METHODS

Catches of sportfishermen fishing out of Flamingo, in Everglades National Park, were censused from May 1976-December 1979. Samples taken from Flamingo were felt to be representative of all park areas except the upper west coast (Ten Thousand Islands) (Fig. 1). Time and economic constraints prevented collecting samples of the Ten Thousand Island area at Everglades City (Area 6). For every fish sampled, the sex, length (mm F.L.), weight (.01 kg), and area of capture were recorded and scales for age and growth analyses were collected. Sex and reproductive condition were determined by inspection of the gonads. Stomachs were examined in the field for food items. Detailed methods for the collection and processing of data followed those reported by Rutherford, Thue and Buker (1982). The following criteria (Bagenal, 1979) were used to evaluate the validity of age determinations from scale annular marks:

1. Fish body growth is proportional to scale growth.

2. Scale annulus formation is seasonal and occurs only once each year.

3. Back-calculated lengths of fish at age N are between observed lengths at capture of fish aged N-1 and N.

4. Lengths at capture of fish aged by scales agree with modal lengths of age groups determined by the Petersen length-frequency method.

Scales were collected for age analyses from behind the left pectoral fin. A motorized roller type Ann Arbor fish scale impression press was used to press the scales on plastic slides. Photographic enlargements (8.05 x) of the scales made from the slides on a 3M reader-printer were then examined for number of annuli.

Seasonality of scale annulus formation was estimated by plotting scale radius marginal increments against month of capture. Fish body length was regressed on total scale radius by sex and area of capture to determine proportionality of fish body growth to scale growth. Scale magnification does affect slope but not the length intercept of this regression (Zar, 1974). The y intercept of this regression was used as the correction factor (a) in the Lee formula (Bagenal, 1979) to back calculate fish length at each annulus.

Differences in fish length among sexes and areas of capture were compared by a two-factor analysis of variance for both back-calculated lengths and lengths at capture. A Student Newman Keuls (SNK) test was used to indicate what specific differences were significant (Zar, 1974).

Mean calculated fish lengths at annulus were fitted to the von Bertalanffy growth equation (Bayley, 1977) to describe snook growth. Length-weight relationships were calculated (Bagenal, 1979) for each sex and area of capture and compared by analysis of covariance (Zar, 1974).

Annual survival rates (S) and total instantaneous mortality coefficients (Z) were calculated for fully recruited snook by using the age distribution of harvested fish (Robson and Chapman, 1961). Natural mortality coefficients (M) were estimated utilizing Pauly's (1980) equation. Fishing mortality coefficients were obtained by subtracting natural mortality coefficients from total mortality coefficients. Conditional fishing and natural mortality rates and exploitation ratios were then calculated from these mortality coefficients (Ricker, 1975).

RESULTS

Three hundred and twenty five snook were collected from North Florida Bay and the inland waters of the park (Areas 1, 3, 4, and 5) (Fig. 1). No fish from South Florida Bay (Area 2) or the Ten Thousand Islands (Area 6) were sampled. Fish ranged in length from 284-940 mm (F.L.) and in weight from 0.7-11.6 kg. Two hundred ninety four snook were examined for age and growth information, 269 of which the sex was determined.

Length Frequency

The mean length of all fish was 643 $\pm$ 11 mm F.L. (Fig. 2). The mean length of females ($\bar{x}$ = 680 $\pm$ 25 mm, n = 71) was not significantly different from the mean length of males ($\bar{x}$ = 632 $\pm$ 14 mm, n = 222) (Fig. 3). Mean lengths and length distributions of males, females and combined sexes were not significantly different among areas of capture.

Length distributions of all fish (combined sexes and unsexed fish) differed significantly (x^2 = 22.739; $p < .01$) by season. Small fish (< 500 mm) occurred proportionately more often in winter (December, January and February) than in any other season. Mean fish length was smallest in winter and greatest in spring (March, April and May). There were no significant seasonal differences in length distributions of males or females when they were considered separately.

Verification of Aging Technique

Scales from 294 snook were analyzed for annular marks. Figure 4 shows a ctenoid scale from a 3-year-old male snook with annuli, circuli, radii, and focus labeled. Annular zones are distinguished primarily by complete circuli surrounded by discontinuous or broken circuli. The last few circuli laid down before the annulus are often incomplete in that they do not continue all the way around to the ctenii. Annular circuli are complete and cut across the ends of the incomplete circuli inside of them. New radii often originate in the immediate vicinity of annuli and provide especially useful clues to the location of annular marks in large scales of older fish.

The validity of aging snook by scale annuli was established by meeting all criteria listed in the methods section. Fish body length was regressed on total scale radius for each sex in each area of capture to determine if a relationship existed between fish growth and scale growth. Fish body length was significantly ($p < .001$) correlated with scale radius for each sex and area of capture. Two significantly ($.025 < p < .05$) different fish length-scale length relationships were determined by