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Overfishing of the Common Snook

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Abstract

The chief aim of this project is to determine if the populations of the common snook, *Centropomus Undecimalis*, in the Atlantic and Gulf coast are being affected by overfishing. This is established by evaluating the intrinsic rate of change for these populations and their carrying capacities. It turns out that the carrying capacity for the population of the Atlantic coast is approximately one million snook and its intrinsic rate is 0.00621, while the carrying capacity of the Gulf coast's population is 2.9 million snook and its intrinsic rate is 0.00165. The decline of both populations is most likely due to the overfishing; however Gulf coast's population of the snook is decreasing at a faster rate than in the Atlantic.

Keywords

Common Snook, Overfishing, Carrying Capacity

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PROBLEM STATEMENT

Assess the impact of overfishing on the populations of common snook of the Atlantic coast and the Gulf coast of Florida.

MOTIVATION

Common snook is a fish found in the coastal waters of Florida. Snook is very popular for sport and subsistence fishing, both of which put an increased pressure on its population. Snook has been declared a game fish, and so its commercial fishing and sale are prohibited. The population levels are mostly controlled by setting the fishing limits, which are determined from the estimates of its current population size.

Currently, common snook fishing is prohibited between December 15 and January 31 statewide in Florida and a bag limit of 1 or 2 fish per person per day depending on the area is imposed. The caught fish cannot be shorter than 28" or longer than 32" in the Atlantic; in the Gulf, they cannot be shorter than 28" or longer than 33" (Fish and Wildlife Conservation Commisson. J.F. Griffin.).

MATHEMATICAL DESCRIPTION AND SOLUTION APPROACH

We use snook population data for both Atlantic and Gulf coasts of Florida collected from 1896 until 2010 (see Tables 1-2 and Figures 1-2) to predict carrying capacities and growth rates of both populations. Initially, we've tried to apply the logistic growth model,

$$N(t) = \frac{K}{1 + \left(\frac{K}{N_o} - 1\right) e^{-rt}} \qquad \text{Eq. 1}$$

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where N_0 is the initial population, K is the carrying capacity, and r is the intrinsic growth rate. However, we were unable to get a good estimate for K and r in the Equation 1 for the provided data using the Excel's solver tool. Instead, we decided to use the following model

$$N(t) = \frac{K}{1 + \left(\frac{K - N(t-1)}{N(t-1)}\right) e^{-rt}} \qquad \text{Eq. 2}$$

which estimates the next year's population based on the population for the current year. The values of K and r were again estimated using the solver tool. The initial value of K for this calculation was chosen to be the double of the mean (1,303,007 for the population in the Atlantic and 2,869,883 for the population in the gulf); we chose 0 for the initial value of r.

DISCUSSION

We have estimated that the carrying capacity of the snook population in the Atlantic is 996,778.7 and its intrinsic rate is 0.00621. The carrying capacity of the Gulf's population is 2,869,958.03 and its intrinsic rate is 0.00165. In the Atlantic, the snook population has been decreasing slowly since 1992; in the Gulf, the population fluctuated from 1989 until 2000 and then dramatically declined.

CONCLUSION AND RECOMMENDATIONS

It is clear that the population of the common snook in the Gulf is declining more rapidly than its population in the Atlantic. However, it seems that both populations are being overfished.

Furthermore, there may be other factors that impact the population of the snook (see (Mote Marine Laboratory) (Muller and Taylor)). For example, the shallow, coastal regions

inhabited by snook are affected by pollution like urban and agricultural runoff. Dolphins, birds, and larger fish pray upon snook and it competes with other species for space and nutrition. In 2010, snook populations suffered due to a deep freeze from January to February and dead snook were being pulled out of the water by the thousands. Incorporating other data into our model (such as release rates) may help to better assess and predict the population of snook in the future.

NOMENCLATURE

Symbol	Meaning
$\boldsymbol{N(t)}$	Snook's population at the time t (in years)
$\boldsymbol{N_0}$	Initial population
$\boldsymbol{K}$	Carrying capacity
$\boldsymbol{r}$	Intrinsic rate

REFERENCES

Fish and Wildlife Conservation Commisson. J.F. Griffin. "Basic Recreational Saltwater Fishing Regulations." 3 May 2012. eregulations. <http://www.eregulations.com/>.

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APPENDIX-TABLES

Year	Population
1986	581688
1987	723209
1988	654179
1989	578548
1990	649360
1991	834893
1992	992259
1993	931549
1994	865707
1995	783207
1996	742466
1997	688213
1998	663389
1999	682911
2000	679118
2001	630555
2002	621110
2003	633115
2004	588827
2005	580697
2006	560160
2007	504250
2008	456482
2009	345284
2010	316409

Table 1: Atlantic population of snook from 1986 until 2010. The data is provided by Dr. Robert Muller from the FWC: Fish and Wildlife Research Institute in St. Petersburg, FL.

Year	Population
1986	606846
1987	605655
1988	945140
1989	1167367
1990	1452475
1991	1350194
1992	1212708
1993	1189455
1994	1295157
1995	1320324
1996	1168693
1997	1372624
1998	1425590
1999	1590628
2000	2001466
2001	1887771
2002	1764112
2003	2420511
2004	2626599
2005	2006222
2006	1699178
2007	1526497
2008	1267498
2009	1052766
2010	918058

Table 2: Atlantic population of snook from 1986 until 2010. The data is provided by Dr. Robert Muller from the FWC: Fish and Wildlife Research Institute in St. Petersburg, FL.

APPENDIX-FIGURES

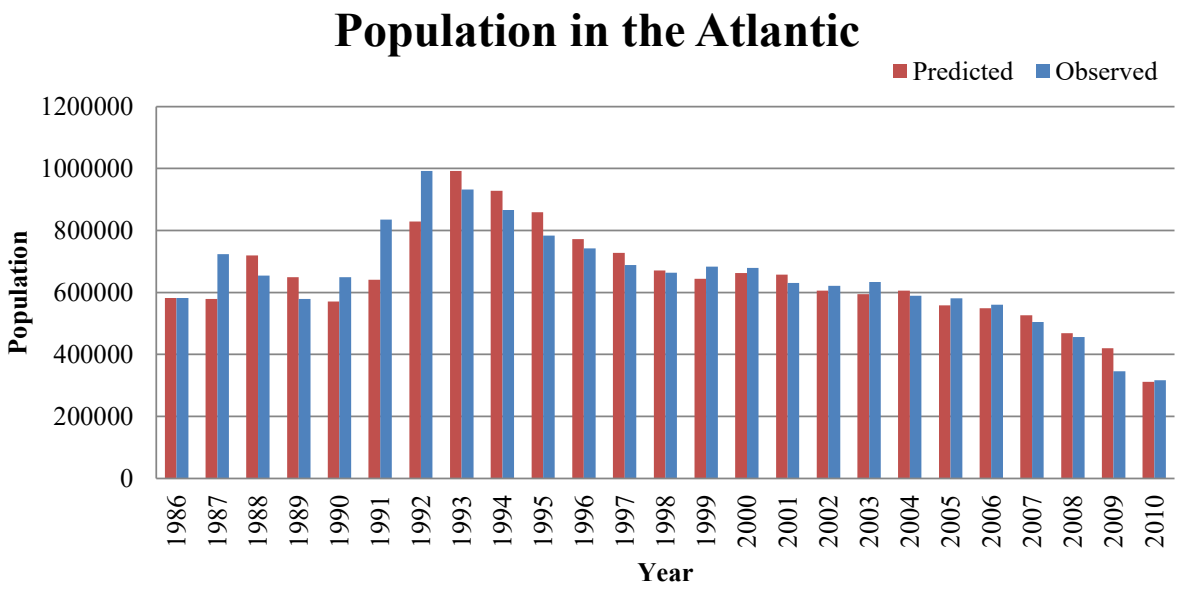

Figure 1: Predicted and observed population size for Atlantic's population of the snook.

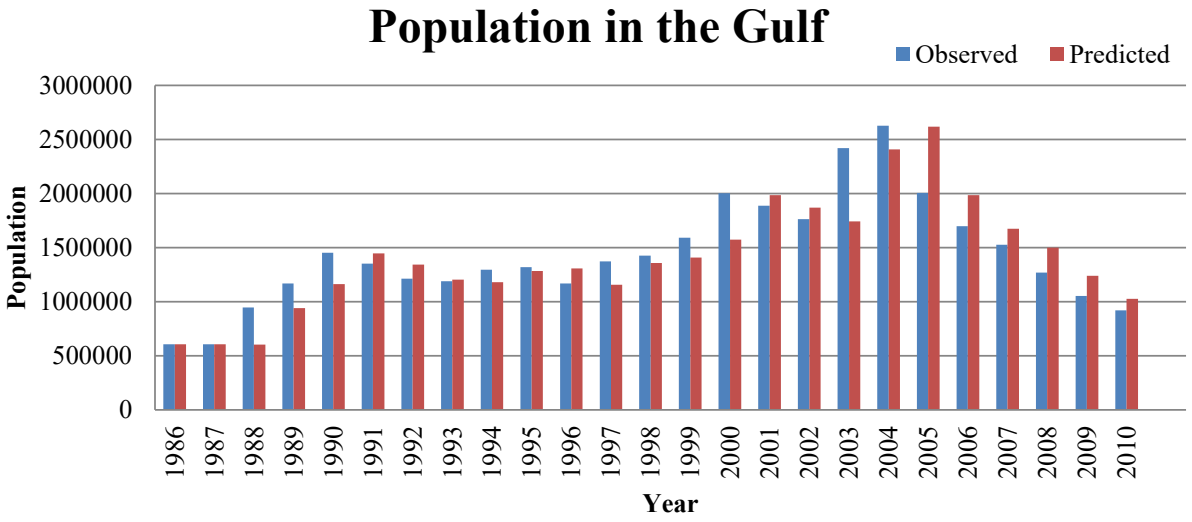

Figure 2: Predicted and observed population size for Gulf's population of the snook.

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