An Interdisciplinary Study of St. Georges Bay Fish Harvesters' Ecological Knowledge and White Hake (*Urophycis tenuis*) Predation on Juvenile American Lobster (*Homarus americanus*), Phase I

A Preliminary Report of Research Results

SRSF Research Report #3

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2002

White Hake (*Urophycis tenuis)* Predation on Juvenile American Lobster (*Homarus americanus*) in St. Georges Bay, Nova Scotia.

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Acknowledgements

This study could not have been initiated, conducted and completed without the assistance of Dr. Anthony Davis (St. FXU), Dr. Mark Hanson (DFO Moncton), Dr. John Wagner (St. FXU), Mr. Marc Lanteigne (DFO Moncton), Dr. Michael Chadwick (DFO Moncton), and Ms. Kay Wallace (Gulf Nova Scotia Bonafida Fisherman's Association). We are especially grateful to Gulf Nova Scotia Bonafide Fishermen's Association members Mr.Greg MacPherson, for the use of his boat and assistance, and Mr. John Andrew Boyd for his help in catching, sampling, and processing the fish. Thank you also to Arisag Fisheries Limited for allowing us to store the sampled stomachs in their freezer.

The research was supported by a Fisheries and Oceans Science and Technology Horizons Internship, Fisheries and Oceans contributed services research funds, in-kind contributions such as boat time and equipment from the Gulf Nova Scotia Bonafide Fishermen's Association and its members, and in-kind contributions such as faculty time, office and laboratory space, computer time, and business office-based grant management services from St. Francis Xavier University. The diverse sources of the resources assembled in support of this research reflects the full spirit of partnership within which this work has progressed.

Summary of Findings

White hake (*Urophycis tenuis*) are a groundfish species that inhabit the waters of the Southern Gulf of St. Lawrence (sGSL). Most of the basic feeding information for white hake is all but lacking for the sGSL population. Recently, many St. Georges Bay fish harvesters have expressed concern that the white hake is a predator of juvenile American lobster (*Homarus americanus*). DFO surveys do not support these concerns. Fish harvesters maintain that the results obtained by DFO are the due to inappropriate sampling times and locations. The present study harvested white hake in places and times recommended by St. Georges Bay fish harvesters interested in understanding local white hake predation on juvenile American lobster. Gill nets were placed in three locations in St. Georges Bay in early fall of 2001. A total of 1770 groundfish stomachs were gathered, including 1618 for white hake. Stomach analysis showed that herring and mackeral were a major prey item for all groundfish. While fragments of American lobster were found in Atlantic cod and shorthorn sculpin, no American lobster was found in white hake stomachs. These results contribute to a multi year study of white hake predation in St. Georges Bay. In the next study phase it is recommended that sampling occur during early summer in shallower water.

Introduction

White hake (*Urophycis tenuis*) are a groundfish species that inhabit the waters of the Southern Gulf of St. Lawrence (sGSL). In the coastal waters, they appear to be the top predator. There are two distinct subpopulations in the sGSL. One population occurs in the deep warm waters of the Laurentian Channel. The second is confined to the coastal waters (i.e., < 40 m deep) of the southern Gulf (Hurlbut & Clay 1998). Today, white hake is limited to the eastern end of the Northumberland Strait. The fishery is closed due to low numbers of this fish, as well as the fact that its only known remaining spawning area is in St. Georges Bay (Poirier et al. 2000; Hurlbut & Poirier 2001). Annual surveys show that other historical spawning areas (e.g., Baie Verte, NB) currently have little to no hake. As with many of the marine fishes in Canada's Atlantic waters, the basic feeding information of white hake is all but lacking for the sGSL population(s) (reviewed by Hanson & Lanteigne 2000).

The few available white hake diet studies, conducted in the Gulf of Maine and Georges Bank, suggest adult white hake (>45 cm) are primarily piscivores (Vinogradov 1984; Garrison & Link 2000), while smaller hake (<45 cm) eat mostly small crustaceans such as shrimp and mysids (Tyler 1972; Bowman 1981; Garrison & Link 2000). Hanson & Lanteigne (2000) have provided the only published data that we know of on the feeding habits of white hake in the sGSL. The few available studies of white hake feeding in other ecosystems are of very limited use in describing white hake predation in the sGSL as it is such a unique habitat. The cold intermediate layer of the sGSL contacts the bottom for much of the area and white hake largely avoid this cold-water zone. Most studies of white hake feeding were done on shelf-dwelling populations rather than on

coastal-water dwelling populations. As well, coastal waters in the sGSL reach temperatures > 20 C during summer and they are ice-covered from January to March or April. These conditions cause all adult white hake to make a seasonal migration out of the shallows to overwinter in the Laurentian Channel (Clay 1991). The situation for small white hake (< 35 cm) is a bit different. Populations of small white hake enter estuaries during late summer and early autumn (Hanson & Courtenay 1995; Bradford et al. 1997) where they feed extensively on sand shrimp (*Crangon septemspinosa*) (J. M. Hanson, unpublished data). White hake then leave the estuaries in November and overwinter on grounds in the Laurentian Channel.

Recently, many St. Georges Bay fish harvesters have reported groundfish predation, particularly that of white hake, upon juvenile American lobster (*Homarus americanus*). They are concerned that recovering groundfish populations, as a consequence of the fishing moratorium, are increasing predation on juvenile American lobster. This increased predation is thought to threaten the recruitment of juveniles into the harvestable American lobster stock. Since fishermen sample the white hake population during the ice-free season, they should know when and where white hake predation on American lobster was likely to be detected. But, the results of recent DFO seasonal survey studies do not support the concerns of St. Georges Bay fish harvesters. The fish harvesters argue that the studies have been conducted in the wrong places and at inappropriate times of years. In order to address this situation, a research collaboration was formed between Interdisciplinary Studies in Aquatic Resources (ISAR) and Social Research for Sustainable Fisheries (SRSF) at St. Francis Xavier University, Fisheries and

Oceans Canada (Gulf Region, Moncton, N.B.), and the Gulf Nova Scotia Bonafide Fishermen's Association (GNSBFA).

The purpose of the present study was to harvest a sample of white hake stomachs sufficient to develop some baseline information. As part of a multiphase study, we think this research will build a representative basis for a diet analysis over a number of successive years and provide insight into white hake predation including rates of predation on juvenile American lobster in St. Georges Bay.

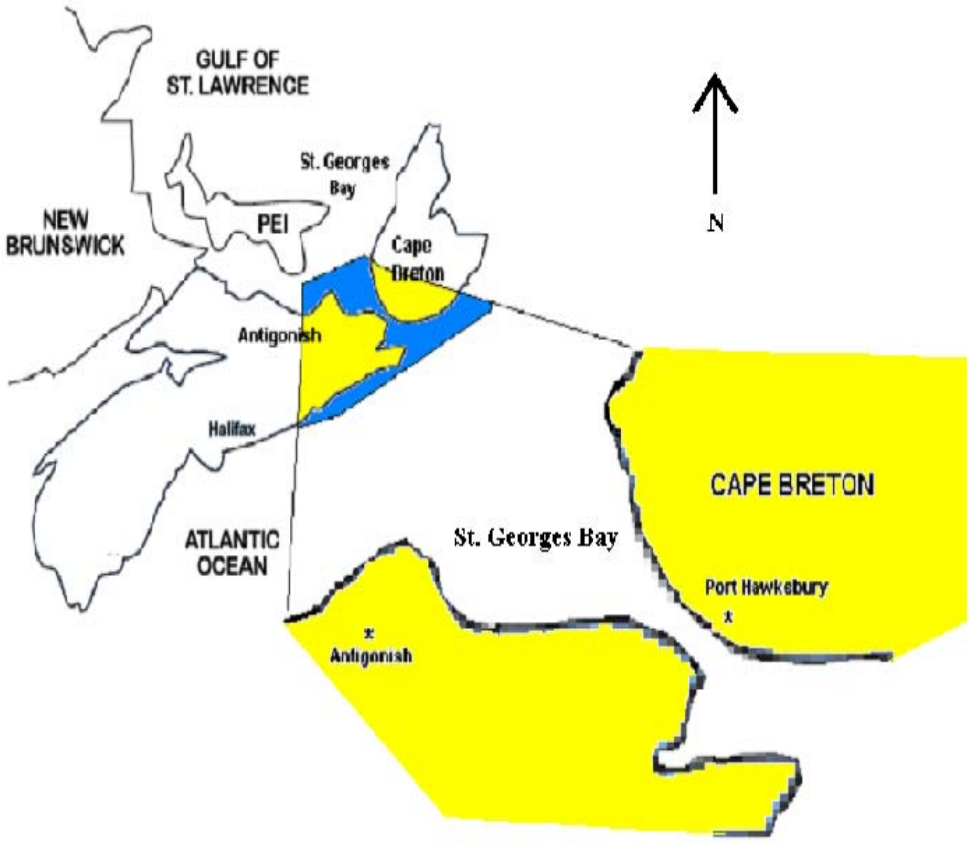
Methods and materials

Sample Site Selection

An informal roundtable discussion concerning the research was held with several GNSBFA members during July 2001 at the GNSBFA office in Lakevale, Antigonish County, Nova Scotia. As a result of this discussion, three stomach sampling areas in St.Georges Bay, Nova Scotia were identified (Figure 1).

A nautical chart of St. Georges Bay was employed for the purpose of precisely identifying the locations and net setting directions through use of loran bearings. These

Figure 1. Map showing the location of the sampling area of St. Georges Bay, Nova Scotia, as mentioned in the text.



areas were described by members as likely to contain adult white hake. The members also suggested that some hake previously caught in these areas contained juvenile American lobsters in their stomachs. The roundtable discussants also agreed that the sampling should take place during the period of late summer and early fall.

Sampling procedure

Each of the three areas was sampled with 1 string of gillnets. Each string was composed of 4 nets. These strings had alternating net mesh sizes of 5 ½ and 6 inches. The

purpose of this procedure was to sample select for adult fish, particularly white hake. In addition, the use of gillnets was thought to reduce the likelihood of the caught fish regurgitating the stomach contents when being landed. Sampling commenced on September 4th 2001 and ended September 20th 2001.

Stomach sampling

All caught fish were taken out of the nets on board the vessel and their stomachs were removed. Each fish was also measured in length to the nearest centimetre. Individual stomachs were labelled with site number, date, species, length of fish, and placed in plastic bags. The site number would be used later as a reference for determining which of the three sites from which each fish was sampled. The plastic bags were immediately placed on ice and stored in insulated boxes. Upon return to the wharf, the stomachs were placed in a freezer for latter contents description and analysis.

Stomach analysis

The ISAR student intern was trained in stomach contents description and analysis in the Moncton, N.B., Fisheries and Oceans science laboratory by Dr. Mark Hanson. All hake stomachs were analysed for content. Stomachs were thawed in cold water in a laboratory at St. Francis Xavier University. Each stomach was cut opened and prey contents were identified to the species level. The content descriptions began on November 2001 and were completed by early January 2002. When identification was uncertain, the items were forwarded to Dr. M. Hanson for identification. Five items were treated in this manner. These data are included in the following description and analysis.

Statistical Analysis

A one-way ANOVA (alpha=0.05) was performed on the white hake data to determine if there was a significant difference between white hake lengths for all three sites. This calculation was made using the SPSS 80 program. Graphs were generated using the Microsoft Excel program.

Results and Discussion

A total of 1618 white hake stomachs were gathered. Similar numbers of white hake as well as lengths were sampled from each of the three sampling sites (Table 1).

Table 1. Number and average lengths of white hake sampled in early fall of 2001 in St. Georges Bay, Nova Scotia.

Site No.	White Hake No.	Avg. Length (cm)
1	559	62.9
2	529	63.6
3	530	63.7

The size distribution (Figure 2) shows the sampling method was very selective for adult white hake. While there were 17 hake under the length of 45 centimetres, the overall results indicate that the sampling method was very selective for adult white hake (Table 1, Figure 2). The ANOVA showed that the lengths of white hake did not significantly differ between each of the three sites (p=0.138). This result may also indicate that all sampled hake came from a single population in St. Georges Bay. This helps show that we sampled local white hake, and that they were not immigrants.

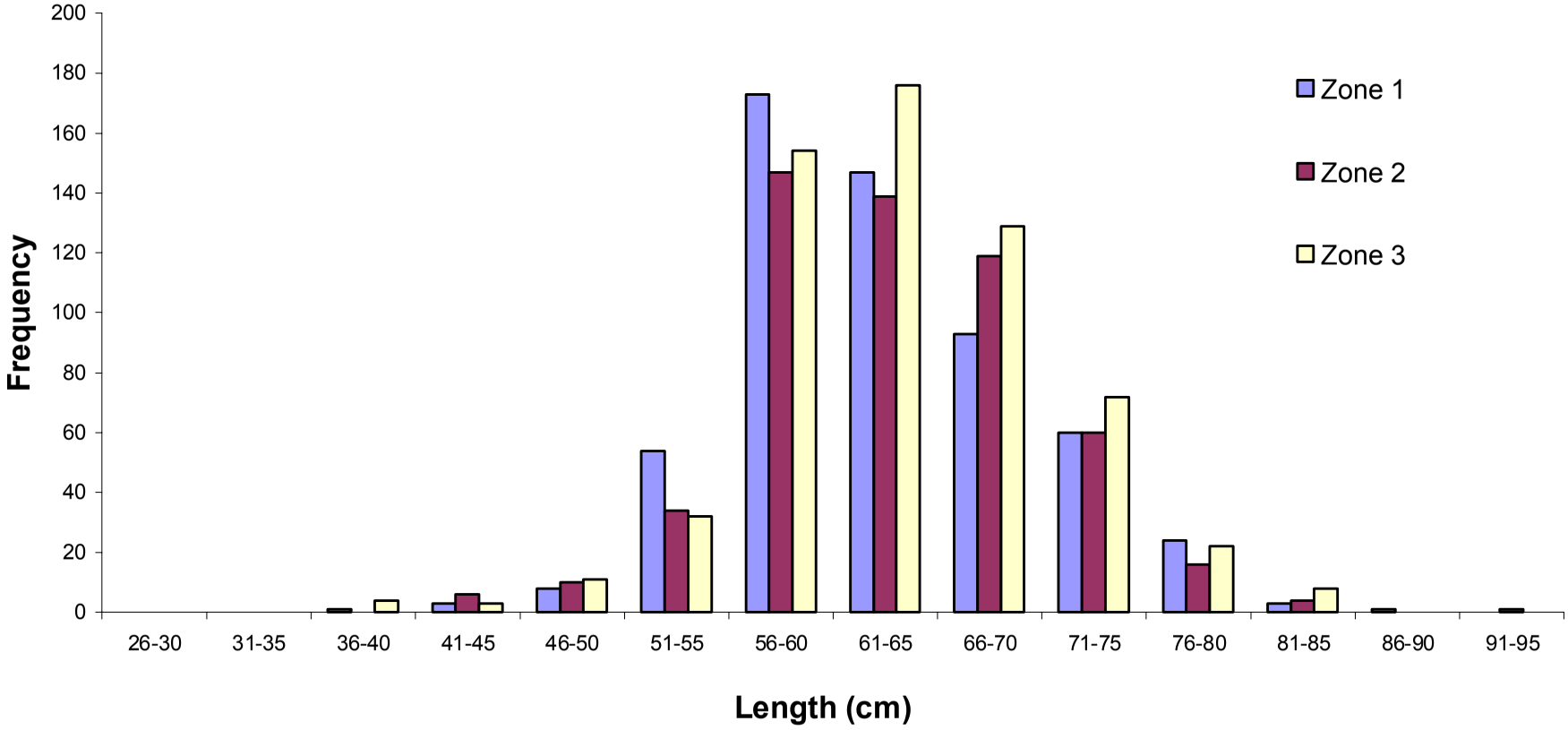


Figure 2. Graph showing the distribution of sampled white hake for each sampling site. White hake were sampled in early fall of 2001 in St. Georges Bay, Nova Scotia.

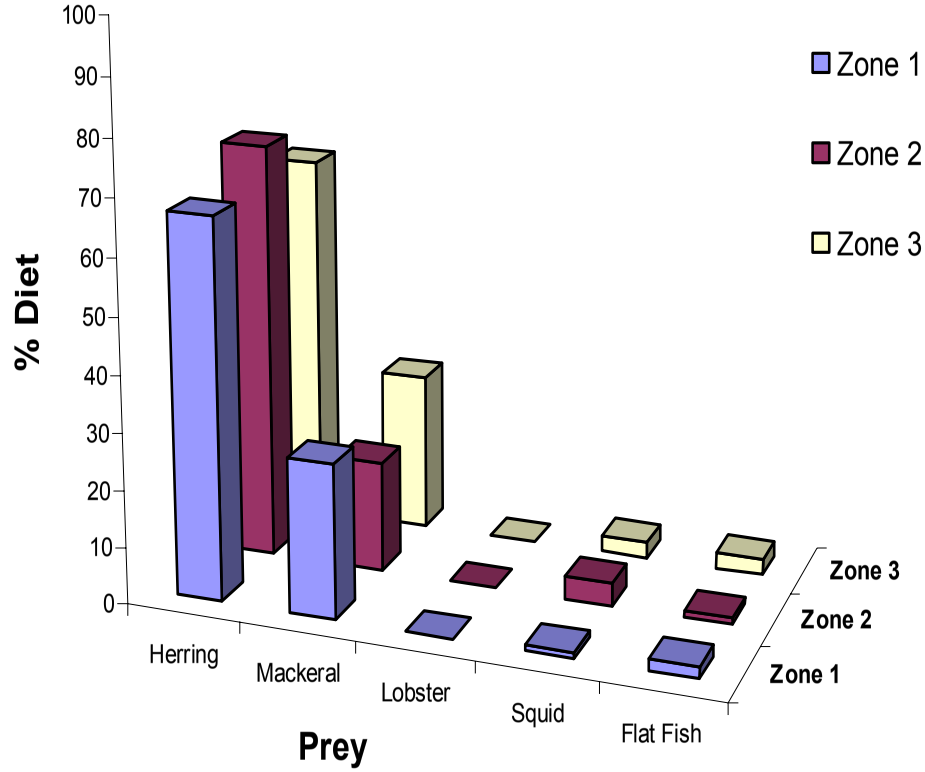


Figure 3. Results of the stomach content analysis of white hake. White Hake were sampled in early fall of 2001 in St. Georges Bay, Nova Scotia. Other prey includes roundfish remains and crustaceans.

Figure 3 shows the percentage of prey consumed by white hake. The largest percentage of prey seen in the stomachs of white hake was herring, contributing an average of 68.5 % by weight of all stomach contents. Mackeral, squid and flatfish made up the remainder of the major prey of sampled white hake with 24.8 %, 2.6 %, and 2 % respectively. Other prey found include shrimp (*Pandulas montagui, Crangon septumspinosa*), rock crab, white hake and cod. Hanson and Lanteigne (2000) have reported similar results. They found very few lobster in sampled white hake as well. Out of the 2300 fish that they sampled, a total of three white hake contained lobster. While these numbers are still quite small, they did find American lobster as a prey item. It should be noted that the lobsters found were very small juveniles (14 and 15mm carapace lengths), which suggests the white hake had been foraging in very shallow waters (Hanson and Lanteigne 2000).

Other Sampled Fish

In this study, shorthorn sculpin was clearly the most notable predator of American lobster. A total of three American lobster were found in the stomachs of shorthorn sculpin (Table 2). There were only 35 shorthorn sculpin sampled. This small sample size, with a high occurrence of American lobster in the stomachs, may reflect that a population of shorthorn sculpin could have a significant impact on American lobster numbers (Hanson and Lanteigne 2000).

Table 2. Presence of American lobster in the stomachs of fish. Fish were sampled in early fall of 2001 in St. Georges Bay, Nova Scotia.

Species	No.	Occurrence (yes/no, #)
Atlantic cod	100	yes, 1
Shorthorn sculpin	35	yes, 3
Sea raven	10	no, 0
Dogfish	7	no, 0

Atlantic cod ate very few American lobster. Examination of 100 Atlantic cod stomachs showed that one individual contained the remnants of one American lobster. Hanson and Lanteigne (2000) have also showed a low occurrence of American lobster in the stomachs of Atlantic cod. They sampled 10484 Atlantic cod and found 6 of these fish contained an American lobster. These fish were also sampled in the summer and autumn, and in water depths similar to those fished for the present study. At these depths (~30m) the availability of small American lobster as a food source is quite unlikely (Hanson and Lanteigne 2000).

American lobsters were not found in the stomachs of sea raven or dogfish. However, the sample size was likely too small to be representative of these populations in St. Georges Bay. Only 10 sea raven and 7 dogfish were sampled. While no diet studies could be found on sea raven, Hanson and Lanteigne (2000) have commented on the diets of dogfish. Their sample size was still quite small, with 132 individuals; but they reported

no American lobsters in dogfish stomachs (See Appendix 1 for graphical representations of the stomach contents described for each of the major 'other' species sampled.).

Conclusions

In summary, this study showed that for the time of year and in the depths sampled, white hake are not an important predator of American lobster. A second phase of research in different locations and times may realise different results. As this study sampled white hake in waters of depths reaching >30m, it may be worthwhile to sample in shallower waters where juvenile American lobster are more plentiful (Hanson and Lanteigne 2000). The largest occurrence of lobster as a prey item was found in shorthorn sculpin. Predation by this poorly studied species may be important respecting juvenile American lobster. Future work on the predatory habits of this species may be useful in acessing the extent that the species interacts with American lobster and impacts of recruitment dynamics.

Appendix I

Results From the Stomach Content Analysis of Species Landed Other Than White Hake

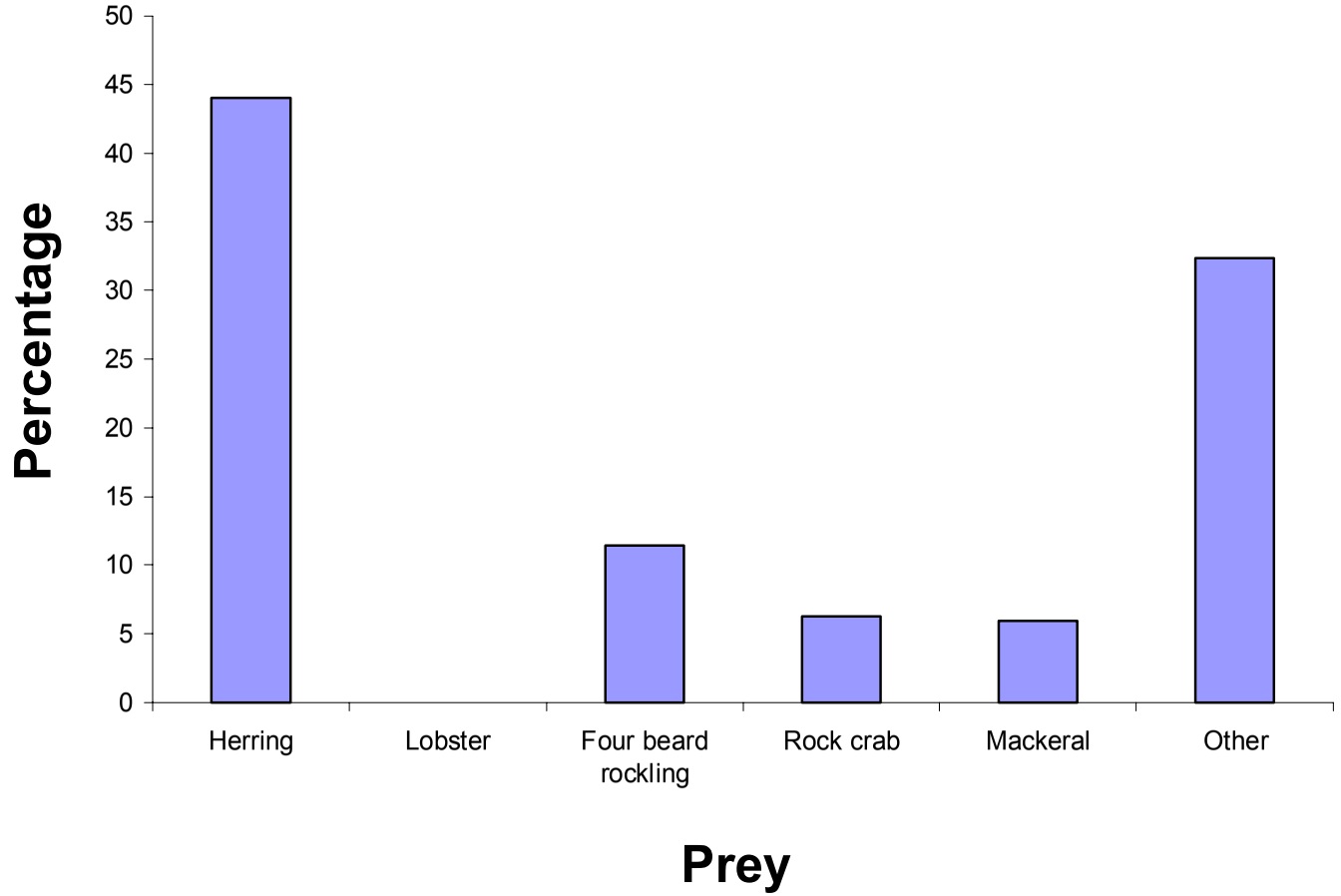


Figure 1. Percentage of Prey Consumed by Sampled Atlantic Cod in St. Georges Bay, Nova Scotia.

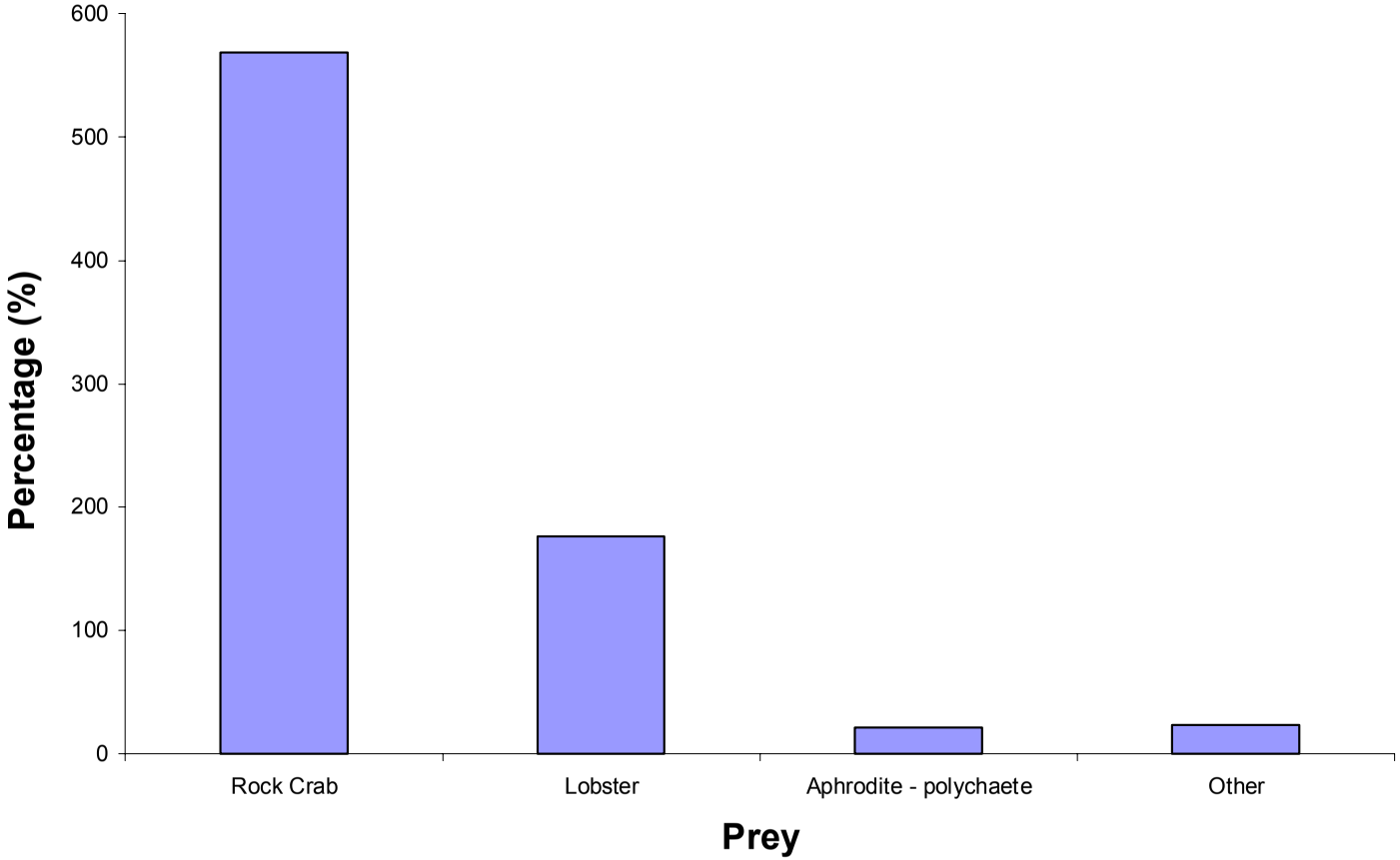


Figure 2. Percentage of prey consumed by sampled Short Horned Sculpin in St. Georges' Bay, Nova Scotia (2001).

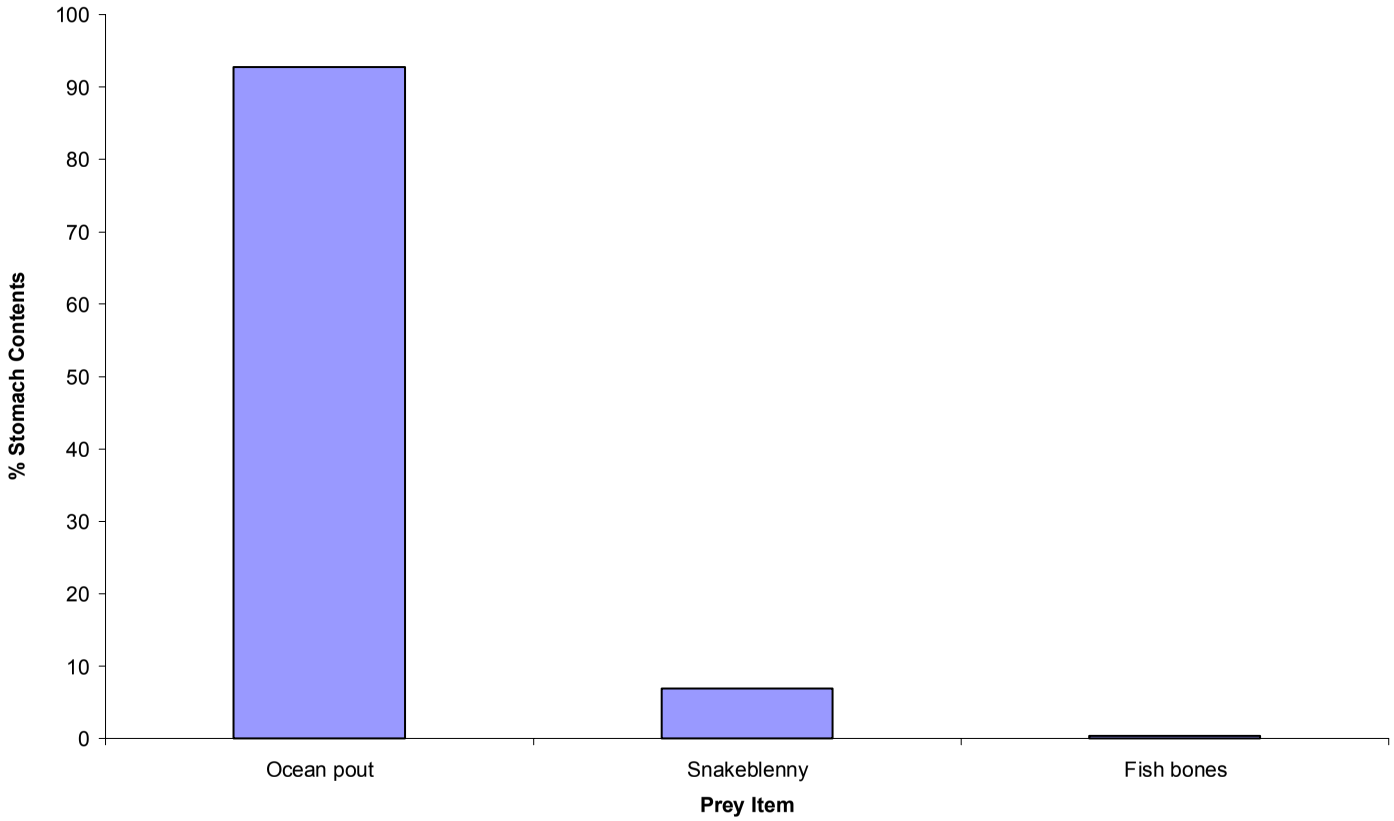


Figure 3. Percentage of Prey Consumed by sampled Sea Raven in St. Georges Bay, Nova Scotia (2001).

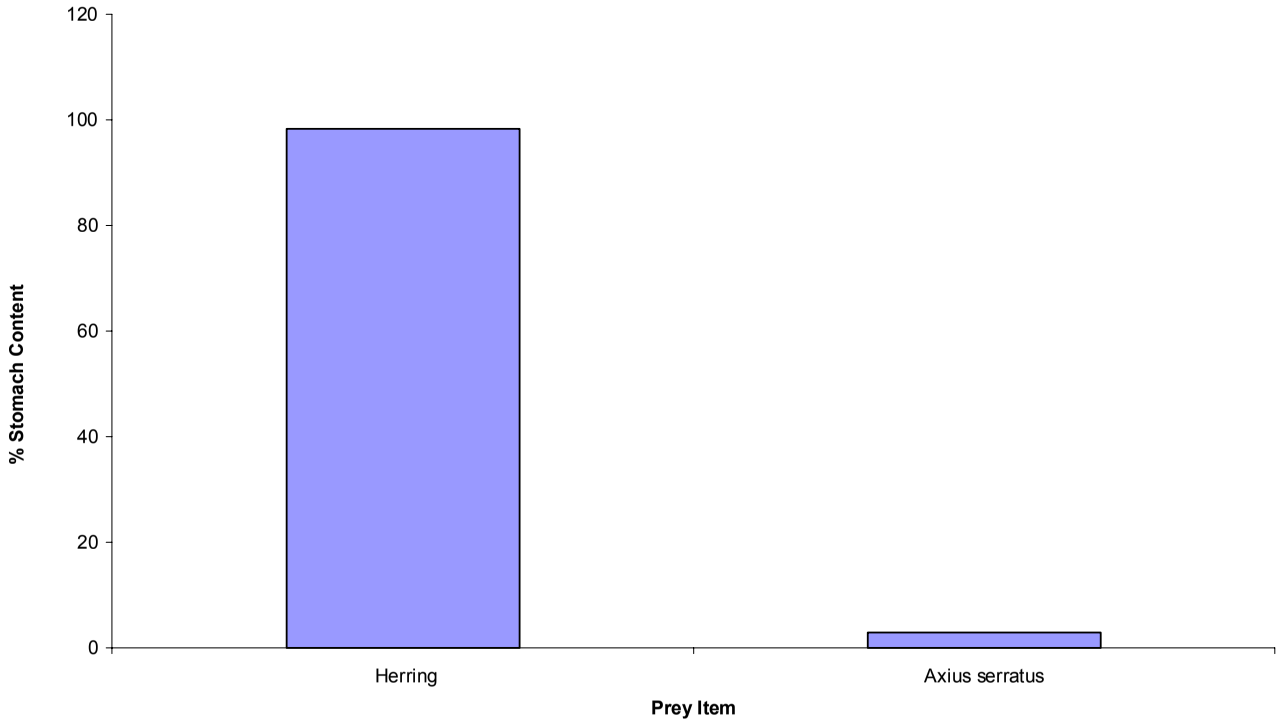


Figure 4. Percentage of Prey Consumed by Sampled Dogfish in St. Georges Bay, Nova Scotia (2001).

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