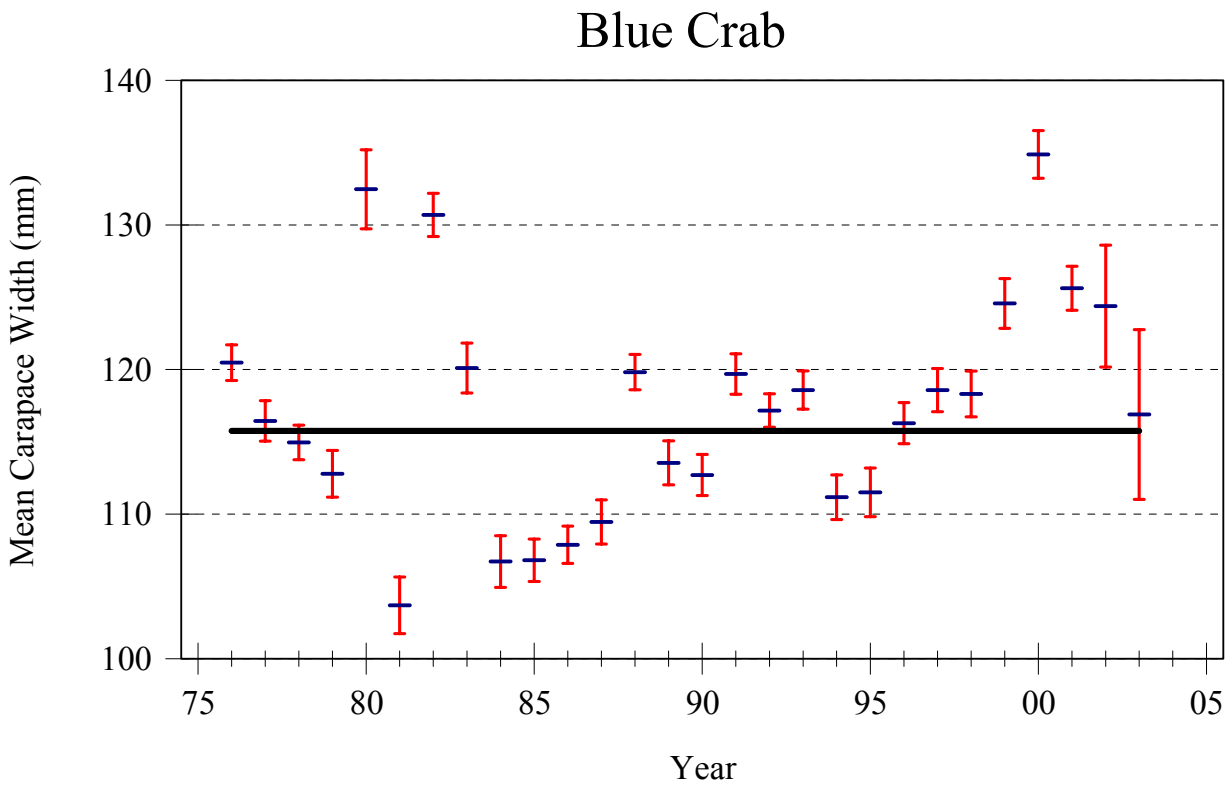


Figure 23. Size statistics by year for blue crabs relative to the long-term average.

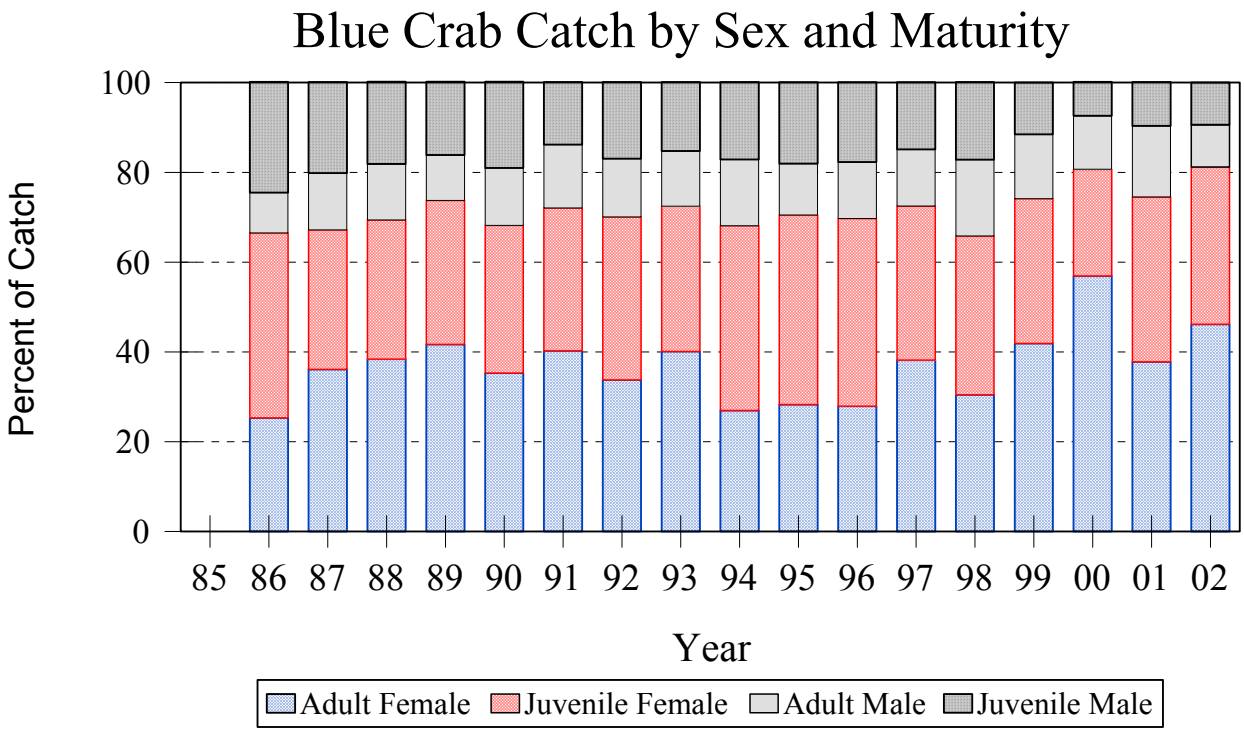


Figure 24. Blue crab catch by sex and maturity. Adults females are classified as those which have undergone a terminal molt. Adult males are those 120 mm carapace width or greater. Data from 1976 to 1985 were removed due to inconsistencies in the data which needs to be addressed.

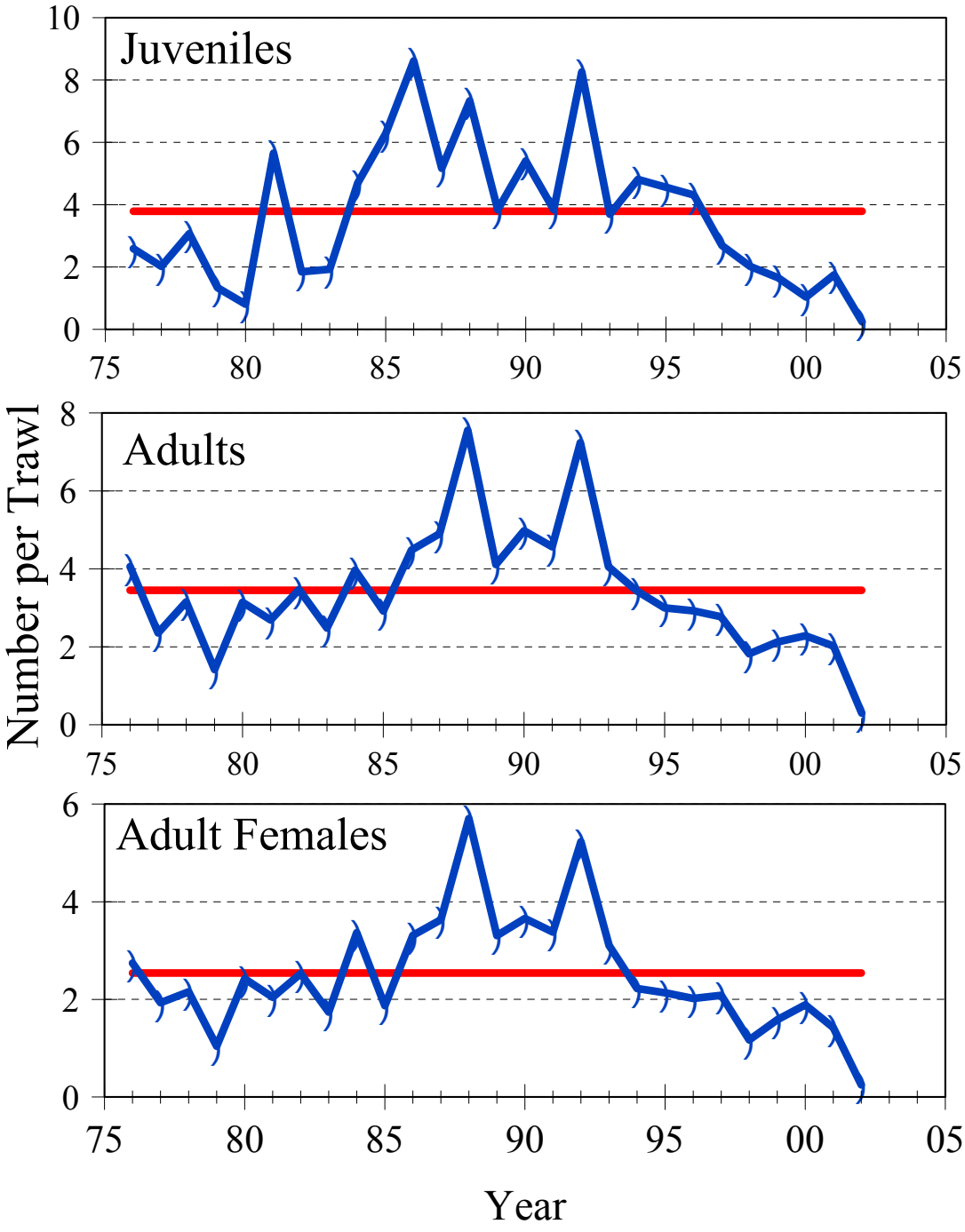


Figure 25. Annual estimates of abundance for blue crabs by maturity and sex. Adults females are classified as those which have undergone a terminal molt. Adult males are those 120 mm carapace width or greater. The horizontal line represents the historic mean (1976-2002). Please note data is missing for much of 1979 which may cause erroneous results.

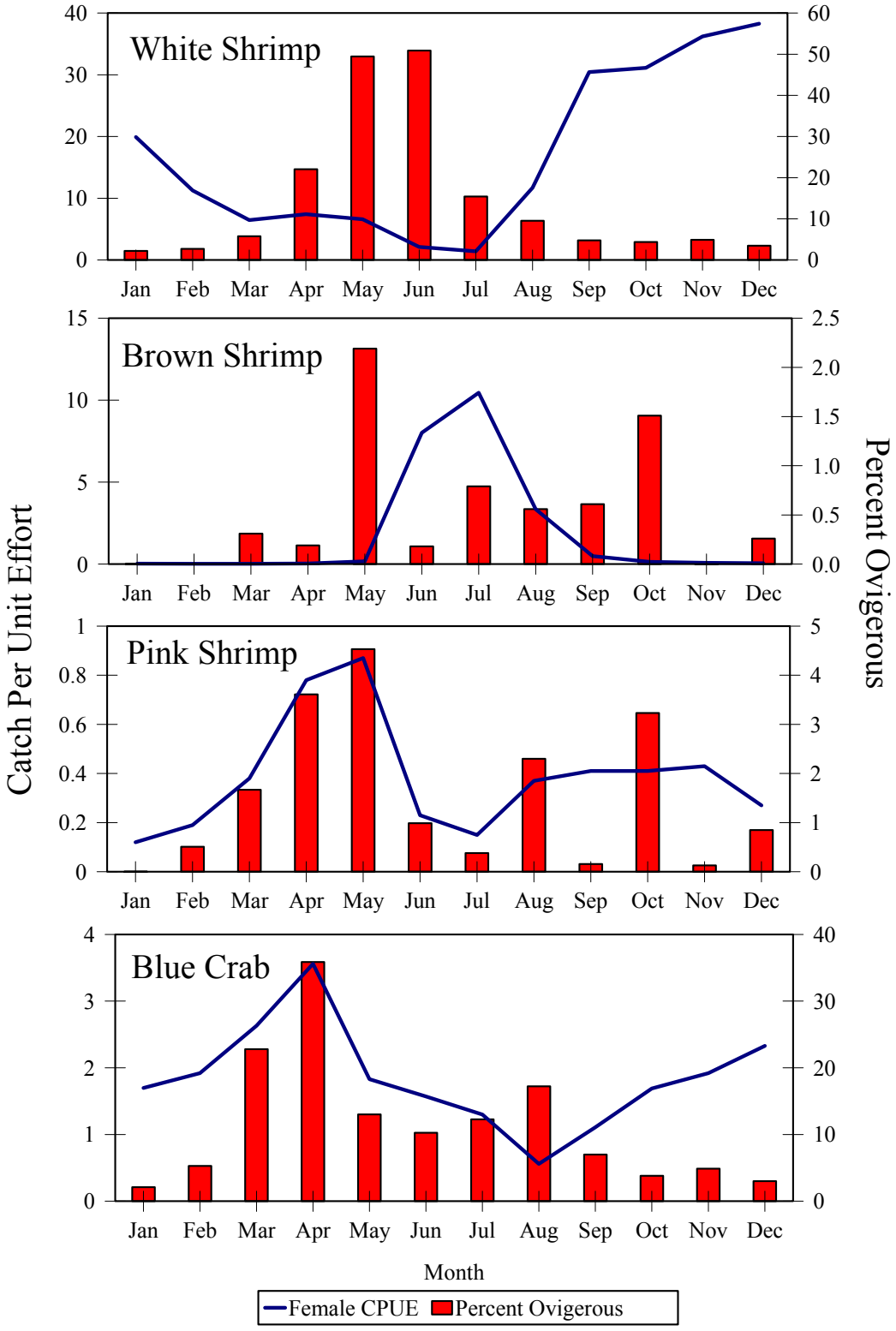


Figure 26. The long-term monthly (1976-2002) percent of ovigerous females and catch per unit effort measured as a geometric mean number of females per trawl. Shrimp species are based on all females, blue crabs are based on adult females.

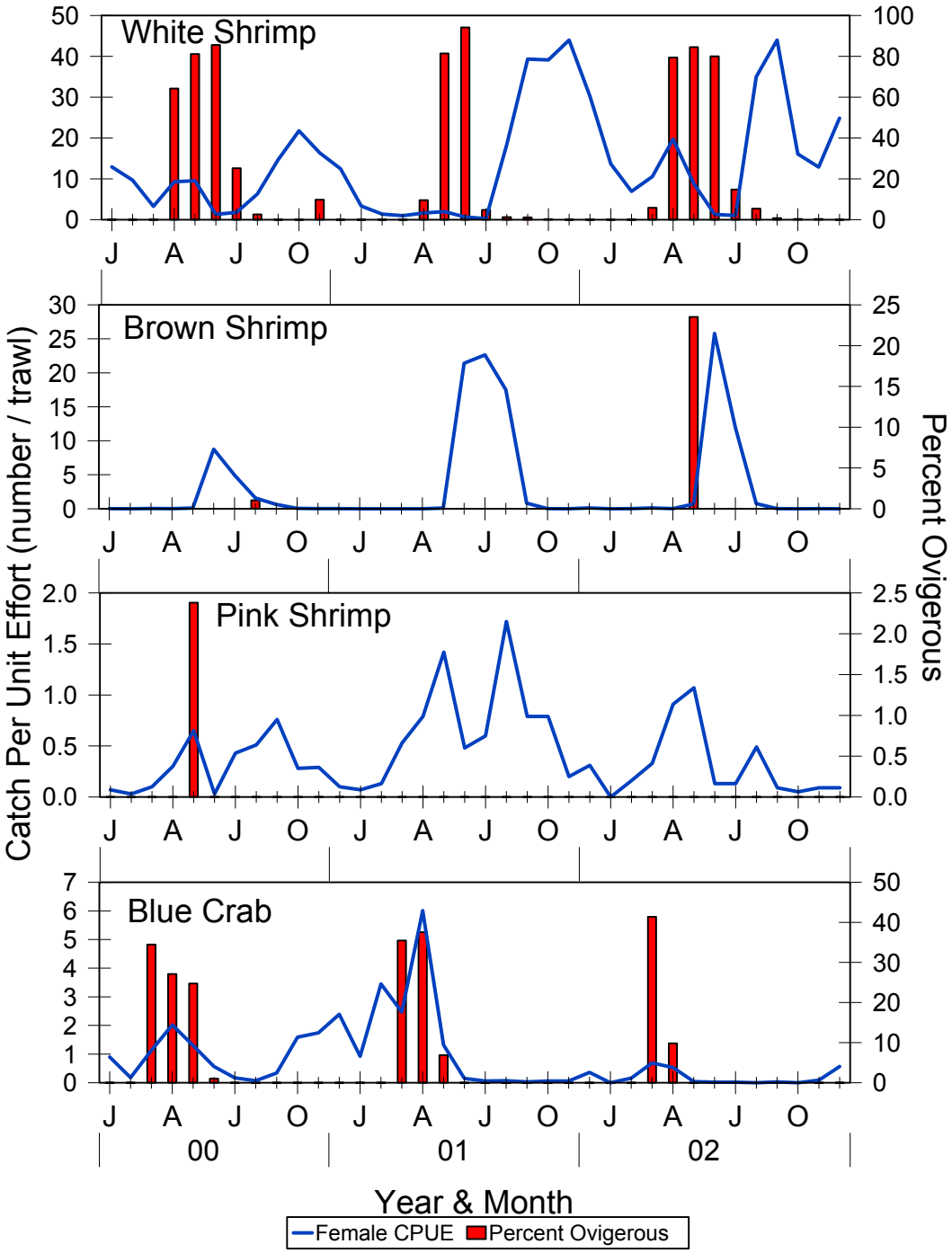


Figure 27. Monthly (2000 - 2002) percent of ovigerous females and catch per unit effort measured as a geometric mean number of females per trawl. Shrimp species are based on all females,blue crabs are based on adult females.

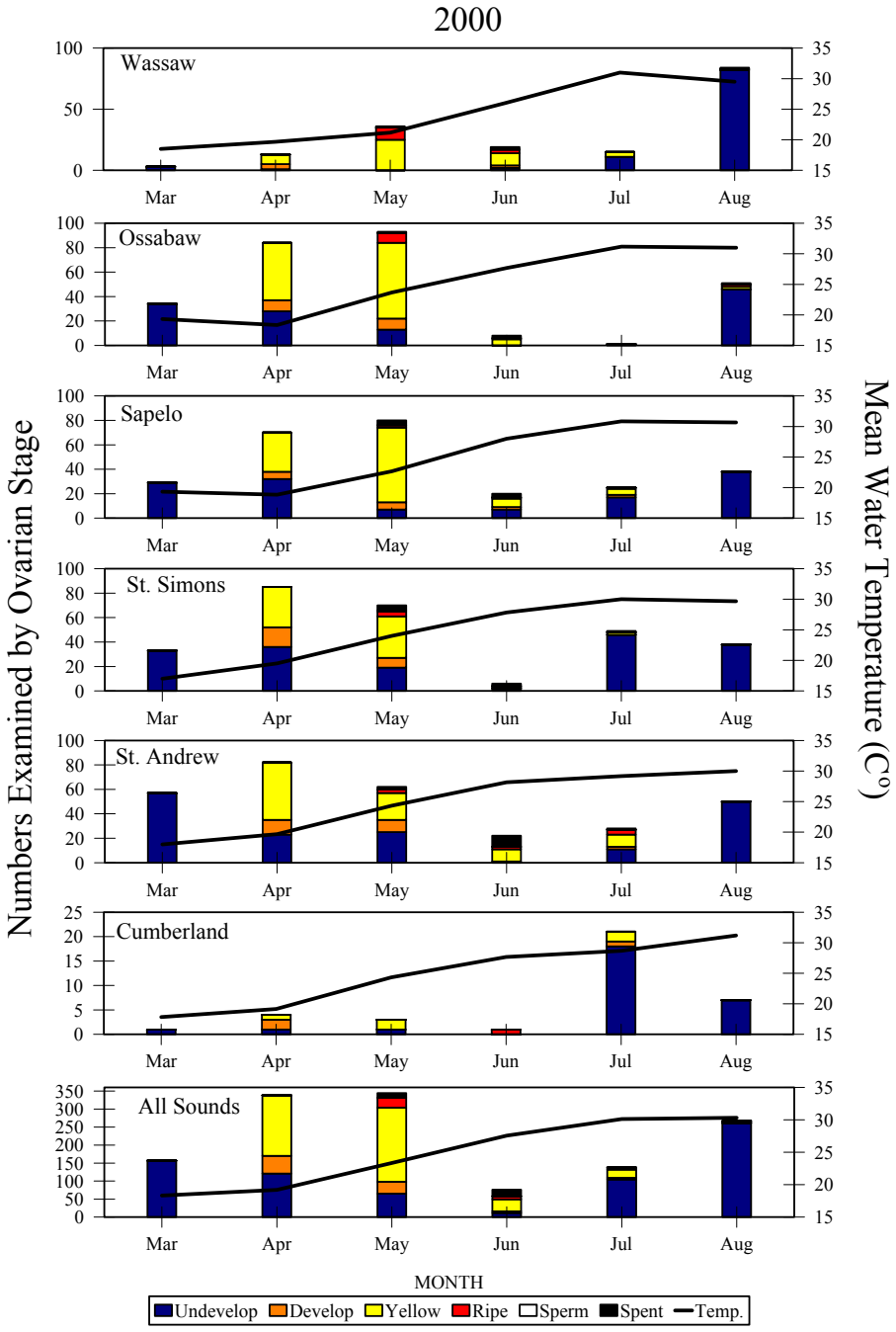


Figure 28. White shrimp ovarian stage by sound system for the 2000 spawning season.

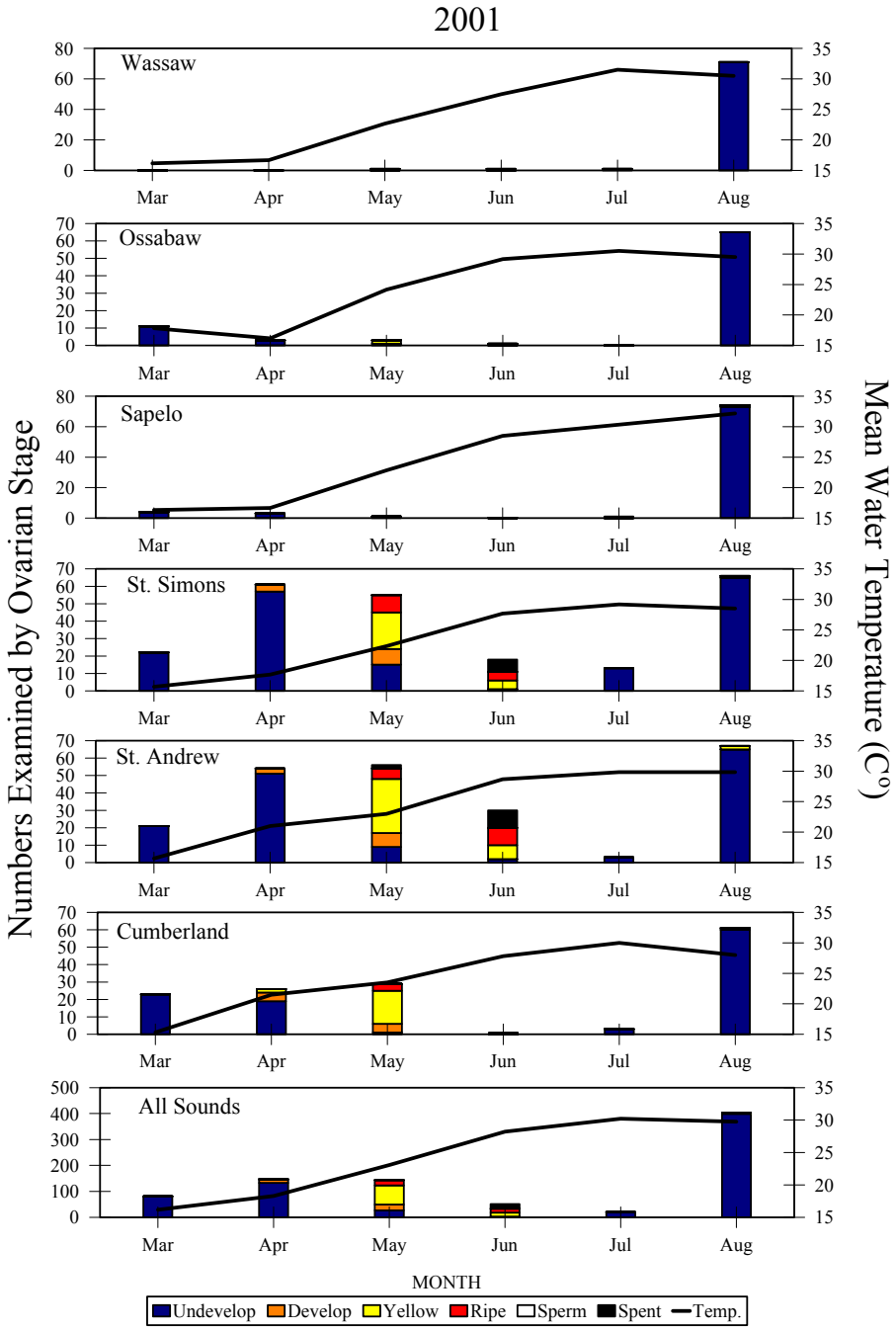


Figure 29. White shrimp ovarian stage by sound system for the 2001 spawning season.

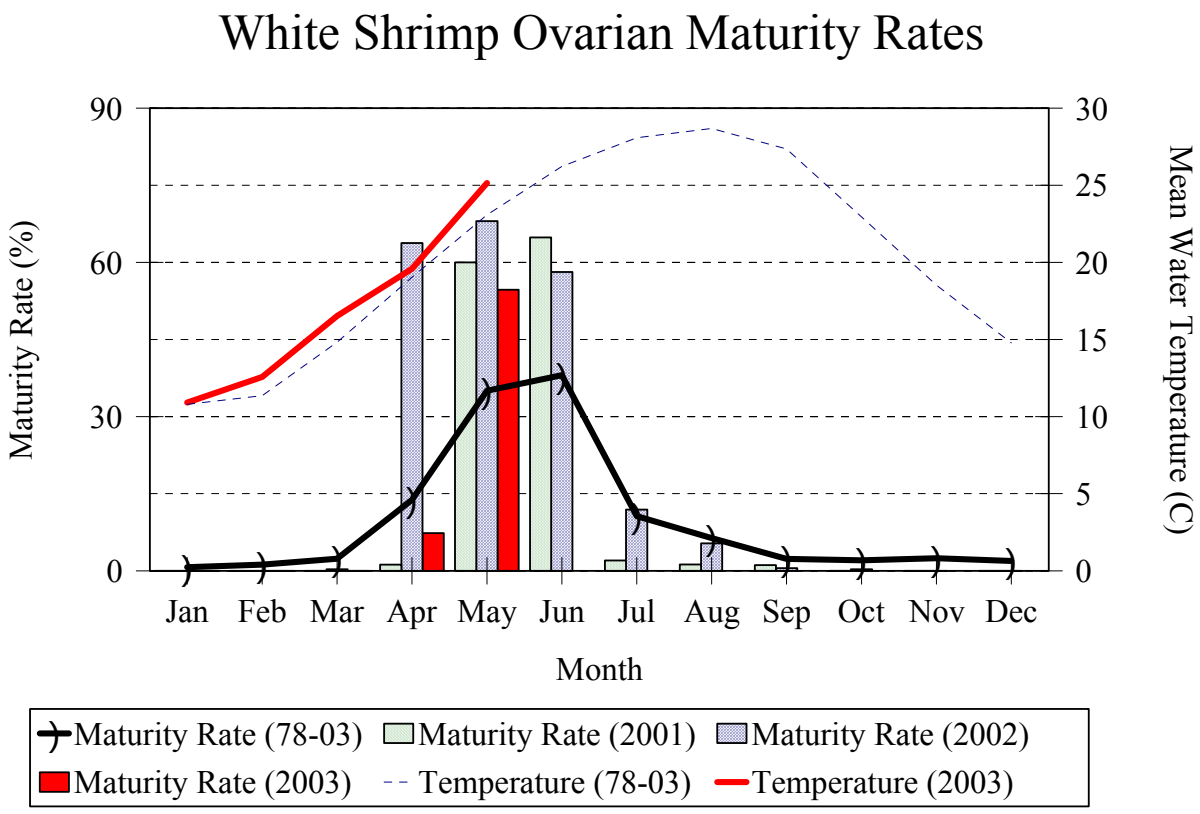


Figure 30. Long-term (1978-03) maturity rates and mean water temperature by month compared to recent years (2001-2003).

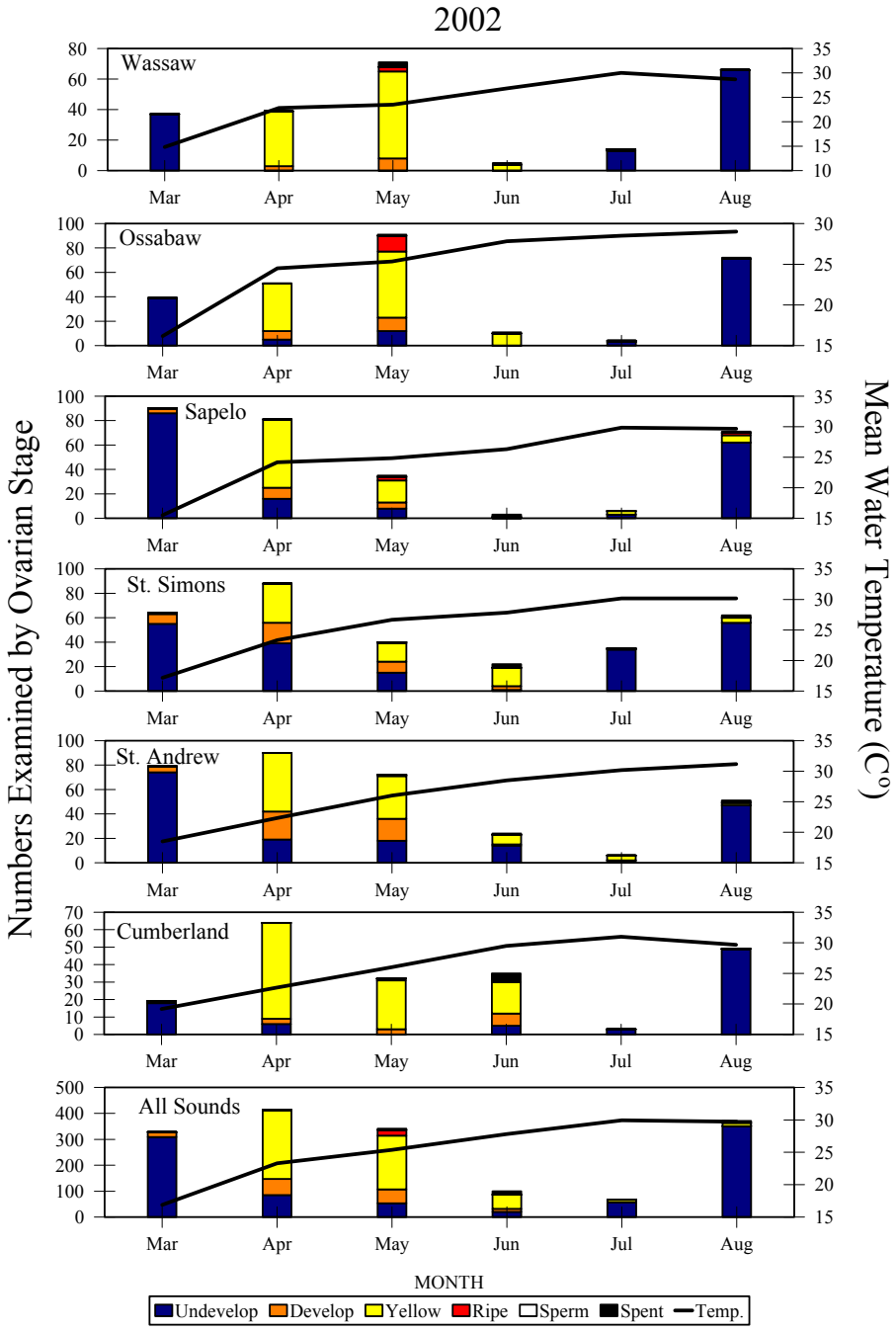


Figure 31. White shrimp ovarian stage by sound system for the 2001 spawning season.

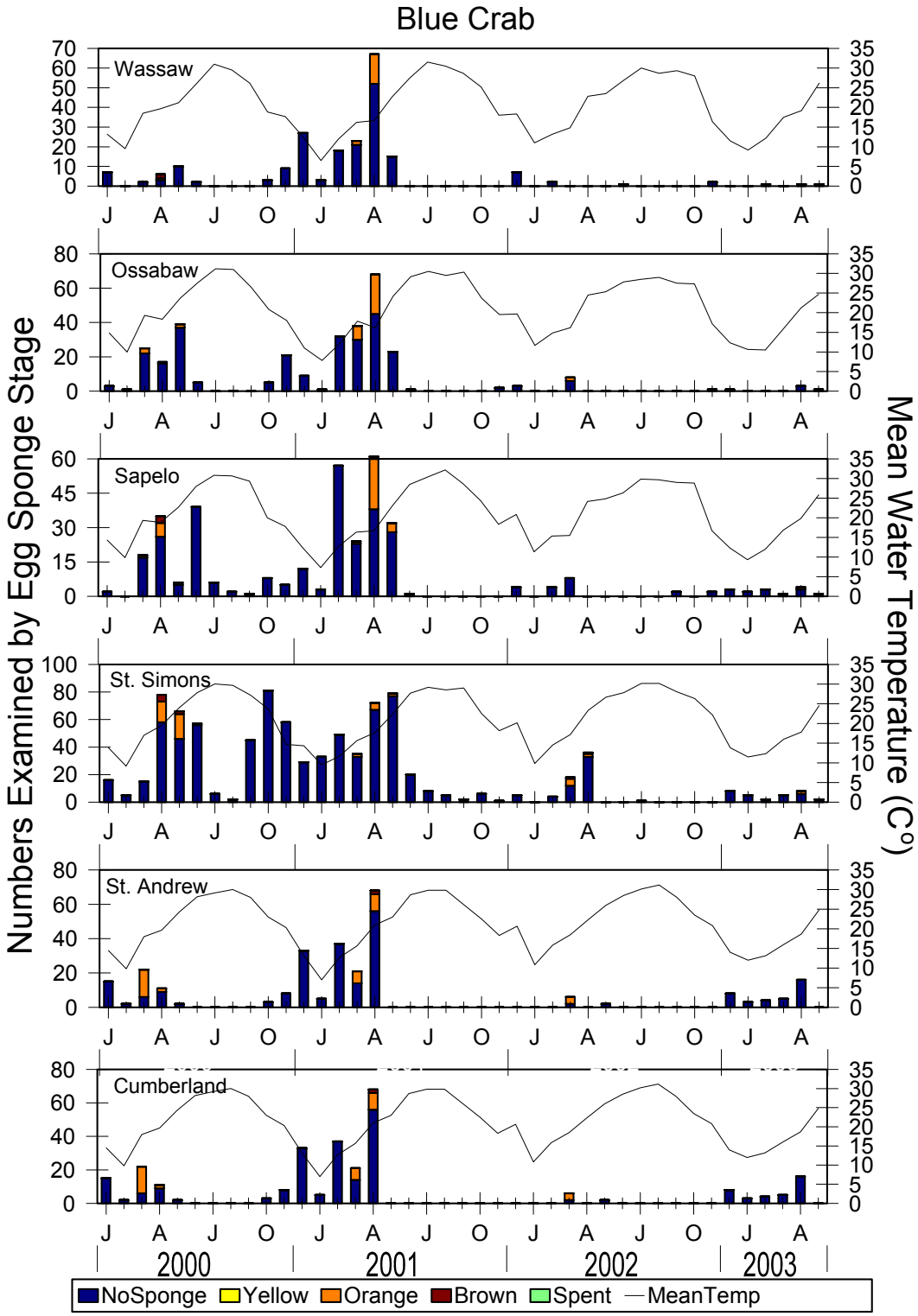


Figure 32. Blue crab sponge stage by sound system (Jan 2000 – May 2003).

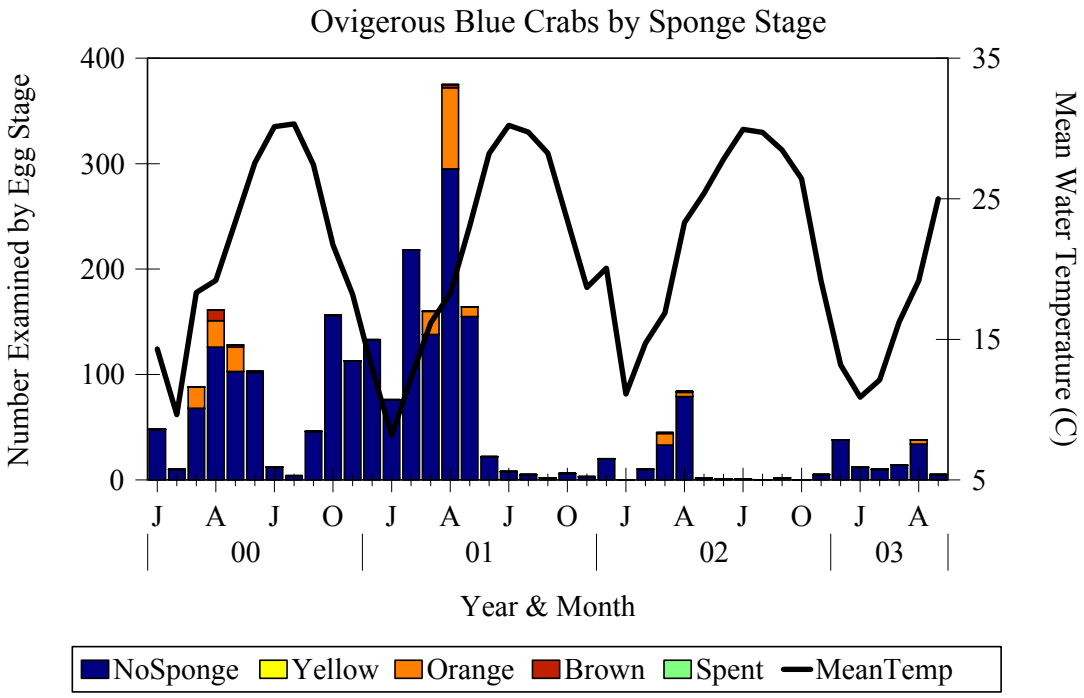


Figure 33. Overall blue crab sponge stage (Jan 2000 – May 2003).

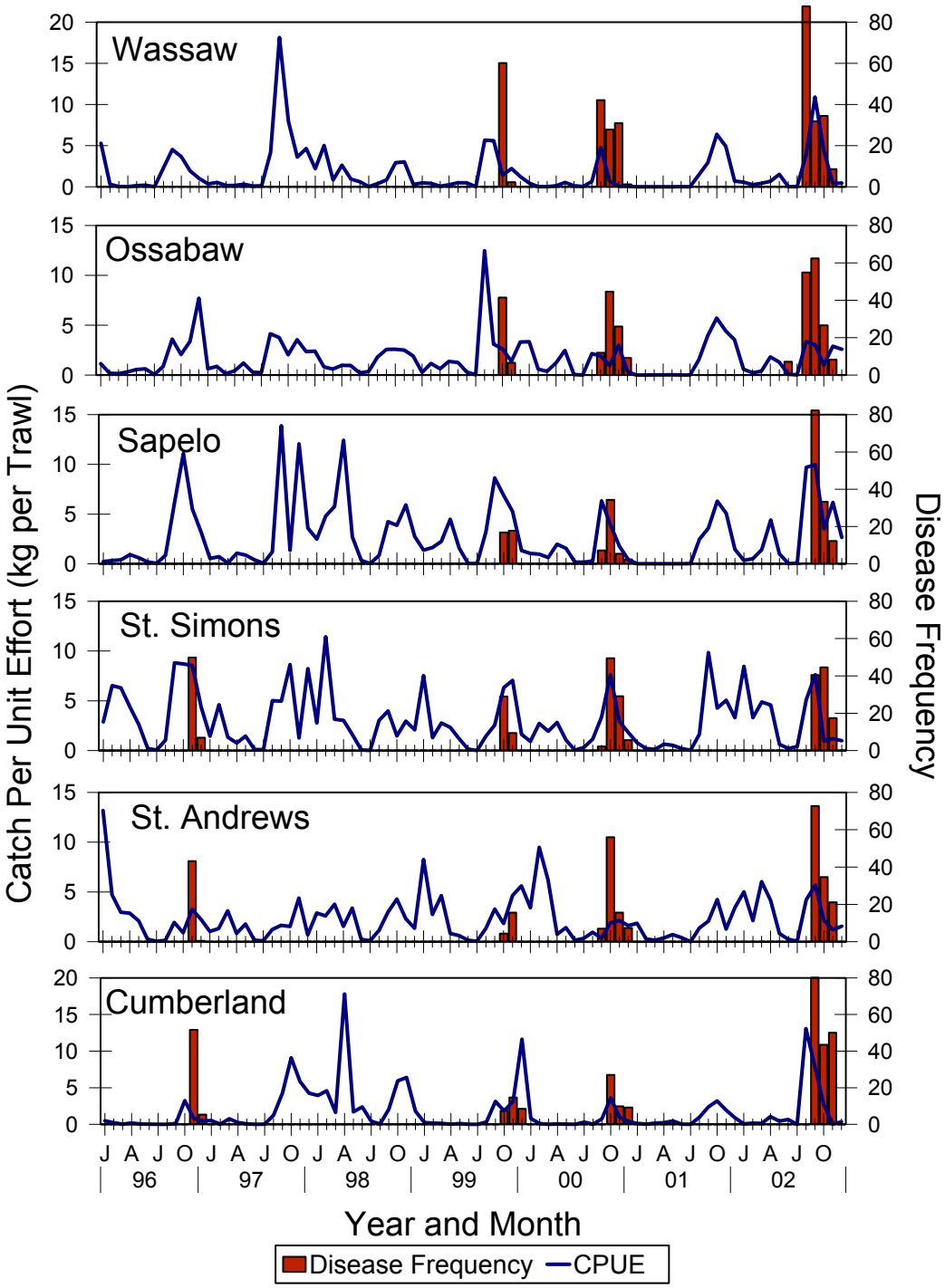


Figure 34. White shrimp monthly CPUE and black gill infection rate by sound system, 1996-2002.

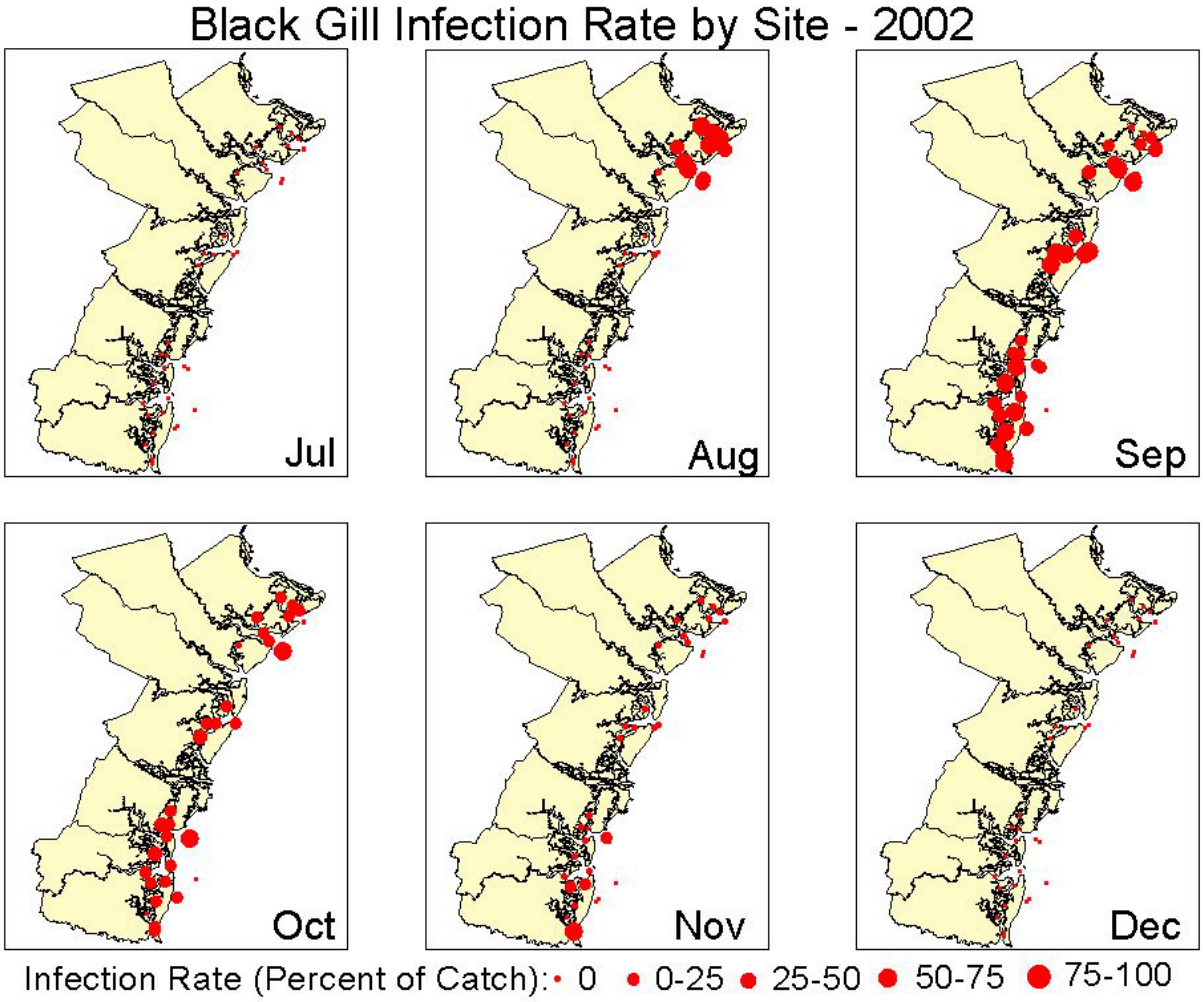
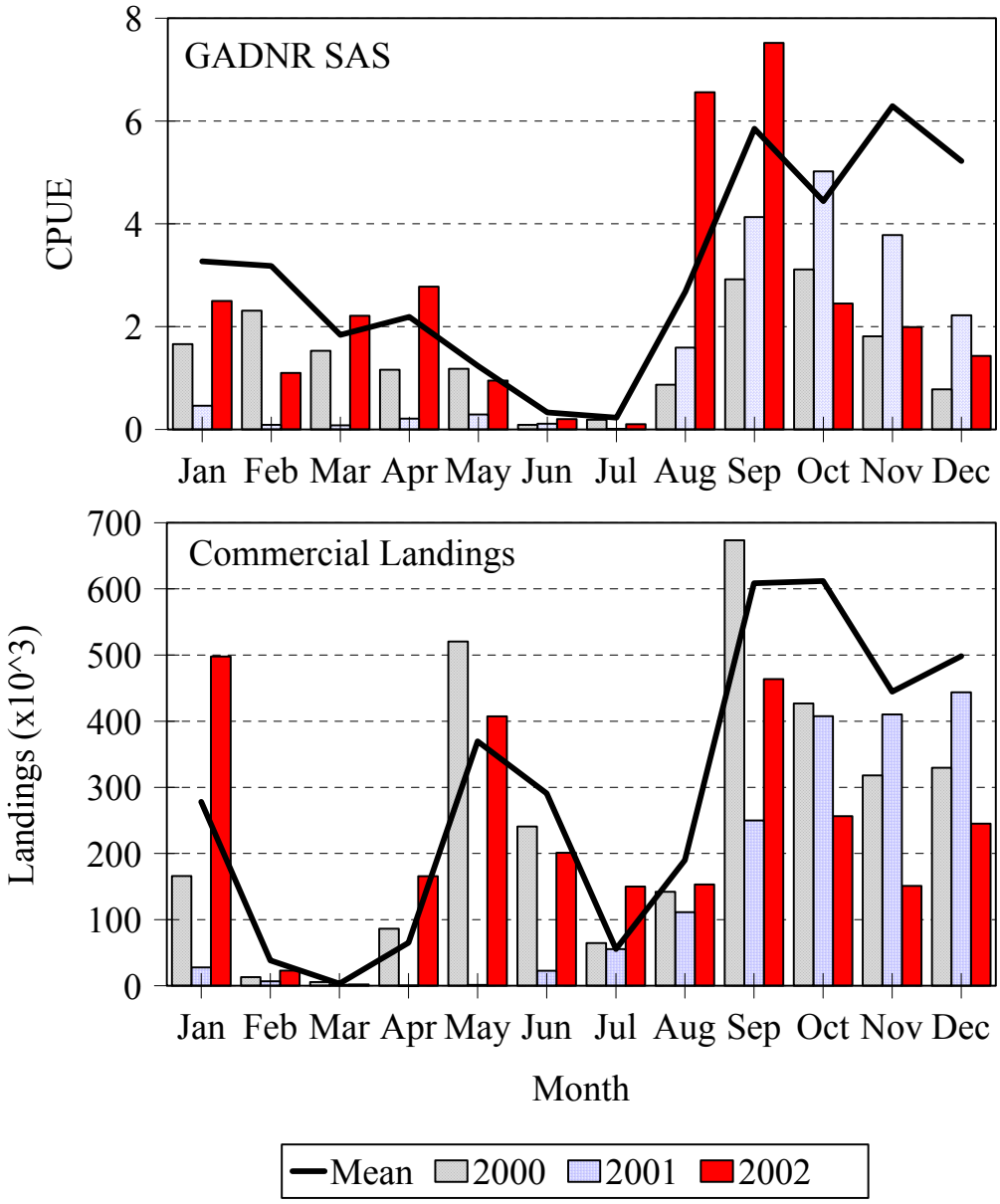


Figure 35. Distribution of black gill infection rate in white shrimp observed in 2002.



Mean: Landings in lbs - 1983 - 2002.
CPUE in kg / 15 minute trawl, 1976 - 2002.

Figure 36. Long-term monthly averages of commercial white shrimp landings and catch per unit effort from Assessment data with comparison to 2000-2002.

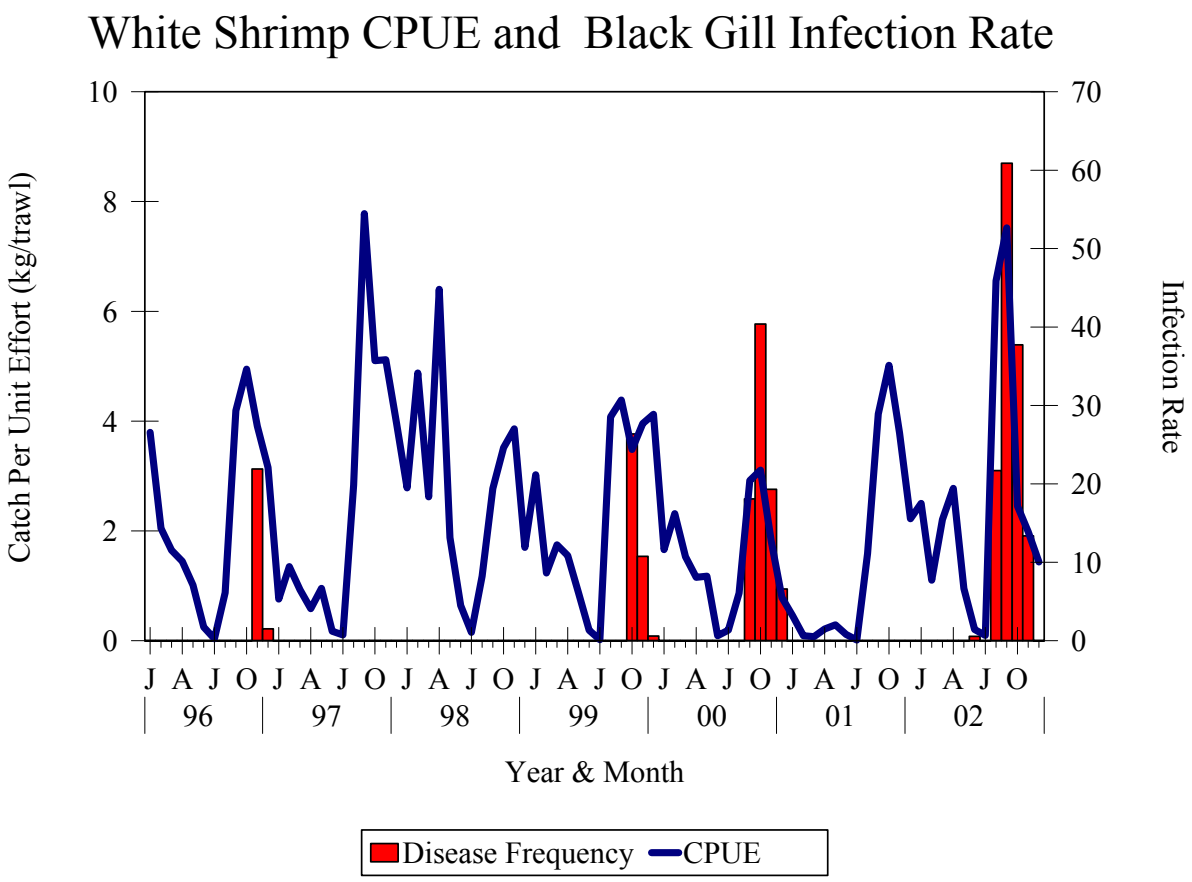


Figure 37. White shrimp monthly CPUE and black gill infection rate, 1996-2002.

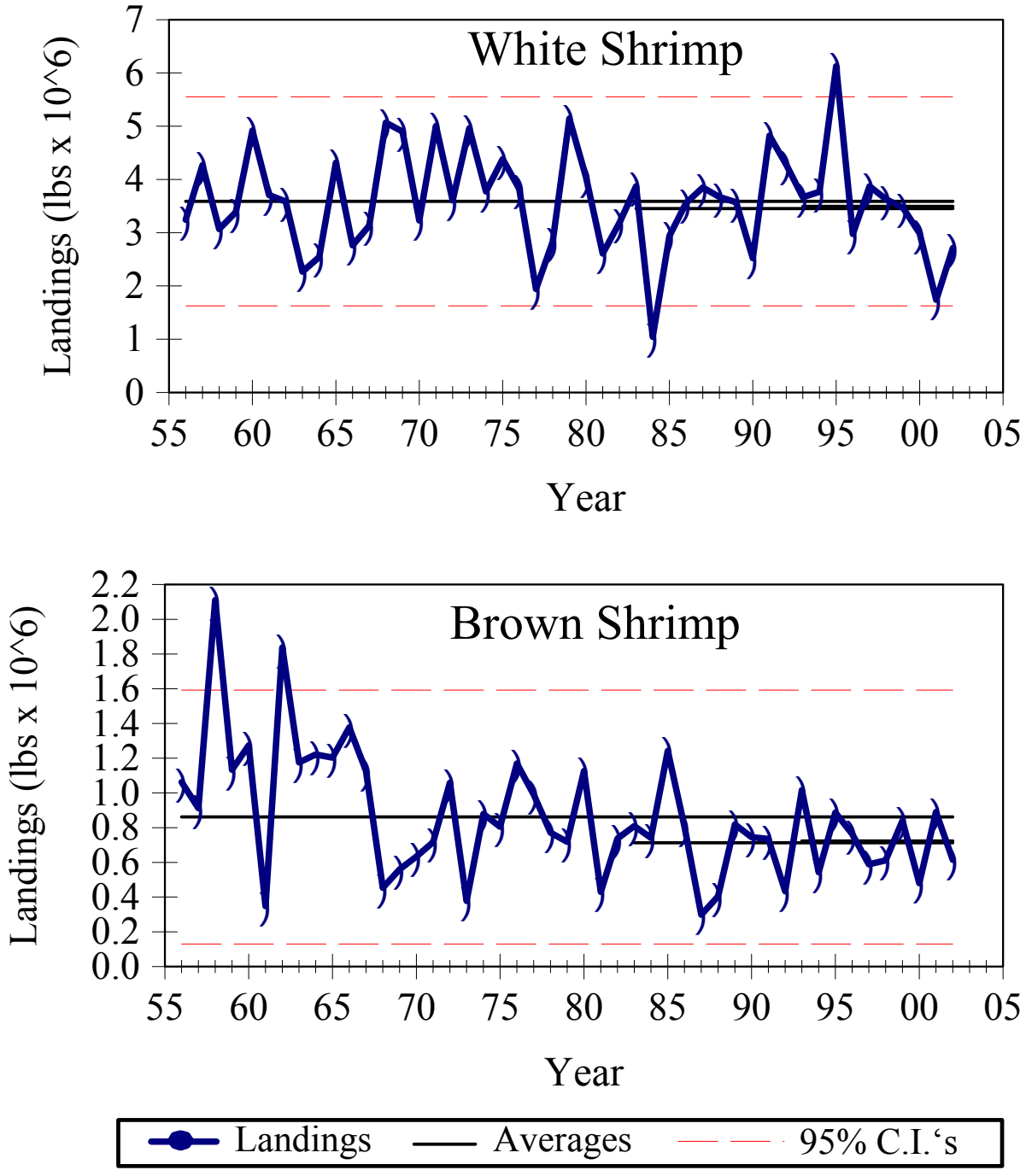


Figure 38. Annual commercial landings for white and brown shrimp, with associated long-term (1957-2002) average, associated 95% confidence intervals, twenty and ten-year averages.

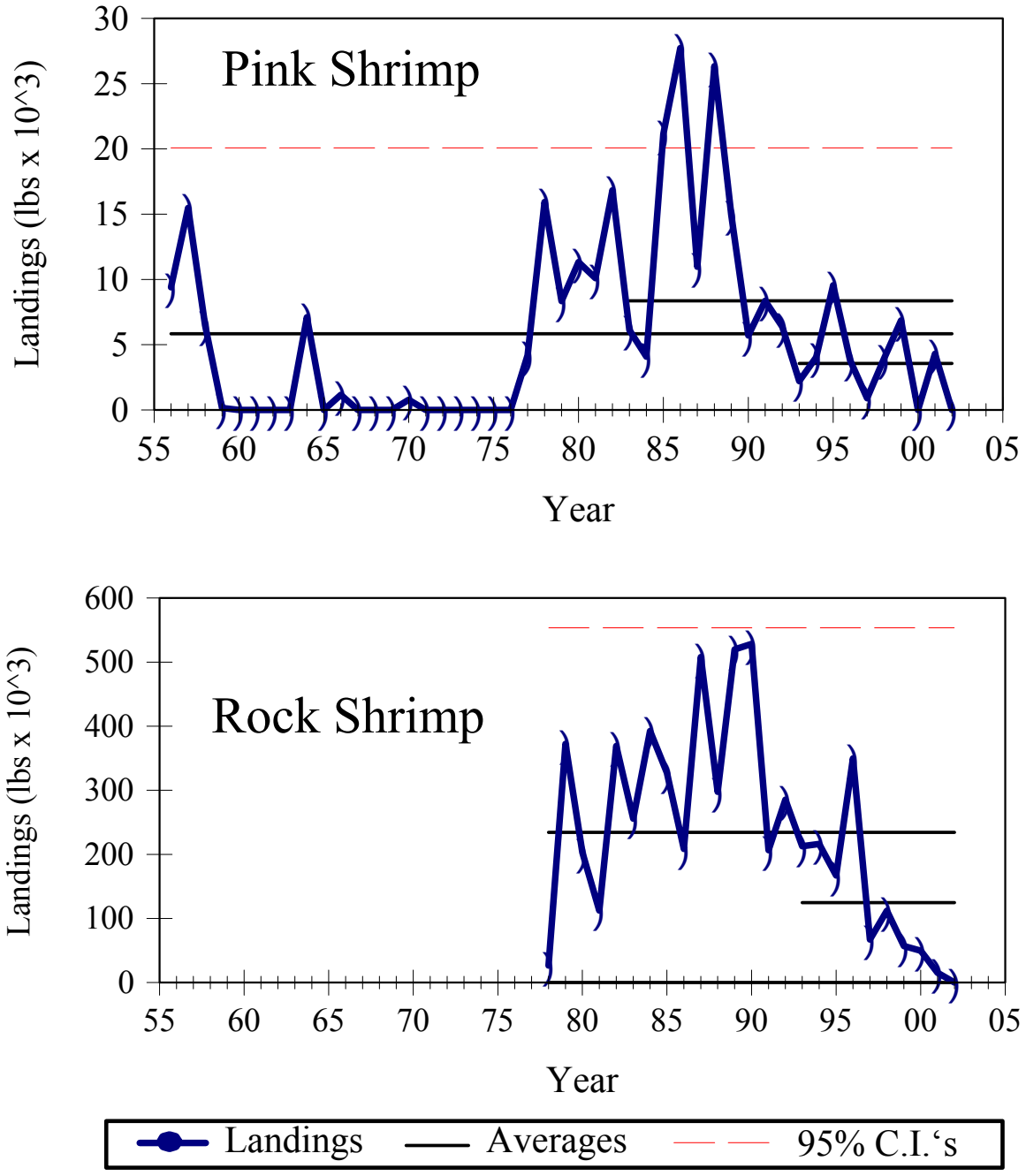


Figure 39. Annual commercial landings for pink and rock shrimp, with associated long-term (1957-2002) average, associated 95% confidence intervals, twenty and ten-year averages. Harvest records of rock shrimp are unavailable prior to 1978.

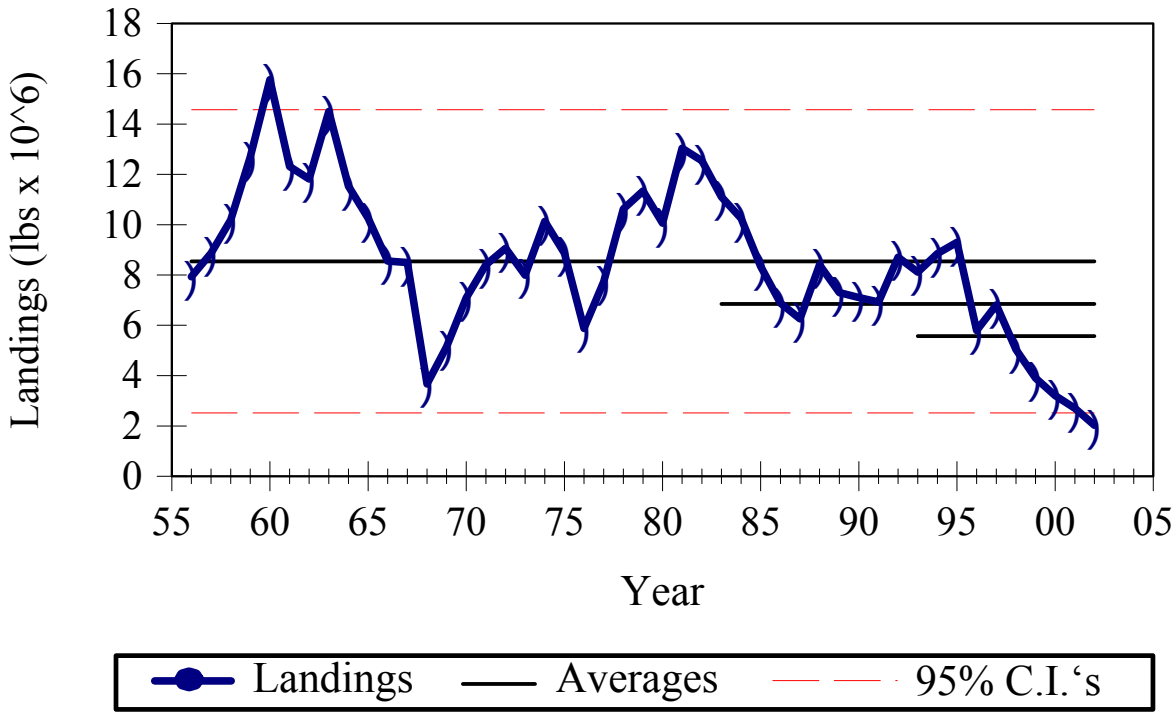


Figure 40. Annual commercial landings for blue crabs, with associated long-term (1957-2002) average, associated 95% confidence intervals, twenty and ten-year averages.

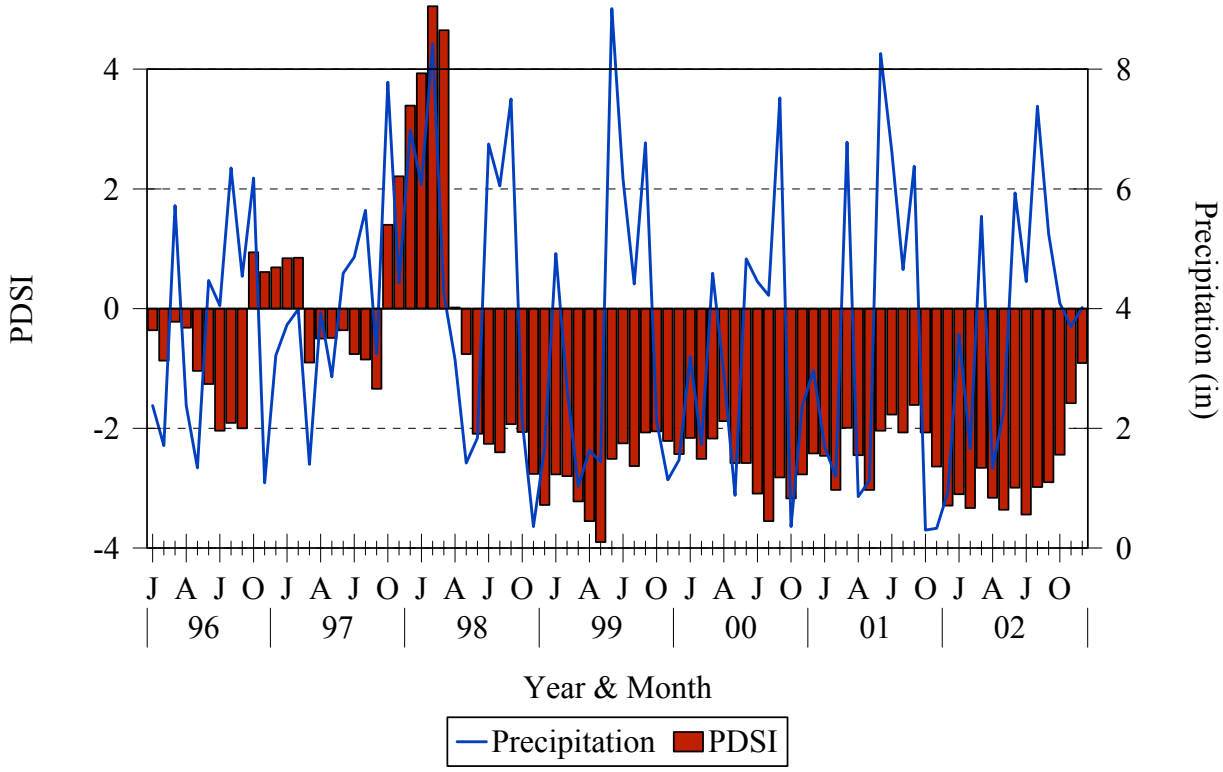


Figure 41. Monthly precipitation and Palmer Drought Severity Index (PDSI) for Georgia's climatic region 9 (Coastal counties) from 1996-2002.

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APPENDICES

Appendix A-1. Summary of Georgia historical landings by broad category (1972-2002).

Year		Hard Clams	Other Finfish	Scallops	Hard Blue Crabs	Whelks	Food Shrimp	Bait Shrimp	Misc. Crustacean & Mollusks	Shad	Offshore Demersals	Pelagics	Oysters
1972	lbs		555,166		9,058,780		4,664,809			346,319	173,829	4,665	152,116
	$$$		86,777		825,211		5,614,712			112,085	81,251	539	86,812
1973	lbs	5,820	506,819		7,984,185		5,338,510			242,887	84,371	4,755	105,998
	$$$	4,510	108,312		968,650		9,343,486			92,094	40,431	599	65,122
1974	lbs		433,901		10,130,822		4,653,108			161,973	125,337	6,193	64,664
	$$$		103,174		1,225,878		5,586,851			62,930	78,729	1,744	36,040
1975	lbs		503,707		8,865,380		5,210,767			183,209	57,381	7,418	44,062
	$$$		134,355		1,154,720		10,484,899			99,745	43,465	1,801	25,613
1976	lbs	10,885	526,296		5,872,611		4,993,351			93,220	173,496	8,489	71,839
	$$$	16,397	155,110		1,087,285		10,878,695			57,535	127,185	3,599	49,240
1977	lbs		372,498		7,721,668		2,938,085		100	119,119	369,906	9,777	87,221
	$$$		127,352		1,632,092		5,842,002		30	85,041	334,832	3,491	75,009
1978	lbs		446,253	86,848	10,628,294		3,644,387			240,029	372,454	40,000	20,938
	$$$		134,040	117,718	1,877,446		11,856,875			156,132	379,707	30,630	18,792
1979	lbs		364,506	32,760	11,337,528		6,242,617		3,029	268,323	162,523	19,976	11,375
	$$$		143,931	45,209	1,983,890		25,149,919		569	226,603	163,984	13,995	11,459
1980	lbs		647,242		10,060,060	184	5,386,930		6,467	188,899	240,009	23,025	33,117
	$$$		315,718		1,964,414	120	17,342,696		1,865	174,470	189,367	13,939	42,112
1981	lbs	5,855	416,390	2,576	13,038,389	6,848	3,167,329		5,917	196,200	224,956	21,663	24,898
	$$$	21,015	203,854	2,576	2,462,704	4,337	10,612,382		5,334	148,100	210,774	11,569	35,715
1982	lbs	9,725	633,976	152,736	12,541,821	85,560	4,307,817		37,516	199,332	126,960	36,211	18,292
	$$$	38,273	305,271	144,596	2,437,269	42,076	19,618,111		26,193	166,268	121,351	49,647	24,016
1983	lbs	3,482	540,742		11,104,160	200,977	4,941,029		37,546	228,105	80,427	5,315	4,427
	$$$	13,965	260,881		2,667,429	88,579	22,334,781		37,595	176,750	95,857	3,497	6,013
1984	lbs	3,474	369,570	223,976	10,228,314	559,629	2,190,024	123,107	57,398	218,008	570,595	59,381	5,644
	$$$	11,869	233,224	131,388	2,239,332	263,558	7,438,035	892,056	48,236	153,317	669,841	61,240	8,590
1985	lbs	6,966	409,612	201,752	8,341,523	203,100	4,530,935	149,129	37,651	243,123	601,624	126,901	36,898
	$$$	25,436	322,317	178,719	1,962,204	95,692	15,979,249	1,173,678	41,803	146,129	771,116	113,799	67,832
1986	lbs	17,220	539,922		6,879,908	123,936	4,806,493	67,528	54,308	158,820	600,712	243,344	3,941
	$$$	52,398	387,035		2,000,785	52,346	21,611,526	552,929	69,735	99,565	853,506	172,968	7,878
1987	lbs	34,151	428,280		6,267,748	934,019	4,665,389	67,645	107,976	291,211	358,953	128,327	9,080
	$$$	156,351	300,660		1,856,647	519,091	16,426,062	692,688	159,528	219,653	498,816	95,037	17,885
1988	lbs	63,988	787,013		8,399,140	1,003,846	4,514,968	60,894	108,951	148,230	248,497	78,871	35,513
	$$$	278,108	372,424		3,007,337	403,949	17,640,973	657,509	154,718	109,739	343,297	81,669	71,145

continued

Appendix A1. Continued.

Year		Hard Clams	Other Finfish	Scallops	Hard Blue Crabs	Whelks	Food Shrimp	Bait Shrimp	Misc. Crustacean & Mollusks	Shad	Offshore Demersals	Pelagics	Oysters
1989	lbs	12,284	307,635		7,296,666	422,893	4,895,800	79,850	108,761	134,318	282,629	22,830	68,081
	$$$	54,679	256,190		2,337,221	208,891	15,708,155	887,470	206,604	122,850	406,720	18,182	137,171
1990	lbs	4,192	236,339		7,105,524	1,018,969	3,810,507	61,506	63,992	94,692	523,906	183,146	71,689
	$$$	22,884	184,299		2,222,868	507,718	14,002,679	678,009	171,809	79,371	730,622	93,035	150,468
1991	lbs	6,241	262,910		6,927,785	881,278	5,825,908	76,380	54,905	80,980	522,658	50,350	84,641
	$$$	32,595	175,652		1,976,309	464,121	20,741,100	856,545	141,924	67,656	747,236	43,727	167,459
1992	lbs	4,815	226,725		8,707,692	456,224	5,056,044	70,175	69,318	97,228	330,216	51,966	85,464
	$$$	25,994	191,104		2,989,219	247,566	18,599,482	784,660	206,580	71,068	455,281	35,732	182,021
1993	lbs	9,162	234,404		8,112,326	396,173	4,938,784	64,582	83,301	63,023	363,925	106,579	35,704
	$$$	43,155	203,289		3,010,039	242,049	17,488,827	618,320	229,072	66,534	541,729	47,905	76,697
1994	lbs	10,824	196,631		8,853,564	672,617	4,581,070	60,833	65,782	75,785	417,159	180,057	13,624
	$$$	73,158	163,725		4,510,691	377,323	19,783,714	562,552	211,057	80,945	655,338	122,826	29,764
1995	lbs	9,763	170,141		9,298,860	557,129	7,255,073	59,753	83,673	172,525	398,103	96,548	6,340
	$$$	64,974	163,436		5,020,608	336,654	27,002,973	572,736	257,288	131,350	698,915	78,981	15,571
1996	lbs	31,647	161,044		5,791,688	425,534	4,132,607	53,798	108,745	152,241	339,553	69,187	4,269
	$$$	194,409	152,500		3,018,151	254,717	16,335,208	519,561	368,962	109,285	576,617	35,166	9,227
1997	lbs	16,281	184,650		6,808,290	621,230	4,543,631	58,376	179,622	125,872	262,831	35,386	7,480
	$$$	114,521	174,552		3,835,798	389,437	22,254,286	590,563	532,564	93,540	443,529	32,290	18,428
1998	lbs	17,416	95,645		5,035,542	582,515	4,370,638	59,887	140,892	136,881	276,170	19,354	6,956
	$$$	122,891	88,690		2,603,991	406,942	19,080,321	634,375	490,948	86,370	502,850	18,189	17,212
1999	lbs	24,912	106,779		3,901,477	591,166	4,380,827	59,918	239,458	45,905	306,919	119,695	6,608
	$$$	153,074	103,670		2,045,645	415,000	18,364,973	665,633	469,301	45,496	607,009	71,030	17,325
2000	lbs	25,352	72,448		3,202,383	421,243	3,516,895	52,363	94,610	58,081	398,833	27,329	3,800
	$$$	212,821	72,298		2,077,436	277,482	17,205,600	565,352	399,445	33,490	791,729	28,285	9,733
2001	lbs	24,872	30,122		2,702,343	325,761	2,698,445	62,759	1,225,170	34,611	451,522	27,351	8,528
	$$$	186,644	30,714		2,500,704	245,330	10,181,393	576,569	496,320	27,729	869,233	23,516	22,254
2002	lbs	48,611	41,310		2,022,074	63,585	3,338,453	44,144	1,552,468	27,699	456,283	69,544	7,996
	$$$	319,412	41,935		1,962,140	49,621	10,937,811	395,008	440,048	22,682	931,940	43,742	19,997
Average	**lbs**	**15,623**	**358,912**	**116,775**	**8,073,482**	**476,856**	**4,540,093**	**71,582**	**123,962**	**159,972**	**314,882**	**60,470**	**37,774**
(72-01)	**$$$**	**83,484**	**188,485**	**103,368**	**2,316,732**	**265,590**	**15,683,666**	**693,400**	**196,978**	**110,061**	**434,344**	**43,621**	**50,087**

ALL SHRIMP WEIGHTS ARE IN POUNDS OF TAILS.
CLAM, OYSTER, WHELK AND SCALLOPS ARE IN POUNDS OF RAW MEATS.
ALL CRABS AND FISHES ARE IN POUNDS OF WHOLE ANIMALS.
UPDATED 03/27/2003

Appendix A-2. Historical Georgia white shrimp landings (lbs, heads-off) by month and calendar year (1956-present)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1956							335,015	359,088	654,129	1,016,079	611,216	267,865	3,243,392
1957	24,256	20,367	40,057	65,588	291,659	129,375	256,593	666,904	859,666	1,007,140	484,023	425,061	4,270,689
1958	64,675	13,110	8,983	5,363	12,424	11,872	11,762	449,055	578,412	947,240	582,675	384,047	3,069,618
1959	34,133	20,788	18,918	23,424	74,471	42,875	107,888	306,193	734,170	915,725	639,040	469,534	3,387,159
1960	107,364	23,698	29,361	65,164	114,105	290,761	27,283	244,609	1,026,455	1,343,768	846,921	798,481	4,917,970
1961	97,915	30,878	25,001	21,686	39,934	52,376	88,504	348,549	724,479	872,226	933,140	471,111	3,705,799
1962	167,113	11,849	29,059	23,701	106,013	69,744	47,185	312,322	848,246	837,045	683,258	450,953	3,586,488
1963	54,861	600	6,318	8,127	15,480	30,549	7,023	173,124	477,305	710,754	489,700	296,109	2,269,950
1964	7,763	190	15,501	2,233	13,964	35,501	11,915	171,012	721,031	687,154	459,382	415,626	2,541,272
1965	112,399	11,938	56,939	44,696	291,927	238,473	32,248	412,530	997,606	954,994	628,272	533,700	4,315,722
1966	65,401	10,519	22,829	9,353	31,228	7,737	0	233,819	563,160	755,599	561,744	502,431	2,763,820
1967	35,524	2,935	19,159	8,672	123,975	48,788	10,957	56,455	953,534	886,715	643,167	343,101	3,132,982
1968	84,401	2,683	0	839	30,274	30,950	41,237	533,111	1,600,672	1,081,626	998,278	664,754	5,068,825
1969	77,346	1,400	0	0	4,458	26,458	30,060	497,516	1,542,677	1,171,358	904,505	644,501	4,900,279
1970	26,752	10,721	2,731	1,256	10,009	16,029	6,772	234,523	871,429	768,022	739,407	542,966	3,230,617
1971	126,728	0	0	0	148,306	264,922	238,520	363,569	1,010,627	1,392,340	878,392	582,823	5,006,227
1972	55,288	13,672	5,270	79,892	519,174	383,596	90,896	235,276	636,450	674,533	652,255	260,000	3,606,302
1973	63,602	49,369	723	2,752	186,070	584,284	203,948	278,056	1,292,167	1,003,193	665,815	630,794	4,960,773
1974	53,005	0	0	68,691	454,980	253,078	101,664	157,065	706,049	723,638	573,978	682,137	3,774,285
1975	53,544	6,780	6,137	28,864	483,687	462,616	102,394	138,670	989,584	895,837	659,139	552,776	4,380,028
1976	194,332	10,286	0	38,785	498,655	297,720	58,072	74,975	776,914	978,835	614,167	280,940	3,823,681
1977	25,124	212	1,504	0	3,825	0	0	56,860	508,875	370,515	372,190	603,613	1,942,718
1978	220,117	5,905	585	129	3,502	4,484	7,974	231,562	643,076	712,842	653,911	346,587	2,830,674
1979	225,726	70,089	9,122	115,986	376,609	166,476	23,067	212,150	1,181,702	1,302,655	762,841	696,884	5,143,307
1980	255,999	4,233	535	29,550	504,911	459,435	21,499	178,683	846,248	608,723	468,844	662,089	4,040,749
1981	165,129	550	247	359	2,959	1,704	4,101	107,567	483,393	743,923	618,069	481,201	2,609,202
1982	48,213	2,208	8,156	66,072	312,309	263,575	21,432	215,745	757,803	673,995	321,788	493,715	3,185,011
1983	555,538	215,911	3,047	5,958	298,292	422,494	40,417	112,994	520,184	596,921	613,037	487,098	3,871,891
1984	211,782	805	1,062	687	8,244	22,394	3,808	21,136	99,935	188,843	342,927	143,385	1,045,008
1985	16,137	3,862	208	864	34,749	8,647	3,370	81,902	474,363	719,420	663,425	933,437	2,940,384
1986	352,977	8,806	1,698	53,888	342,556	101,036	24,179	219,196	530,799	645,661	577,871	700,111	3,558,778
1987	512,463	37,669	3,192	11,194	398,333	458,592	56,271	240,631	936,537	527,261	352,126	314,700	3,848,969
1988	453,460	38,294	3,930	10,003	180,396	162,125	43,260	126,168	678,787	610,622	688,721	675,786	3,671,552
1989	32,358	3,231	3,392	42,452	432,350	583,880	95,756	215,730	468,808	639,008	519,600	532,772	3,569,337

continued

Appendix A-2. Continued.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	15,256	1,172	2,112	870	8,048	67,510	34,231	151,502	415,027	866,235	497,669	461,381	2,521,013
1991	299,504	150,420	4,067	461,305	995,807	303,656	68,601	450,845	851,579	420,550	430,366	387,215	4,823,915
1992	343,705	68,739	3,183	56,508	624,460	768,759	96,580	120,389	651,727	595,678	324,836	622,740	4,277,304
1993	176,823	81,395	3,127	17,449	474,904	758,268	46,640	214,348	561,424	484,597	360,488	485,824	3,665,287
1994	313,412	8,237	1,144	62,048	233,728	169,177	55,108	417,766	651,953	842,897	515,830	497,698	3,768,998
1995	511,888	70,630	2,789	47,693	959,737	677,443	56,128	453,724	1,380,332	880,324	359,862	724,540	6,125,090
1996	320,334	10,327	6,294	3,075	140,446	154,794	45,601	95,009	456,512	622,766	572,808	548,837	2,976,803
1997	85,099	7,296	7,535	91,295	346,476	192,438	50,787	226,555	706,261	833,676	534,570	787,672	3,869,660
1998	344,550	5,385	4,363	41,057	638,104	324,326	45,916	167,046	754,472	689,186	287,357	324,231	3,625,993
1999	321,239	13,334	2,538	141,944	342,792	178,149	69,642	78,694	642,223	985,281	370,502	321,768	3,468,106
2000	165,950	13,114	5,630	86,086	520,561	240,770	64,426	142,001	673,449	426,766	317,983	329,742	2,986,478
2001	27,637	6,664	1,373	0	1,245	22,809	55,353	111,333	249,937	407,645	410,144	443,786	1,737,926
2002	497,920	22,954	1,990	165,474	407,309	201,108	149,866	153,020	463,751	256,514	150,982	245,067	2,715,955
2003	84,822	317	1,131	3,605									89,875
Mean 56-02	174,016	23,766	7,892	43,718	261,814	217,212	63,701	235,085	747,956	771,837	560,366	498,970	3,590,978
Mean 83-92	277,902	38,412	3,134	64,993	369,427	290,919	55,297	189,999	608,403	611,993	444,555	498,390	3,453,422
Mean 93-02	276,485	23,934	3,678	65,612	406,530	291,928	63,947	205,950	654,031	642,965	388,053	470,917	3,494,030

* state and federal waters closed to shrimping april and May 2002

Appendix A-3. Historical Georgia brown shrimp landings (lbs, heads-off) by month and calendar year (1956-present).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1956							287,928	393,854	165,822	111,725	103,463	0	1,062,792
1957	8,300	0	0	0	0	325,243	438,032	126,469	12,050	2,000	0	0	912,094
1958	0	0	0	0	193	163,296	1,160,548	281,536	504,357	0	950	0	2,110,880
1959	0	0	0	0	277	330,201	525,558	247,822	29,396	0	0	0	1,133,254
1960	0	0	0	0	0	17,350	663,305	374,425	196,525	22,725	0	0	1,274,330
1961	0	0	0	0	0	772	117,044	96,675	133,325	0	0	0	347,816
1962	0	0	0	0	0	521,938	759,367	410,934	145,262	0	0	0	1,837,501
1963	0	0	0	0	0	153,200	550,550	267,208	204,644	0	0	0	1,175,602
1964	0	0	0	0	187	65,552	783,967	320,109	51,670	0	0	0	1,221,485
1965	0	4,820	11,417	2,765	6,099	279,182	622,029	123,968	39,580	93,838	19,681	0	1,203,379
1966	0	0	0	0	330	75,440	610,683	313,639	268,458	109,237	0	0	1,377,787
1967	0	0	283	0	375	232,036	493,821	368,373	31,494	0	0	0	1,126,382
1968	0	0	0	1,428	0	24,448	278,073	132,733	16,382	0	0	0	453,064
1969	0	0	0	0	0	20,496	270,639	225,455	42,864	0	0	0	559,454
1970	0	0	0	0	243	83,289	292,453	134,276	102,841	20,700	0	0	633,802
1971	0	0	0	0	0	23,907	280,934	260,909	150,297	0	0	0	716,047
1972	0	0	0	0	0	27,847	354,419	313,111	363,130	0	0	0	1,058,507
1973	0	0	0	0	0	60,389	163,245	133,258	20,845	0	0	0	377,737
1974	0	0	0	0	0	94,267	377,663	218,193	144,000	44,700	0	0	878,823
1975	0	0	0	0	0	227,499	395,134	154,447	27,884	0	0	0	804,964
1976	0	0	0	0	0	302,037	403,948	342,853	120,832	0	0	0	1,169,670
1977	0	0	0	0	0	143,881	557,323	277,440	12,527	0	0	0	991,171
1978	0	0	0	0	7	107,619	386,238	256,913	20,390	0	0	0	771,167
1979	0	0	0	0	0	134,443	426,857	152,499	3,183	1,691	0	0	718,673
1980	5,105	2,270	583	0	0	141,192	627,336	319,067	30,464	0	286	0	1,126,303
1981	0	0	0	0	50	3,648	225,780	164,021	36,409	0	0	0	429,908
1982	0	0	0	0	0	204,621	422,883	106,633	2,727	0	0	0	736,864
1983	0	0	0	1,143	46	48,862	448,710	218,418	91,472	0	0	0	808,651
1984	0	0	0	0	30	76,497	303,840	197,064	75,004	86,909	1,348	841	741,533
1985	0	0	0	0	166	171,178	614,546	331,786	118,050	4,647	0	1,748	1,242,121
1986	173	0	0	0	4	275,647	417,648	82,203	31,112	5	0	0	806,792
1987	0	0	0	0	31	68,525	192,369	35,808	792	0	0	209	297,734
1988	0	0	0	0	0	9,864	200,725	164,157	29,069	115	0	0	403,930
1989	1233	1341	625	370	0	179,429	532,213	96,557	2,155	985	1302	2411	818,621

continued

Appendix A-3. Continued.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	3,134	2,237	111	623	1,893	382,445	268,116	63,978	17,623	1,614	1,797	1,484	745,055
1991	3,148	548	1,597	1,220	1,850	297,527	362,971	57,177	2,200	3,197	3,337	0	734,772
1992	2,558	465	684	286	0	43,284	228,334	146,443	1,394	6,523	1,476	2,378	433,825
1993	0	557	0	0	0	185,954	634,384	182,759	11,697	585	0	0	1,015,936
1994	0	4,896	431	406	1,603	232,928	245,093	54,703	426	380	1,595	530	542,991
1995	481	2,035	0	0	686	498,958	321,096	63,790	116	0	0	0	887,162
1996	0	0	0	0	0	122,006	454,586	173,913	8,993	4,150	86	0	763,734
1997	0	0	0	0	736	94,715	338,651	148,906	5,065	465	0	0	588,538
1998	0	0	0	0	130	201,618	231,455	159,341	19,082	0	0	0	611,626
1999	0	0	0	0	57	330,435	377,816	109,873	21,907	0	0	0	840,088
2000	0	0	0	0	4,039	168,319	224,470	83,256	0	0	0	0	480,084
2001	0	0	0	0	1,169	165,091	473,105	105,825	140,599	3939	0	0	889,728
2002	0	0	0	326	8,747	386,479	169,106	41,168	9,041	0	0	0	614,867
2003													
Mean 56-02	524.6	416.7	342.0	186.2	629.3	167,468.6	415,212.6	192,211.6	73,684.1	11,066.6	2,879.2	204.3	861,218.0
Mean 83-02	536.4	604.0	172.4	218.7	1,059.4	196,988.1	351,961.7	125,856.3	29,289.9	5,675.7	547.1	480.1	713,389.4
Mean 93-02	48.1	748.8	43.1	73.2	1,716.7	238,650.3	346,976.2	112,353.4	21,692.6	951.9	168.1	53.0	723,475.4

Appendix A-4. Historical Georgia pink shrimp landings (lbs, heads-off) by month and calendar year (1956-present).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1956	?	?	?	?	?	?	0	2,550	3,555	3,300	0	0	9,405
1957	0	0	4,331	4,800	0	6,350	0	0	0	0	0	0	15,481
1958	0	0	0	0	1,775	3,771	0	0	0	0	950	0	6,496
1959	0	0	0	0	0	150	0	0	0	0	0	0	150
1960	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	7,100	0	0	0	0	0	0	0	0	0	7,100
1965	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	1,149	0	0	0	0	1,149
1967	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	775	0	0	0	0	0	0	0	775
1971	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	1,770	0	0	2,426	0	0	0	0	0	0	0	4,196
1978	0	0	0	0	4,347	5,972	14	5,378	225	0	0	0	15,936
1979	0	0	0	7,043	0	0	0	0	1,292	0	0	0	8,335
1980	0	4,448	260	0	0	2,058	0	0	3,711	346	507	0	11,330
1981	20	0	1,392	259	690	1,200	0	2,953	2,534	0	827	213	10,088
1982	10	928	430	6,817	2,160	154	0	3,214	0	444	1,543	1,132	16,832
1983	0	272	379	0	0	0	0	0	888	1,349	2,398	841	6,127
1984	455	1,058	88	142	363	145	0	0	0	0	421	1,406	4,078
1985	0	0	0	0	1,774	359	0	0	3,492	6,401	9,113	0	21,139
1986	2,312	0	0	5,267	5,898	448	0	1,183	1,641	4,556	4,177	2,251	27,733
1987	0	1,045	1,541	413	402	64	80	0	896	2,406	1,856	2,267	10,970
1988	227	728	1,069	3,537	7,487	5,074	188	2,206	526	133	643	4,524	26,342
1989	3,568	1,845	893	1,095	0	0	0	965	436	1,164	1,784	3,231	14,981

continued

Appendix A-4. Continued.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	1,388	889	48	263	813	33	0	291	98	691	634	554	5,702
1991	1,295	235	491	515	390	43	966	1,446	1,244	959	780	0	8,364
1992	32	199	296	123	0	2,557	52	290	247	1,401	604	577	6,378
1993	0	842	234	0	0	0	160	379	347	252	0	0	2,214
1994	962	915	184	173	30	0	31	564	156	164	631	226	4,036
1995	233	863	0	125	0	0	0	232	1,827	1,704	0	4,561	9,545
1996	0	0	115	0	0	51	11	0	0	0	167	3,454	3,798
1997	0	899	0	0	0	0	0	0	0	0	0	0	899
1998	0	0	1,828	0	7	0	0	0	0	0	1,244	860	3,939
1999	0	0	0	4,989	0	0	0	91	1,778	0	0	0	6,858
2000	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	2,936	0	0	710	0	0	0	649	0	0	4,295
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003													
Mean 56-02	228.3	368.2	513.4	773.1	637.8	633.5	32.0	487.0	529.6	551.5	601.7	555.3	5,844.1
Mean 83-02	523.6	489.5	505.1	832.1	858.2	474.2	74.4	382.4	678.8	1,091.5	1,222.6	1,237.6	8,369.9
Mean 93-02	119.5	351.9	529.7	528.7	3.7	76.1	20.2	126.6	410.8	276.9	204.2	910.1	3,558.4

Appendix A-5. Historical Georgia rock shrimp landings (lbs, heads-off) by month and calendar year (1978-present).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1978	0	1,645	0	0	9	4,149	0	6,200	11,573	3,034	0	0	26,610
1979	0	0	519	6,551	59	8,029	109,794	173,444	2,987	37,898	33,018	0	372,299
1980	57,456	56,090	21,264	132	43	1,469	564	4,326	283	59,419	0	2,126	203,172
1981	5,832	0	80,201	21,623	0	0	0	0	65	4,815	0	0	112,536
1982	6,488	39,688	17,038	1,038	2,737	0	155	42,933	0	32,733	179,489	46,810	369,109
1983	0	13,856	9,495	0	0	0	10,849	1,021	25,448	60,855	75,191	59,105	255,820
1984	16,228	30,381	4,412	2,209	16,242	19,442	3,223	32,147	55,529	110,468	26,196	76,122	392,599
1985	12,722	9,783	0	0	14,057	0	0	720	115,749	113,273	55,136	5,866	327,306
1986	615	90	0	0	0	2,212	2,896	13,082	20,314	62,373	64,772	42,159	208,513
1987	730	11,978	20,132	41	1,728	0	267	0	45,888	115,316	200,618	111,018	507,716
1988	16,019	32,680	36,755	1,383	0	1,159	213	19,012	44,023	36,294	42,573	67,607	297,718
1989	82,135	44,358	23,701	8,578	0	0	0	63,000	113,707	49,696	80,591	53,901	519,667
1990	54,261	45,278	5,414	15,324	38,799	7,442	0	89,811	69,606	118,378	69,118	14,869	528,300
1991	19,947	12,058	6,864	3,439	0	0	18,183	55,602	67,692	7,854	14,898	0	206,537
1992	787	1,812	6,130	2,457	0	1,325	23,798	114,468	87,714	33,591	9,536	3,645	285,263
1993	0	6,869	269	0	0	0	8,731	48,007	75,334	73,592	0	0	212,802
1994	1,938	38,190	8,943	12,175	1,725	0	37	42,194	62,392	36,100	4,170	8,555	216,419
1995	5,032	8,947	0	0	1,987	0	0	74,596	42,423	19,200	0	14,733	166,918
1996	0	2,140	1,436	0	9,331	112,633	50,654	49,304	40,470	34,660	28,234	20,805	349,667
1997	0	13,145	7,171	6,990	0	0	0	30,057	722	9,011	0	0	67,096
1998	0	0	11,669	0	0	0	0	8,765	33,377	0	31,958	26,448	112,217
1999	0	2,912	0	4,179	0	0	0	12,090	11,374	26,537	0	0	57,092
2000	0	988	1,436	0	391	287	12,614	0	0	18,036	11,469	4,520	49,741
2001	0	0	3,887	0	0	11,476	0	0	0	0	0	0	15,363
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003													
Mean 78-02	11,208	14,916	10,669	3,445	3,484	6,785	9,679	35,231	37,067	42,525	37,079	22,332	234,419
Mean 93-02	697	7,319	3,481	2,334	1,343	12,440	7,204	26,501	26,609	21,714	7,583	7,506	124,732

Appendix A-6. Historical Georgia hard blue crabs landings (1000's of lbs) by month and calendar year (1956-present).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
1956	35	493	569	900	1062	1020	901	733	827	633	497	258	7,928
1957	413	477	448	775	969	1042	999	964	1029	798	646	307	8,868
1958	189	77	879	861	1575	1252	1213	1218	1034	931	682	275	10,185
1959	296	398	812	1378	1163	1354	1435	1438	1322	1408	1089	591	12,683
1960	724	962	782	1564	1743	1611	1434	1775	1491	1575	1472	633	15,766
1961	903	989	965	1213	1212	1207	1167	1263	1015	1011	760	610	12,312
1962	405	957	878	960	1042	1054	1177	1358	1211	1227	915	634	11,816
1963	840	734	1493	1571	1363	1338	1496	1221	977	1401	1466	599	14,500
1964	484	788	907	906	1249	894	1106	1347	954	1058	936	903	11,532
1965	490	245	543	733	815	1204	1311	1305	1195	934	952	531	10,258
1966	318	298	749	623	766	1061	860	1228	1002	1042	445	166	8,556
1967	653	427	1008	640	808	552	814	1121	915	858	488	212	8,497
1968	213	160	354	512	208	47	261	365	597	571	262	118	3,669
1969	62	132	177	333	436	757	933	626	619	539	414	119	5,147
1970	20	272	343	546	589	828	961	1088	724	924	616	181	7,092
1971	431	711	937	784	499	949	1023	898	904	670	349	255	8,409
1972	529	330	949	707	566	902	1046	1077	1141	943	585	285	9,059
1973	401	233	517	628	806	1017	1039	905	948	760	514	227	7,994
1974	623	401	701	948	909	743	1029	1171	1034	1309	927	336	10,131
1975	738	466	401	581	852	1017	1011	991	975	994	666	175	8,865
1976	46	276	308	540	694	935	913	655	744	384	306	72	5,873
1977	17	45	162	502	887	954	982	1136	1010	907	888	232	7,722
1978	18	11	397	666	876	1363	1448	1531	1377	1401	1033	510	10,628
1979	59	105	852	1113	1200	1207	1403	1537	1411	1577	720	156	11,338
1980	189	90	194	572	975	1464	1415	1420	1480	1194	767	300	10,060
1981	85	294	741	1116	1239	1429	1551	1580	1685	1829	1054	435	13,038
1982	250	898	652	857	1059	1471	1526	1361	1414	1599	1024	427	12,537
1983	222	156	174	468	830	1316	1488	1607	1597	1701	1055	489	11,104
1984	28	264	353	730	1123	1362	1161	1264	1112	1446	979	434	10,255
1985	177	257	325	625	798	1030	1219	1142	872	1061	670	166	8,342
1986	54	190	295	639	771	1044	978	806	869	724	358	152	6,880
1987	45	39	100	246	562	938	857	823	953	876	503	313	6,256
1988	115	184	289	434	551	1185	1151	1083	1300	953	831	325	8,400
1989	451	228	139	318	646	958	918	1027	961	777	722	153	7,298

continued

Appendix A-6. Continued.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	118	216	256	426	714	1005	896	870	822	1107	442	234	7,105
1991	166	158	169	438	580	888	842	823	784	1111	628	342	6,927
1992	241	254	175	372	632	986	1002	1132	1113	1520	991	291	8,709
1993	234	106	118	228	659	839	1031	1149	1115	1223	864	547	8,113
1994	153	467	264	650	515	954	971	935	1301	1488	905	252	8,854
1995	146	85	101	248	467	820	1051	1098	1675	1920	1252	437	9,299
1996	81	115	119	283	608	668	621	648	867	824	660	298	5,791
1997	167	155	156	479	610	748	845	918	982	916	546	286	6,808
1998	223	141	108	334	371	450	598	660	761	841	405	146	5,038
1999	75	66	83	209	218	320	426	437	582	742	419	323	3,901
2000	185	129	117	254	273	335	303	320	411	420	337	118	3,202
2001	36	83	55	358	503	399	293	273	243	219	158	82	2,702
2002	43	44	55	139	180	234	264	273	260	259	173	102	2,026
2003	34	45	24										
Mean 56-03	264	305	442	647	791	961	1008	1034	1013	1034	710	320	8,542
Mean 93-02	134	139	118	318	440	577	640	671	820	885	572	259	5,573
Mean 83-02	148	167	173	394	581	824	846	864	929	1006	645	275	6,851

Appendix B. The 11 criteria established in 1979 to manage marine wildlife in Georgia, Official Code of Georgia Annotated (O.C.G.A.) 27-4-130.

Factors governing the decision to open or close salt waters. Public notice of opening or closing of waters.

(a) When this article provides that a determination to open or close any of the salt waters of this state, or to allow or disallow the use of certain equipment, is to be made in accordance with current, sound principles of wildlife research and management, such determination shall be made only after a consideration of the following:

(1) The abundance and size of the seafood species in question;

(2) The number of persons licensed to take seafood;

(3) The department´s forecast for commercial catches;

(4) The quantity, in terms of pounds, and the value, in terms of dollars, of anticipated commercial landings;

(5) The available climatological and meteorological data and influence on water temperature;

(6) The life history of each seafood species in question;

(7) The coastal ecological features directly related to the life history of such species;

(8) Anticipated amount and location of the demand for a seafood species;

(9) The resources which influence or are influenced by the abundance of and the spatial and temporal variations in seafood species;

(10) The water quality and other biogenic factors which influence sound wildlife research and management; and

(11) Any other factors based on recent scientific and technological advances which could result in a better management of Georgia´s seafood resources.

(b) Public notice of the opening or closing of salt waters as provided in this article shall be given by posting a notice of all such openings at the courthouse in each coastal county and by such other means as may appear feasible to inform interested persons of the opening or closing. Such notices shall be posted at least 24 hours prior to any action taken pursuant to this Code section. (Code 1933, § 45-900, enacted by Ga. L. 1979, p. 678, § 35; Ga. L. 1982, p. 3, § 27.)

Appendix C. Lengths versus mean count size for Georgia white shrimp. Length taken from tip of rostrum to tip of telson. Taken from Stevens, S.A. and A. Kvaternik. Length-weight relationships for white shrimp in Georgia waters. 7pp. *Unpublished manuscript*.

Length (mm)	Heads-On No./lb	Length (mm)	Heads-On No./lb	Length (mm)	Heads-On No./lb	Length (mm)	Heads-On No./lb	Length (mm)	Heads-On No./lb	Length (mm)	Heads-On No./lb
51	480	76	140	101	58	126	30	151	17	176	11
52	452	77	135	102	57	127	29	152	17	177	10
53	426	78	130	103	55	128	28	153	16	178	10
54	403	79	125	104	53	129	27	154	16	179	10
55	380	80	120	105	52	130	27	155	16	180	10
56	360	81	115	106	50	131	26	156	15	181	10
57	341	82	111	107	49	132	26	157	15	182	10
58	323	83	107	108	48	133	25	158	15	183	9
59	306	84	103	109	46	134	24	159	14	184	9
60	291	85	99	110	45	135	24	160	14	185	9
61	276	86	96	111	44	136	23	161	14	186	9
62	263	87	93	112	42	137	23	162	14	187	9
63	250	88	89	113	41	138	22	163	13	188	9
64	238	89	86	114	40	139	22	164	13	189	8
65	227	90	83	115	39	140	21	165	13	190	8
66	217	91	81	116	38	141	21	166	13	191	8
67	207	92	78	117	37	142	20	167	12	192	8
68	198	93	75	118	36	143	20	168	12		
69	189	94	73	119	35	144	20	169	12		
70	181	95	71	120	34	145	19	170	12		
71	173	96	68	121	33	146	19	171	12		
72	166	97	66	122	33	147	18	172	11		
73	159	98	64	123	32	148	18	173	11		
74	152	99	62	124	31	149	18	174	11		
75	146	100	60	125	30	150	17	175	11		

Appendix D. Season opening and closing dates for commercial shrimp and crab/whelk trawling in state territorial waters and sounds.

Commercial Food Shrimp Trawling					Crab/Whelk Trawling (4-inch mesh)	
State Territorial Waters (Beaches to 3 miles)			Sounds		State Territorially waters (0-3 nm)	
License Year	Opening	Closing	Sounds		Opening	Closing
1977-78	07/06/77	02/08/78	N/A		N/A	N/A
1978-79	06/26/78	01/01/79[1]	N/A		N/A	N/A
		02/01/79[2]				
1979-80	06/19/79	01/18/80	N/A		N/A	N/A
1980-81	06/10/80	01/15/81	N/A		*	*
1981-82	06/22/81	01/15/82	N/A		01/01/82	04/10/82
1982-83	06/01/82	02/28/83	N/A		01/27/83	05/01/83
1983-84	06/08/83	12/31/83	11/15,18,22,25,29, 12/2,6,9,13,16		02/15/84	05/09/84
1984-85	06/22/84	12/31/84	N/A		01/01/85	05/03/85
1985-86	07/01/85	01/31/86	12/2,7,10,13		02/21/86	05/07/86
1986-87	06/09/86	01/17/87	12/20/86		02/03/87	05/15/87
1987-88	06/04/87	02/29/88	N/A		03/01/88	04/30/88
1988-89	06/13/88	02/28/89	11/7-12		03/01/89	04/30/89
1989-90	06/01/89	12/31/1989**	11/9-11		01/17/90	05/12/90
1990-91	06/11/90	02/28/91	N/A		01/01/91	04/24/91
1991-92	06/01/91	02/29/92	N/A		01/01/92	04/30/92
1992-93	06/08/92	02/17/93	N/A		01/01/93	04/30/93
1993-94	06/01/93	01/21/94	N/A		01/01/94	04/30/94
1994-95	06/20/94	7/23--8/31/94 [3]	N/A		01/01/95	04/30/95
		01/16/95 [4]				
		02/13/95				
1995-96	06/01/95	08/01/95 [5]	N/A		01/01/96	04/30/96
		12/31/95 [5]				
		01/10/96				
1996-97	06/24/96	01/22/97	N/A		01/01/97	04/19/97
1997-98	06/12/97	01/24/98	N/A		01/01/98	04/30/98
1998-99	05/26/98	02/04/99	N/A		01/01/99	04/30/99
1999-2000	05/26/99	02/01/00	N/A		12/20/99	04/07/00
2000-01	05/24/00	12/31/00	N/A		12/21/00	04/27/01
2001-02	06/25/01	01/11/02 [6]	N/A		12/26/2001[7]	04/26/02
		02/22/02				
2002-03	06/12/02	01/18/03	N/A		01/29/03[7]	04/25/03

**EEZ closed April 3 - June 1, 1990.

[1]North of the Hampton River closed.

[2]South of the Hampton River closed.

[3] Altamaha Channel closed (July 23 – Aug. 31 1994) due to flooding from tropical storm "Alberto". Reopened Sept. 1.

[4]Altamaha Channel closed January 16, 1995 -- small shrimp.

[6]Altamaha Channel closed January 11, 2002 -- small shrimp.

[7]Whelk opening only -- low abundance of blue crabs.

Appendix E. A chronology of management actions from March 2000 to February 2003.

MARCH 2000

03/16 DR. Richard Lee and Keith Maruya of Skidaway Institute of Oceanography gave a talk on crab disease and mortality at Coastal Resources Division.

APRIL

04/07 The 2000 Commercial Whelk season closed in state waters at 8:00 p.m.

MAY

05/16 Staff attended the Commercial Food Shrimp Advisory meeting held at Holton's seafood in Midway Georgia.

05/24 Georgia's 2000-2001 Commercial shrimp season opened in state waters at 7:00 a.m.

JUNE

06/11-13 Staff attended a South Atlantic Fisheries Marine council meeting in Islamorada, Florida.

JULY

07/03 National Marine Fisheries Service proposes special Management Zones off Georgia.

07/18 South Carolina DNR reported Black Gill disease in their commercial trawls off Hilton Head.

07/20 In late July SEAMAP group found black gill shrimp in samples from offshore Georgia and Florida.

AUGUST

08/16 Randy Manning and Keith Maruya State toxicologists talk to CRD staff about the Hercules/toxophene superfund site.

08/30 No report of Black Gill Disease in shrimp samples taken in state waters.

SEPTEMBER

09/12 National Marine Fisheries announces a Control Date for the South Atlantic Penaeid Shrimp Fishery.

09/14 Georgia DNR personnel observed black gill in 17.1% of shrimp sampled coastwide.

OCTOBER

10/03 CRD staff and biologists conducted the annual emergency ON-CALL workshop.

10/05 Staff attended the Blue Crab Issues Subcommittee meeting, issues discussed conducting BCISC business, ACCSP Project Updates, Landings, Assessment and Hematodinium updates as well as Legislative Reviews and Sponge Crab issues.

10/07 CRD held its annual Coast Fest activities for the general public at Coastal Resources Headquarters in Brunswick.

10/16 National Marine Fisheries announced new Special Management Zones off Georgia.

10/24 Staff attended the Food Shrimp Issues Subcommittee meeting to report on Landings, and Assessment, Black Gill Update, South Carolina Viral Research, BRD Permits Issues during 2000, BRD Testing Protocol Changes, SAFMC – night trawling update Industry Newsletter, Reporting Issues, Law and Subcommittee Vacancies.

NOVEMBER

11/02 South Carolina staff arrived to collect shrimp for virus and DNA testing.

11/08-09 CRD's Federal Aid Coordinator attended the SAFMC meeting held in Charleston, South Carolina.

11/14 Staff gave presentation to Brunswick Kiwanis Club.

11/27-28 Staff attended crustacean and trawl workshop meeting in Charleston, South Carolina.

DECEMBER

12/11-12 ACCSP - -Subcommittee Meeting in St. Petersburg, FL.

12/13 CFAC Meeting held at Coastal Resources Division, Brunswick.

12/31 Food shrimping closed on December 31, 2000. It was closed to all user groups and gears-- commercial and recreational, trawl, cast net and beach seines--due to low over-wintering white shrimp stocks.

JANUARY 2001

01/30-2/1 Staff attended the AFS Meeting – GA Chapter in Athens Ga.

01/19 Staff attended a Permit Coordination Meeting at CRD.

FEBRUARY

02/19 Staff attended a Sediment Contamination Meeting conducted by Herb Windom and Keith Maruya.

02/20 Staff conducted phone call to all state bait shrimp dealers to assess the status of the stock.

02/21 Staff attended the Southern Division meeting of the AFS held in Jacksonville, Florida.

02/22 Governor Roy Barnes requested a Disaster Declaration from the Small Business Administration for Georgia's failing shrimp industry. It was granted soon after.

MARCH

03/4 Bait shrimping closed on March 4, 2001 for both commercial and recreational user groups, and all gear types.

03/7-8 Staff attended the Annual SAFMC meeting held on Jekyll Island.

03/13 Food shrimping in the federal waters of the Exclusive Economic Zone (EEZ) closed in Georgia and South Carolina.

03/20 Staff conducted BCISC Meeting in Midway where Hematodinium, Disaster Declarations, Term Limits for Lottery, Sunset for Violations Point System, Reporting Update and Requirement Changes and Landing and Assessment Updates were discussed.

03/28 CRD personnel conducted Disaster Declaration Meeting – UGA-MAREX.

APRIL

04/12 Staff collected crab samples from the Doboy Sound System for virus test analysis.

04/16 Personnel conducted recovery trawls coordinated with US Coast Guard Station Brunswick.

04/27 Whelk/crab trawling closed on April 27, 2001.

MAY

05/17 Jack Blanton of the Skidaway Institute of Oceanography came to CRD to talk about ongoing research being conducted at the Institute.

05/22 Staff conducted bait zone checks with industry personnel in offshore waters of Sapelo Sound.

05/23 Staff attended the CFAC Meeting held in Midway.

05/25 Bait shrimping re-opened for commercial and recreational bait collection.

05/29 More spot checks were conducted with shrimp industry representatives off St. Simons and Cumberland.

05/29 Shrimp fishery opened in Federal Waters off Georgia and South Carolina.

JUNE

06/4 Blue crab and shrimp cast net license lottery drawings were held.

06/16 The federal waters (EEZ) re-opened at 12:01 a.m. on June 16, 2001.

06/17-18 CRD's Federal Aid Coordinator attended the SAFMC held in St. Augustine Florida.

06/25 Georgia's food shrimping season opened at 7:00 a.m. on June 25, 2001 for all recreational and commercial food shrimping (trawling, cast netting, and beach seining).

06/25 Over-flight vessel counts on opening day revealed 296 commercial trawlers fishing on opening day.

JULY

07/6 Staff attended the BCIS meeting where License Lottery and Transfers update, Landings update, Industry Logbooks, Bottlenose Dolphin Take Reduction and Options for Emergency protection of Sponge Crabs were discussed.

07/11-12 Staff attended a Bottlenose Dolphin Take Reduction Team Meeting – Raleigh, NC.

07/26 Staff conducted a BCISC Meeting at CRD.

07/25-31 Staff collected fish and crab samples from areas in Liberty, Glynn and Camden counties for analysis by the Environmental Protection Division in Atlanta.

AUGUST

08/10 Staff conducted sampling and opened a number of bait zones in Glynn County.

08/24 Staff conducted sampling to opened upper White Chimney River in McIntosh County to shrimping.

08/30 Staff attended aquaculture pathology work-shop in Savannah, Ga.

SEPTEMBER

09/19-26 Staff collected and worked up Striped mullet samples for testing of toxic chemicals from the Terry and Dupree creek areas in Brunswick, Ga.

OCTOBER

10/6 CRD personnel held the Annual CoastFest event for the public from 10:00 A.M. to 4:00 p.m.

10/15-16 Staff attended an ASMFC Meeting in Rockport, Maine.

NOVEMBER

11/1-7-8 Blue Crab- Sponge Crab Scoping Meeting held in Brunswick, Eulonia and Savannah. These meetings were held in advance of legislative action aimed at banning the possession of egg-bearing (sponge) blue crabs. Oral public comments were collected at the meeting as well as written comments accepted.

11/27-30 Staff attended an international Shrimp Virus Workshop held in New Orleans, LA.

DECEMBER

12/4 CRD's Federal Aid Coordinator attended the SAFMC meeting in Wrightsville Beach

North Carolina.

12/6 Staff attended the BCIS meeting, where Hematodinium updates, Federal Fisheries Category Shift, Landings updates, Summation and Discussion of Scoping Meetings Were discussed.

12/11 Food-Shrimp Subcommittee meeting held. New Sub-Committee members, Bycatch Observation, BRD Permits Issued during 2001, Proposed TED Revisions, Black Gill Update, Landings and Assessment Updates were discussed.

JANUARY 2002

01/04 Staff conducted spot check of the Altamaha sound and offshore areas do to reports of undersized shrimp being harvested in the surrounding location.

01/22-25 Staff attended the week long DNR's Board Meeting held in Atlanta Georgia.

01/28-30 Commercial and Recreational Fisheries personnel attended the Annual Georgia AFS Meeting and Fish Symposium held in Augusta Georgia.

FEBRUARY

02/07 Bolivian Ambassador to the United States Alfonso Via Reque visits CRD and takes a day out on the Research vessel ANNA.

02/09 CRD's staff participates in the annual Weekend for Wildlife on Sapelo Island Georgia.

02/22 Shrimp season closed to harvest for all user groups in the State waters of Georgia at 8:00 P.M.

02/28 Staff attended the Southeastern Estuarine Research Society and Crustacean workgroup meeting held in Savannah Georgia. Staff gave presentations on Shrimp and Crabs Assessment and updates on Black Gill disease.

MARCH

03/01 SEERS Meeting in Savannah Georgia continued.

03/04 Staff conducted spot check of the Sapelo sound and offshore areas due to reports of undersized shrimp being harvested in the surrounding location.

APRIL

04/23 Atlanta's EPD personnel at CRD to pick up samples of shrimp, fish and blue crabs for toxic analysis in the Atlanta laboratory.

04/26 Whelk season closed in State Waters officially at 8:00 P.M. The take of Blue crabs was once again prohibited in this trawl fishery.

MAY

05/06 Staff conducted updates the ACCSP, discussed were Bottlenose Dolphin Take

Reduction Team updates, Fair and Equitable use of Resources, Hematodinium update, Sponge Crab Legislation Finalization, Landings update, and Terms and Chairmanship.

05/14 Staff attended the Food Shrimp Issues Subcommittee meeting where updates on TEDs, Landings, CRD's Assessment survey and Food Shrimp Opening Day Recommendations were given.

05/16 Commercial Fisheries staff attended the CFAC meeting held at Coastal Resources.

JUNE

06/12 Georgia's Shrimp season officially opened in State Waters.

06/17-18 CRD's Federal Aid Coordinator attended the SAFMC and SSC meeting held in Key West, Florida.

JULY (NO MAJOR FISHERIES ACTIONS)

AUGUST

08/27 Staff attended the Blue Crab Issues Subcommittee meeting where Commercial Fisheries and Revocable Permits, Results of Side Scan Sonar search for Ghost Traps, Biodegradable Panels, Hematodinium update, Landings update and Declines and Federal Relief Effort were discussed.

SEPTEMBER

09/09-10 Commercial Fisheries Staff attended the SEAMAP/Shallow Trawl Workgroup meeting held in Charleston South Carolina. State landings, Data retrieval, Black Gill and Hematodinium were all discussed during the meeting.

09/23&24 Blue Crab Disaster Relief Scoping Meetings held in Brunswick and Richmond Hill. These meetings were held to disseminate information regarding requesting a federal Fishery disaster declaration for the Georgia blue crab fishery. The meetings were Followed by a mail survey to formally gauge the opinion of the crab industry as to Seek the disaster declaration.

OCTOBER

10/05 CRD personnel held the Annual CoastFest event for the public from 9:00 A.M. to 4:00 P.M.

10/13 CRD's Commercial Fisheries staff participated in the Annual Weekend for Wildlife held on Sapelo Island.

NOVEMBER (NO MAJOR FISHERIES ACTIONS)

DECEMBER

12/11 Food Shrimp Issues Subcommittee meeting held. Landings updates, Assessment Survey updates and Closing Day Recommendations were discussed.

JANUARY 2003

01/18 Georgia's shrimp season officially closed to all harvest in state waters at 8:00 P.M.

FEBRUARY (NO MAJOR FISHERIES ACTIONS)