1.1 Introduction

Lake sediments can be very useful in tracking climatological and environmental changes over time. Environmental, climatological, and anthropogenic influences within the surrounding watershed are recorded in the layers of sediment that accumulate at the bottom of a lake. Understanding possible environmental influences on Lake Champlain and its surrounding watershed will help in predicting future conditions and possible impacts on its ecology and trophic status.

This study will be encompassing the last 10,000 years, including the transition from Champlain Sea (CS) to Lake Champlain (LC). Multi-proxy analysis for this study will include variations in lithology, chemistry, and physical properties. Throughout the lake core, changes in the sediment will determine trends in %C contribution since the shift from the marine environment. The proxies that will be utilized in this study include grain size, magnetic susceptibility, X-ray diffractometry, C/N ratios, and organic matter (OM). Changes in these characteristics represent trends in sedimentation rate, fluctuating lake productivity, contribution from the surrounding watershed, climate change, and transition from a marine to lacustrine setting.

Going back far enough in time and obtaining a record of this transition ensures a more thorough and complete history of LC. Correlating a core of LC record with cores previously taken from connecting bays will accomplish several things: double check accuracy of radiocarbon dating of events, more accurately plot sedimentation rates and changes in watershed contribution throughout the Holocene, and comparing how lake response to climactic and environmental changes in a watershed can be different in different locations within the same body of water.

2.1 Previous Studies

Previous studies on LC sediments have encompassed a more recent era of history (Burgess; Koff, 2012; Palmer, 2012). These studies have correlated more recent trophic events to anthropogenic activity and earlier trophic events to changes in lake productivity and the watershed.

The focus of other previous studies has been to capture the marine to lacustrine transition and try to pinpoint when it occurred. Studies on LC sediment have shown signs of a past marine environment in the presence of foraminifera. The gradual disappearance of the forams indicates a drop in salinity (Rodrigues & Vilks, 1994). There is also evidence stating that the CS/LC transition was not sudden but ongoing, shown by the mix of marine and lacustrine ostracodes (Brand & McCarthy, 2005). The freshening of the CS may be due to either the closing of the marine water source to the northeast due to isostatic rebound, an increased volume of meltwater from the Laurentide Ice Sheet, or a large amount of water draining from the glacial lakes found in the modern Great Lakes region (Cronin, 2008). Trends in magnetic susceptibility, grain size, and bulk density may also be significant along the CS/LC boundary. The same study has have shown that from CS to LC, sediments have an increasing grain size while magnetic susceptibility and bulk density decrease (Cronin, 2008).

Some recent studies have focused more on the history of adjacent bays. The St. Albans Bay sediment record has shown periods of productivity yielding increased OM. These changes are probably natural and may be due to changes in amount of precipitation, increased amount of nutrient runoff from the surrounding watershed. There is also evidence for a possible decrease in lake depth due to drought or isostatic tilting (Palmer, 2012). The bottom of the oldest core from this study encompasses a period of high productivity, and one of the aims of the present study is to go back further in the record to capture the span of time leading up to this highly productive state (Palmer, 2012).

A parallel study done on neighboring Missisquoi Bay showed similar fluctuations of productivity and lake level trends. XRD analysis helped determine that the mineralogy of the sediment throughout the core was constant, indicating that a change in sediment source had not taken place in some time (Koff, 2012). Both bays correlate well showing that they responded similarly to climatic changes throughout the Holocene. The most significant inconsistency between the two records was when the productivity of St. Albans bounced back after the 8.2 ka BP cold event, although no similar rebound in productivity was seen in the Missisquoi record around that time (Palmer, 2012; Koff, 2012). Comparing and contrasting the two previous cores with the core taken in this study will help distinguish the capacity of lake response to different changes in environment and climate.

2.2 Objectives

The goal of this study is to assist in understanding the nature of the earlier trophic conditions of Lake Champlain and the events that caused them. Knowing more about the past can help find ways to mitigate environmental problems in the present and for the future. The focused goals of this study are to:

- Investigate the transition from marine to lacustrine environments using grain size and magnetic susceptibility.
- Evaluate changes within the lake and surrounding watershed based on multi-proxy evidence.
- Find possible correlations between periods of increased sediment accumulation recorded in Lake Champlain sediments to those found in that of adjacent bays.