This thesis presents several lines of investigation, which, in combination, offer a detailed way to investigate precontact fishing strategies in the Great Lakes area. Questions to be answered include when, where, and how fish remains originated. Palaeoenvironmental, biogeographical and fisheries science data are used to understand the ancient landscape, fish habitat and distribution, and fish behaviour. Descriptions in the ethnohistoric literature, written by missionaries and explorers in the seventeenth century, are used to understand the techniques and social customs surrounding fishing practices in the early contact period. The main body of information, however, is zooarchaeological. This thesis develops ways of getting more information from small collections of fish bones by looking at species distribution; co-occurrence of fish taxa; fish bone size and state of sexual maturity; and age and season of death. This information is considered at the level of individual archaeological deposits, as well as at the site level.

The multidisciplinary approach developed in this thesis allows an understanding how people in the past scheduled their time, energy, material and labour resources. Inter- and intra-site differences in fishing strategies are investigated at three communities of Iroquoian-speaking people who lived between Lake Simcoe, and Georgian Bay of Lake Huron, Ontario. These sites range in date from the end of the thirteenth century to the beginning of the sixteenth century A. D. The occupants are the cultural antecedents of the Huron, who were living in the area at European contact.

The first two chapters place the research in its environmental and cultural context. The Iroquoian food economy was based on slash-and-burn maize horticulture, gathering, hunting and fishing. Settlement in the contact period consisted of permanently occupied villages with many multi-family longhouses and large external refuse deposits; satellite villages; hamlets and special purpose camps for activities such as corn horticulture and fishing. Most of this settlement pattern probably already existed in the precontact period. In the precontact period, sites were probably occupied for a period of about 20-30 years, after which the community moved to a new location.

Corn horticulture and village life in Ontario have their origin in the first millennium. Unlike in other areas of Ontario, there is no in-situ development of Iroquoian villages in the area between Lake Simcoe and Georgian Bay. The Barrie site represents a community that migrated to the area between Lake Simcoe and Georgian Bay from the north shore of Lake Ontario around A. D. 1280. This site, occupied between A. D. 1280-1330, is the earliest longhouse village known in the area. It was located on Dymen's Creek, at the head of Kempenfelt Bay of Lake Simcoe, and close to Minesing Swamp and the Nottawasaga River, which drains into Georgian Bay of Lake Huron. The Dunsmore site, dating to the period ca. A. D. 1430-1510, and the Carson site, dating to ca. A. D. 1475-1525, were part of a proliferation of permanent villages in the area. These two later sites are located close together, about 4 km north of the Barrie site, near Little Lake and Willow Creek, which are part of the Nottawasaga River drainage.

Both historic reports and more recent ethnographies emphasize the importance of fishing to the Iroquoian people in the area. Until now, this has not really resulted in the necessary refocusing of (zoo)archaeological research aims and methods to include ways of dealing with fish remains in detail, using additional and different approaches to those used on other classes, such as birds and mammals. Fish remains are not necessarily a passive reflection of local availability or ease of capture. In order to understand the nature of fish subsistence strategies, we have to examine collections of fish bones in more detail, going beyond traditional bone fragment counts. The methodological potential and limitations of the fish component of the collections are discussed in detail because many of these issues have not been previously explored in an Ontario context. The discussion focusses on fish remains; discussion other classes of animals is limited to those aspects that may help understand taphonomic or subsistence issues relating to the fish component of the assemblages.

The Barrie, Dunsmore and Carson sites were salvage excavated in the last 15 years. The zooarchaeological samples derive from refuse deposits in houses and from external middens. These assemblages are small (number of fish bones identified below class, excluding scales and vertebrae, is 380, 665, 558, respectively), with a great diversity of species. Small sample sizes, especially at the feature level, are a problem. In addition, the assemblages were recovered with differing intensities of flotation and dry screening, and differing sieve mesh sizes. It was necessary, therefore, to develop ways of sorting out taphonomic differences from real differences in resource exploitation. Prior to discussing fishing strategies, therefore, this thesis presents a detailed comparative analysis of site-specific taphonomic issues, with an emphasis on fragment sizes, fish element sizes, fish vertebrae and scales.

The third chapter discusses laboratory identification and computer-based quantification of the zooarchaeological assemblages. The samples are quantified as BW and bone counts. These abundance measures are qualified by a discussion of eight so-called “diagnostic elements” that are readily identified to species even when broken: articular, ceratohyal, cleithrum, dentary, hyomandibular, operculum, preoperculum and quadrate. It is argued that other cranial bones are unevenly represented because of differences in osteology, mechanical strength and associated susceptibility to fragmentation and other taphonomic factors, rather than small sample size. This preliminary discussion on diagnostic
elements highlights the over-representation of, for example, pectoral spines and vertebrae surrounding the air bladder, and problems of quantifying lake sturgeon remains.

The fourth chapter deals with various aspects of taphonomy: fish butchering, processing, consumption, discard, burial, and recovery. Vertebrae were identified to the level of family in order to identify fish processing. Expected ratios of cranial bone to vertebrae must take into account the range of cranial elements that can be identified, as well as the range of vertebrae in different fish species, and their sizes in relation to the sieve mesh aperture. In general, vertebrae were under-represented with respect to cranial bones, suggesting that catch site butchering was limited. Iroquoian cooking methods relied heavily on stews. Fish bones were likely discarded with the head, or included in the cooking process. Many of the fish bones originally deposited would be unlikely to be preserve or recovered. Dogs were likely a major taphonomic agent at each village, but especially at Carson, which produced a lot of dog bones. Burial conditions at the Barrie, Dunsmore and Carson sites were favourable to the preservation of all bone, including, at Dunsmore and Carson, fish scales.

BW was used to assess fragment sizes of the different taxonomic classes. Since individual fish bones often weigh very little, taphonomic issues within this class had to be assessed in a different manner, using fragmentation rates and fish element size. Fish element size was estimated using a proportional method, whereby the relative size of elements is expressed as a percentage of that same element in the reference specimen of known size. Wherever possible, these size observations are augmented by osteometrics. By back-calculating the osteometrics to a size percentage in relationship to the comparable metric in the reference specimen, it was possible to utilize all fish element size data and thus increase sample size. These data were used to document differences in fish element sizes between sites and between recovery methods. For example, fish cranial elements from floatation heavy fraction were larger at the Barrie site than at Dunsmore and Carson, despite similar heavy fraction sieve sizes. As expected, flotation has resulted in better fish recovery. At Dunsmore and Carson it has resulted in retrieval of smaller fish remains. At Carson this was unexpected, since the dry screen mesh size and heavy fraction sieve size were almost identical. There are surprisingly few differences between the screened components from Dunsmore and Carson, despite a 3.2 mm difference in mesh aperture.

Chapter 5 presents approaches from various biological, environmental, historical and archaeological subdisciplines that can help interpret archaeological fish remains. The ethnohistorical sources contain some useful details on technique of capture for fish, involving nets, canoes, and spears, although it is recognized that the described events may have been atypical, and that precontact fishing may have differed substantially from that of the early contact period. Reliance on current biogeographical data for species presence or absence in the past results in some circular arguments. In order to understand what kinds of habitats were exploited, it is useful to employ habitat preference studies. A tabulation of habitat preferences at each site displayed considerable differences. The taxonomic distribution at the Barrie site suggests an emphasis on open water, large bays and estuaries, while those at Dunsmore and Carson show an emphasis on large bays, estuaries and coastal marshes.

Since species were not equally available throughout the year, however, seasonal variation in fish behaviour must also be considered as well as habitat. Both active and passive fishing techniques can be expected to have left signatures in terms of quantity of remains, co-occurrence of taxa, and, especially, fish element size. For example, fish caught with techniques of mass capture would probably show somewhat restricted size range in each depositional context.

The 25 or so fish species represented at each site exhibit great seasonal variation in habitat and behaviour, and for most species a spawning-run catch implies something very different in terms of fishing strategies than does a non-spawning-run catch. It was, therefore, necessary to somehow distinguish mature from immature fish in species that can be readily caught both during the spawning season and outside of it. The second application of fish element size, therefore, is as an approximation of state of maturity, in order to identify probable spawning-run catches. For example, if the reference specimen of species A is 30 cm long, and the size at maturity for both sexes in local waters is 15 cm, it can be argued that fish cranial bones less than half the size of the comparable measurement in the reference specimen probably belong to immature individuals. Macroscopic size observations and osteometrics can thus be used as a general guide for maturity and hence time, location and mode of capture. Mature fish may have been part of a spawning-run catch, whereas most immature fish were not. Immature fish could still have been caught at the time of the spawning-run, but for most taxa this represents a different intensity of fishing effort, in a different location.

Working at the feature level, we examined differences in fish faunal assemblage composition that may reflect differences in timing of procurement events and refuse disposal. This suggests that, while some taxa were probably exploited mostly during their spawning-run, other taxa were exploited throughout the warmer months, including, but certainly not restricted to, their spawning season.

Calcified structures, such as scales and pectoral spines, offer the potential of establishing age structure of the catch, as well as season of capture. The age of the fish can be used to infer whether the individual was sexually mature or not. This is a major benefit, since age is a more reliable indicator of maturity than size.

Using these diverse sources of information, fish remains
from the Barrie, Dunsmore and Carson sites were assigned to one of three fisheries complexes: 1) Spring Spawning-run Fishery: a watercourse-oriented inland fishery that focuses on intensive exploitation of spring-spawning taxa such as the lake sturgeon, white sucker, longnose sucker, yellow perch and walleye; 2) Generalized Warm Weather Fishery: a generalized bay or inland fishery for opportunistic warm weather exploitation of resident taxa that do not aggregate in harvestable quantities during their spawning-runs, such as pikes, brown bullhead, members of the Sunfish family, and of immature and non-spawning yellow perch; and 3) Lake Fishery: a lake-oriented fishery on Kempenfelt Bay and Nottawasaga Bay that included inshore exploitation of autumn-spawning Salmonidae.

Fish may be found together in a deposit because they inhabit the same waters and/or they spawn together and/or they are amenable to the same techniques of capture. Chapter 6 provides details of the fish assemblages, and discusses how fish remains from individual features and from the site as a whole relate to the Three Fisheries Model. The Barrie site fish assemblage is dominated by lake sturgeon and yellow perch. The most productive and predictable place for a sturgeon fishing expedition would probably be at or close to the mouth of the Nottawasaga River during the spring spawning-run. The size distribution of yellow perch suggest that the majority were sexually mature when caught, and the contents of certain features appear to be the result of mass-capture events. The ratio of cranial bone to vertebrae may indicate that more off-site processing was practised at Barrie than at the later two sites, and thus suggest a substantial exploitation of waters away from the site, which may have made catch site decapitation more desirable.

Fishing at Barrie appears to make use of rivers and the lake shore, rather than the local stream.

At the Dunsmore site yellow perch is the most important taxon, followed by brown bullhead, Pumpkinseed and northern pike. The average size of brown bullhead cranial bones suggests they belonged to mature individuals. In contrast, the northern pike are probably mostly not sexually mature. The yellow perch are on average somewhat smaller than those at Barrie, and represent a wider range in total length. The difference is most marked in the heavy fraction, suggesting that more intensive flotation would have weighted the assemblage further in favour of smaller individuals. Unequivocal evidence for spring exploitation comes from age and growth analysis on brown bullhead spines (although this does not necessarily represent spawning-run exploitation) and Percidae scales.

Fish assemblages from Barrie, Dunsmore and Carson to suggest inter-site differences in fishing strategies and processing. Fish cranial bone sizes are on average smaller at Dunsmore and Carson. Since recovery at Barrie was more favourable than at Dunsmore, we may assume that differences in average fish element sizes between these two sites are not entirely the result of taphonomic factors; the larger fish element sizes at Barrie may be the result of a greater emphasis on Lake Simcoe. In this respect it is informative to compare Dunsmore and Carson, which are relatively close in time and space. Relative size observations and osteometrics on cranial bone, as well as age-at-death data from spines and scales suggest that differences in fish element size and age between Dunsmore and Carson are not solely a function of differing dry screen mesh sizes. Osteometrics of brown bullhead opercula and growth studies of pectoral spines show a trend towards smaller/younger fish at Carson, both in terms of size distribution and average age. If these fish were caught in Little Lake, it may suggest that fishing in this limiting environment was causing a decline in average size. A similar decline in cranial bone size through time is observed in yellow perch. A decline in mean size caused by fishing pressure is most readily acceptable if the
site occupants were exploiting the same population of yellow perch, probably in the lagoon at Kempenfelt Bay, or the tributary streams. The Three Fisheries Model, however, suggest an alternate explanation: the yellow perch at Barrie were mostly obtained during the Spring Spawning-run Fishery, whereas those at Dunsmore and Carson were mostly obtained during the Generalized Warm Weather Fishery, which is to hypothesized to have included larger numbers of smaller fish. There is also a decline in average age of walleye scales. While there are many large fish represented at either site, the decrease in average age between Dunsmore and Carson may indicate slightly increased pressure on the walleye populations.

Decrease in net mesh apertures is an unlikely explanation for the size differences, since the nets were handmade from plant fibres, and probably displayed a lot of variation in mesh aperture within a single net. Local fisheries biologists have suggested that fish community structure could change quite rapidly, even with modest levels of exploitation, especially in a body of water such as Little Lake, or under heavy spawning-run exploitation. A decline in average fish size in the population can only be explained if the Dunsmore and Carson people were using the same location to fish. If the fish element size decline is a result of extended fishing in the same location over a period of maybe 50 years, it may support the relative chronology of site sequences based on the radiocarbon dates.

When combined, the evidence appears to support differences in location of fish capture. Lake sturgeon bones at the Barrie site suggest exploitation of the Nottawasaga River. Yellow perch at all three sites were likely obtained from Kempenfelt Bay of Lake Simcoe and tributary streams. The large numbers and larger element size of yellow perch suggest a more intensive exploitation of Lake Simcoe and tributaries at the Barrie site. Both the species and size/age distributions of the remaining taxa indicate a growing emphasis on Willow Creek and Little Lake at the Dunsmore site and, especially, at the Carson site.

For comparative purposes the three sites near Kempenfelt Bay were compared with three precontact sites located on Lover’s Creek, south of Kempenfelt Bay, the Wiacek, Hubbert and Molson sites. Large numbers of suckers at these sites appear to indicate a more consistent, stronger emphasis on spring time exploitation and/or lake fishing. Most striking, however, are the large numbers of lake trout, lake herring and lake whitefish at the Molson site, which was occupied in the last decades before contact.

These freshwater Salmonidae were probably more important at all these sites than the limited cranial bone counts suggest. Cranial bones may have been left at the catch site, or they might not have preserved well because of their oily, fragile nature. Vertebrae, on the other hand, would be brought back to the site, either in a whole fish, or as part of a fillet. When vertebrae are added to the cranial bone counts, Salmonidae representation at the Barrie site, for example, increases substantially. Despite these taphonomic issues, however, it appears that only in the seventeenth century, with the occupation of the Molson site, do we see the start of the intensive autumn lake fishery that became one of the most important aspects of the economy during the early contact period. The autumn lake fishery differs from other kinds of fishing activity, both qualitatively and quantitatively. This fishery would have been extremely productive, both in terms of volume of fish that could be obtained in a short period of time and their nutritional value (especially lake trout).

Analysis of non-fish taxa provides support for the trends identified above. The occupants of the Barrie site appear to have had a more seasonally focussed fishing strategy and a concurrent focus on birds and mammals preferring riverine environments and deciduous /coniferous forest. This may indicate that there were few clearings or secondary growth areas in the vicinity of the Barrie site. It was expected that continued human occupation of the area around Kempenfelt Bay would have resulted in more evidence of forest clearance and forest edge habitats at Dunsmore and Carson. Indeed, the emphasis on local, predictable, small-unit resources at Dunsmore suggests these resources were specifically targeted. Contrary to expectations, the Dunsmore and Carson sites contained fewer of these disturbed habitat species than the Barrie site. This finding is less contradictory than it seems. The pristine environment may have offered more subsistence options, however, the lack of forest edge and clearance habitats may have directed subsistence efforts towards a more limited range of habitats. Thus, while the Barrie people travelled further for their fish, they also small mammals that were attracted to the horticultural activity around the site. In this respect relative representation of deer bones is informative. The fact that this area of Ontario provides little suitable deer habitat is reflected in small numbers of deer bones at all three sites. However, there are substantially more at the Barrie site than at the later sites. While deer thrive in forest ecotones, they will also browse on stands of corn. The presence of deer is, therefore, compatible with the pioneer status of the Barrie village – deer would be attracted to the novelty of the newly created corn fields. They may also relate to the hypothesized greater mobility of the Barrie people, enabling them to encounter deer in adjacent areas that had larger deer populations. The abrupt decline in deer representation at Dunsmore and Carson could have been in part the result of the hunting efforts of the Barrie people; they may have reduced the already minimal deer populations to such an extent that hunting them was no longer feasible. Alternatively, the deer at the Barrie site may have derived from areas further south.

A major difference between these three sites is seen in the reliance on dog, which is much greater at Carson than at the other two sites. People can make up for a loss of animal protein from large mammal resources by more intensively exploiting the smaller mammals and the one domesticated resource, the dog. Dogs may thus have allowed and/or encouraged people to spend more time in and around the
village. This fits with the interpretation of the deer data, and
the more local focus of fishing efforts.

Species diversity also fits the fish and mammal data. Species
richness indexes for fish are very similar at all three sites.
Species richness of mammals and birds reflects the more
limited range of environments exploited at the Barrie site,
again confirming its “pioneer” status. Richness of fish, bird
and mammal is greater at Dunsmore than at Carson. This
may relate to the relative site chronology. The Dunsmore
people were exploiting a more pristine environment than the
Carson people in the same general catchment area and may,
therefore, have been slightly less focussed on resources
available in and around the village. Or the greater species
richness may relate to functional differences within the
occupation at Dunsmore. The decrease in number of species
exploited at the Molson site, the latest of the Lover’s Creek
sites, may relate to an increased focus on the autumn Lake
Fishery.

Among the contact period Huron, fish, especially
Salmonidae, were a staple, while meat of mammals and birds
was a welcome seasonal supplement. This in contrast to the
more diffuse strategies of the precontact period, with an
emphasis on shallow water fish and smaller mammals. The
fishing economy of the Barrie site is more focal than that of
Dunsmore and Carson. This is evident from the taxa
exploited, their sizes, and the richness and evenness of the
fish assemblage. It appears that the economy documented in
the early contact period can be viewed as an extension of the
general precontact subsistence pattern. What has become
obvious through this research is that there are many
variations within this general precontact pattern. It will
always be a challenge to separate out taphonomy,
environment and human preference, but this
multidisciplinary approach has provided some new insights.