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A Geographical Interpretation Of Recreational Waterways, With Special Reference To The Trent-severn Waterway

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A GEOGRAPHICAL INTERPRETATION OF RECREATIONAL WATERWAYS, WITH SPECIAL REFERENCE TO THE TRENT-SEVERN WATERWAY

by

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ABSTRACT

This thesis is an attempt to isolate the spatial and other characteristics of waterways whose function, especially in terms of boating, is predominantly recreational.

The thesis makes use of available unpublished data on the Trent-Severn Waterway in Ontario, Canada to establish the elements of a descriptive model which could have validity in other recreational waterways elsewhere. The topological unity of the Waterway at various levels of navigability and its dendritic, quasi-linear form are established and described using a variety of indices, old and new, derived from graph theory.

A further extension of graph theoretic analysis which includes a dynamic component permits the division of the Waterway into seven or eight functional regions based on the destinations of boat trips. The discreteness of these regions results from the predominance of short trips that exhibit a high degree of directional balance. The zones of low traffic density between the regions are termed "cols."

The diversity of the regions is demonstrated by descriptions of the "personality" of each. Boat and boater characteristics are shown to differ considerably among regions.

Limited observational evidence suggests that there is a concentration of recreational activity in the vicinity of the land-water interface. For this and other reasons (*e.g.*, sensory images and perceptions), the Waterway may be considered to extend some distance away from the water itself.

The thesis takes a cursory look at other recreational waterways, and offers the suggestion that the model derived from the Trent-Severn Waterway may have general application to recreational waterways.

PREFACE

The reader who opens this thesis out of a casual interest in boating or other water-oriented activities will not find herein an opportunity to enjoy vicariously a recreational experience. Instead, he will observe that the bulk of this study is based on masses of statistical information. The acquisition, processing, and interpretation of these data have been pursued over a period of several years, with the help and encouragement of many agencies and individuals.

The direct financial assistance of The Canada Council, The Government of Ontario (through its Ontario Graduate Fellowship programme), The Government of Canada (through its National Parks scholarship programme), and Trent University is gratefully acknowledged. Equally important and also acknowledged with thanks is the information provided by the Ministry of Transport of the Government of Canada and by the erstwhile Department of Lands and Forests of the Government of Ontario. Officials of both of those agencies willingly provided whatever help they could.

Inevitably, the most tedious and time-consuming stages of conducting such research are beyond the capacity of any one individual. I am deeply appreciative of the long hours devoted to these tasks by many individuals, but particularly by Douglas Barr, in carrying out the meticulous tasks of cartography, by Cathy Hewton, in applying her usual diligence and efficiency to the typing of the manuscript, and by my wife, Lois, whose assistance in processing the data was absolutely

indispensable. All of them worked under pressure, and all of them gave of themselves ungrudgingly.

The responsibility for interpreting the data must lie with the author. He has had much help, however, from various colleagues, and the members of his advisory committee, Professors Nicholson, Hossé, and Butler have offered valuable criticisms and have bent over backwards to expedite the completion of this work.

Much credit must go to the other authors cited in the list of References, who have unknowingly laid foundations for this thesis. Their works are cited in the text wherever appropriate, using a numerical coding of the references according to the alphabetical sequence in the list of References.

I reserve the warmest thanks for those who have continuously, but unobtrusively, offered encouragement in the years since the thesis was undertaken. I refer to my friend and colleague, Peter Adams, and above all to my wife.

F. M. H.

Peterborough, Ontario
August, 1972.

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CHAPTER ONE

INTRODUCTION

1.1 RECREATIONAL TRAVEL AS AN AREA OF GEOGRAPHIC STUDY

Mankind, particularly Western Man, is one of the most mobile of species. He travels far, and he travels often. He travels by many media, and he travels for many reasons. His travels have been of profound interest to historians, and have been the subject of literary works in many languages. The interest of geographers in man's travels is by its very nature a spatial phenomenon, and geographers concern themselves with the spatial dimensions of many phenomena.

The geographical study of travel is far too broad a field to be treated in depth in any single study. In fact, for some geographers, who define the discipline as the study of "spatial interaction,"[1] the geographical study of travel is tantamount to Geography itself. A detailed study of the patterns of man's movements over the face of the earth can give insight into many aspects of "the vast overriding system on the earth's surface comprised by man and the natural environment" (Ackerman, 1, pp. 8-9). In the investigation of this system, Geography proceeds by "dividing the earth into meaningful parts" (Broek, 31, p. 5), and the individual geographer makes his contribution either by offering a logical system of fragmenting the earth's surface for the purpose of detailed study, or by synthesizing a number of diverse elements into "comprehensive regions." The present study is directed towards the first

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[1]E.g., Edward L. Ullman. See, for example, Ullman, 142, p. 56, wherein he first proposes this definition, subsequently elaborated in Ullman, 143, pp. 1-13.

of these two objectives. It uses travel patterns of a particular kind to characterize portions of the earth's surface as recreational waterways. If recreational waterways can be conceptualized through this approach, then a foundation will have been laid for their further study.

One can disaggregate the study of human travel into problems of manageable dimensions in a variety of ways. The customary approach is to consider only a single mode of travel (e.g., train, car, etc.) and to study it in depth. Another alternative is to focus on travel for a particular purpose (e.g., journey-to-work studies, consumer shopping behaviour, etc.). This study concerns itself with recreational travel, and, more particularly, recreational travel by boat.

The geographical literature contains several studies purporting to deal with patterns of recreational travel, most of them by other media than by boat, of which the studies by Wolfe (159; 160; 162; 163); Klopchic (89; 90; 92), Canadian Government Travel Bureau (43), Ellis and Van Doren (57), and Boggs and McDaniel (10) are typical. In most of these studies, that which is called recreational travel is only partly so. The studies deal primarily with travel to and from the site at which recreation is carried on. Such travel often does have recreation as one component in its motivation, but it is in many cases not the primary motive, in that very often the experience of travelling is not that which the traveller is seeking but simply the means of reaching that which he is seeking. The distinction is blurred, but in the case of recreational boating it is not necessary to make the distinction at all, for the recreational experience usually begins from the moment that the journey begins. In other words, recreational travel is almost entirely recreational in its purpose when it is by boat. The journey itself is recreation. This study, therefore, deals with patterns of boat travel while the boats are actually being used for recreation, rather than the patterns of travel to and from the recreational area. It studies mobility in recreation, rather than mobility as one of the well-known factors contributing towards recreation. The existing studies of recreational travel and recreational highways are not analysed in detail here as their contribution to this study is minor.

1.2 RESEARCH OBJECTIVES AND STRATEGY

The objective of the research described in this thesis is to analyse and thereby clarify the concept of recreational waterways. In doing so, it is not intended simply to analyse the terminology or to provide a definition for the term. The name "recreational waterways" is merely a convenient label for parts of the earth's surface which have a particular set of properties and which are identifiable by that complex of characteristics. The aim is to describe rather than to define. The study constructs a descriptive model of the concept, basing it only on the lemma that a waterway, to be a recreational one, must be used predominantly for recreational purposes. This working definition is a functional rather than a descriptive one. In addition, there is an implicit element of form in the definition: for a variety of reasons, it makes little sense to treat an isolated lake as a waterway, even if it is predominantly a recreational lake. The concept which this thesis analyses relies on the notion that the essence of a recreational waterway lies in its internal functioning and its configuration, both of which are described in some detail in subsequent chapters.

The basic strategy of the research is to discover whatever unity or disunity there is in recreational waterways, initially by examining their physical unity, but ultimately by measuring the mobility of one of their functional components, the boats themselves. Recreational waterways are examined with a view to assessing the extent to which they approximate functional regions. Functional regions are defined in such a way as to preserve the unity of places which are in some recognizable way interdependent, regardless of any internal diversity of attributes. They commonly focus on some node of intensity, to which forces gravitate, or from which they emanate, at specified levels of intensity. An example of a functional region is one encompassing all places having a majority of people subscribing to a given newspaper. Commonly, a distinguishing characteristic of functional regions is centripetal or centrifugal movement, intensifying near the core and diminishing outward from it. It should be noted that the study of travel patterns by recreational boats is not an end in itself, but merely a way of establishing and portraying the essence of recreational waterways.

1.3 ON THE USE OF A CASE STUDY APPROACH

This study originated when it was observed that on one particular recreational waterway, the Trent-Severn Waterway in Southern Ontario, the spatio-dynamic characteristics were distinct from the paradigm of waterway traffic that is commonly held. Further reflection and investigation led to the conviction that the Trent-Severn Waterway is not unique in possessing these attributes, but that it represents a whole class of waterways in which recreational boating is important, all of which share, to a greater or lesser degree, these same attributes. The elements of the descriptive model to be presented in Chapter 8 are all abstracted from the Trent-Severn Waterway, which is a recreational waterway *par excellence*, and it is therefore useful to focus this study on that waterway so that the model may be presented in a realistic context. Without such a concrete focus, the model would seem too abstruse to be recognizable as a contribution to a science which purports to achieve greater understanding of the earth. It is heretical even for the most *avant-garde* of theoretical geographers to cut into the circumference of scientific reasoning at the point of generalization. As geographers, in contradistinction to geometers or other mathematicians, we conventionally go from the specific to the general and then back to the specific.[2] It is with this justification that the entire study is carried out with reference to a single case.

To assert, as has been done in the preceding paragraph, that the Trent-Severn Waterway is a recreational waterway, before the distinguishing characteristics of recreational waterways have been identified or specified invites criticism. It is inherent in the nature of scientific thought that *a priori* judgments must be made. If the model that is developed from a study of the Trent-Severn fails to represent the idea which the writer is seeking to communicate, then the choice of that example was faulty and not the model to which it gives rise. In this case, however,

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[2]This point is stressed by Berry (7, p. 3).

the general concept of a recreational waterway arose from the particular case of the Trent-Severn, so the choice of the example is necessarily correct. What one may question, therefore, is the generality of the model, and the testing of this proposition is largely left for subsequent workers who may wish to adopt the concept of a recreational waterway as epitomized by the Trent-Severn Waterway.

The model of recreational waterways that is developed in this study is essentially a geographic model. The author is by training a geographer, and those who are most likely to make further use of the concept are also geographers. For these reasons, the symbolization used in developing and presenting the model employs the tools of communication of the geographer: cartographic representation, numerical symbolization, and the particular set of verbal symbols familiar to and accepted by geographers.[3]

1.4 CORRIDORS

To facilitate the comprehension by geographers of the descriptive model of recreational waterways, this thesis, and indeed other descriptions of the Trent-Severn Waterway (e.g., Canada-Ontario Rideau-Trent-Severn Study Committee, 42), make use of the concept of corridors by way of analogy. As a verbal symbol, the term "corridor" has begun to assume an esoteric meaning for geographers. In separate papers published in 1969, Mayer (101, pp. 46-49) and Whebell (156) have used the term to describe a particular settlement pattern. Haake has aided in clarifying this use of the term by referring to them as "urban corridors" (Haake, 74). The significant aspect of the connotation which geographers are imputing to this term is its internal functional unity. Corridors are

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[3]For a brief discussion of geographic methodology, see Balchin (4, pp. 8-10).

recognizable because of their components, which, in all three of the references cited, are cities, and because of their linear arrangement. This connotation is clearly at variance with another conception of a corridor as a means of penetration through mountains (e.g., the Khyber Pass) or through politically unfavourable terrain (e.g., the Berlin Corridor, the Polish Corridor, etc.).[4] The only point of similarity between the emerging use of the word and its earlier meaning is the spatial configuration of corridors, which is essentially linear. Whebell stresses that they are narrow (Whebell, 156, p. 26), "in general not more than a mile" in width (Whebell, 156, p. 14), but recognizes that they extend laterally beyond that distance through "secondary diffusion" (Whebell, 156, p. 4). The linearity of corridors, whether viewed as passes or as functional systems, develops in response to the principle of least effort, as Whebell points out (Whebell, 156, p. 2).[5]

This thesis does not purport to provide a genetic description of recreational waterways. Therefore, it is unnecessary at this point to discuss the evolutionary components of the corridor model, as put forward by Whebell.[6] Instead, if we are to focus on the contemporary elements of what geographers refer to as corridors, we discover that they consist of a series of nucleations, or nodes, with lower densities between them. Through diffusion, spatially separated foci of settlement in any corridor develop similar functions and characteristics, and may

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[4]Stamp, for example (Stamp, 130, p. 131), describes corridors as strips of land passing through foreign land to gain access to the sea. Schmieder et al. (125, p. 55) and Monkhouse (104, p. 88) give similar definitions.

[5]This is why, as Gajda has pointed out (Gajda, 62, p. 11), much of Canada's frontier settlement occurs "in a strip-like fashion."

[6]For example, his description of a "culture gradient."

therefore be unified conceptually into a single formal region. Individually, however, each node has unique properties related to its local and regional resource endowment, and has its own system of complementary relationships with its umland. Around each node there is a pattern of centrifugal and centripetal flows of information and materials. The areas within which these flows occur are therefore classic cases of functional regions.

It is less clear whether a corridor in its entirety is a formal region (as suggested above), because of the similarity of its component units, or whether it is a functional region, or indeed whether it is a region at all. Among the units of a corridor there are, by definition, "strong connecting links" (Whebell, 156, p. 1) consisting of transport routes. In order for transport routes to exist, there must be complementarity among the nodes (Ullman, 144, pp. 867-868). The dependence of corridors for their existence upon the transport links, and hence upon their internal complementarity, serves to classify them as functional regions.

The concept of an "environmental corridor" has also been proposed (Lewis, 98).[7] It emerged from the recognition that many significant landscape elements (waters, wetlands, flood plains, etc.) are "narrow linear bands" enclosed by "slopes of varying degrees," which in turn are "enclosed by rims" (Lewis, 98, p. 28), and that others not so enclosed (ridge lines and shorelines) also form "ribbons in the landscape" (Lewis, 98, p. 29). Within these resource corridors, there are clusters

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[7]Wyatt (164, pp. 129-130) used the term "environmental-recreational corridor" to denote the same phenomenon.

or nodes of "isolated specific resources, both natural and cultural, which occupy a limited space in the landscape . . . historical buildings, chasms, agate beaches, springs, waterfalls, and the like" (Lewis, 98, pp. 30-31).[8] These nodes can be made to complement each other as scenic resources if they are linked by carefully routed highways that make full use of the linear resources and seek "to create variety, surprise, and visual experiences which otherwise would be lacking" (Lewis, 98, pp. 33-34). The similar idea of a rim-enclosed "visual corridor," whether or not there are "nodes" within it, was described at about the same time by The Hudson River Valley Commission (State of New York, 131, pp. 13-15). The terms "open space corridor" and "recreational and scenic corridor" have been applied to linear routes both in valleys and on ridges (U.S. Department of the Interior, 146, pp. 30-34).

Corridors, therefore, have characteristics of both formal and functional regions. It may be that this makes them neither beast nor fowl, and that they do not deserve to be classed as regions at all. It would seem, however, to be a more useful and correct interpretation that corridors are much closer to being comprehensive regions than any which are defined solely by either formal or functional criteria. Particular cases of corridors, of course, are likely to bear a closer resemblance either to one or to the other category. In summary, corridors are regions themselves while containing functional regions within them.[9] Many of the above elements of corridors are noted in the model of recreational waterways presented in Chapter 8.

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[8] All of these concepts were first recognized in Illinois and later transferred elsewhere (Lewis, 97, p. 63).

[9] It will be noted that there has been little need to attach importance to the boundaries of corridors in order to analyse the concept.

1.5 RECREATIONAL WATERWAYS IN THE GEOGRAPHIC LITERATURE

There is a large and growing volume of literature, by geographers and others, on many aspects of outdoor recreation. Many of the outdoor recreation studies pertain to the land which is used for recreation. Many others deal with the participants, - their social-economic characteristics, their geographic origins, their motivations and preferences. Few concern themselves with the mobility of the participants or with their travel patterns within a recreational area. The geographic study of outdoor recreation, in those cases which have focussed on recreational areas, has been largely a static study. Recreational areas have been treated as formal (i.e., uniform) rather than functional regions. As a study of a recreational area, this thesis is unlike others in the field of recreational geography. It is, in many respects, more of a study in transportation geography than a study in recreational geography, if the distinction can be drawn on the basis of the existing literature. It has been suggested (Wolfe, 161) that recreational geography may be thought of as one aspect of transportation geography, but few of the recreational studies done by geographers conform to such a pattern.

Of all the world's surface waters, the area in which pleasure-boats comprise an important segment of the water-borne traffic is extremely limited. This is largely due to the typically small size of pleasure boats, which confines them to inland or otherwise sheltered waterways. Moreover, mass participation in recreational boating, as in many other forms of recreation, can come about only where a population is large and has sufficient income, leisure time, and mobility (Clawson, 49, p. 34), and these features occur widely only in North America, Europe, and Australasia. The paucity of waterways which share both of the aforementioned conditions is reflected in a corresponding scarcity of descriptive or analytical studies of such waterways. What constitutes a recreational waterway is a question that has scarcely been considered at all.

The Government of Great Britain, recognizing that certain existing canals and rivers can no longer usefully form part of a commercial transport system but do have "a potential for all kinds of recreation" (G.B. Ministry of Transport, 71, p. 2), has designated them as "cruising waterways" or "cruiseways" (G.B. Ministry of Transport, 71, p. 3), and maintains and administers them exclusively "for amenity purposes, such as pleasure boating (G.B. Central Office of Information, 70, p. 13). In making the distinction, for administrative purposes, between commercial and non-commercial waterways, the criterion was that the former "can form an economic transport undertaking together with such allied facilities as docks and warehouses (G.B. Ministry of Transport, 71, p. 2). While basing the categorization of waterways on their function and their economic viability, the White Paper (G.B. Ministry of Transport, 71) nevertheless recognized certain other essential or characteristic elements of recreational waterways. It noted the importance of "through or ring routes" in the network, and stressed the need to ensure connectivity among them by maintaining connections from one part of the system to another at a standard of navigability suitable for powered pleasure craft

(G.B. Ministry of Transport, 71, pp. 3-4).[10] It also pointed out the interdependence between recreational use of the waterways themselves and the character of the surrounding environment (G.B. Ministry of Transport, 71, p. 5). Finally, it recognized the actual and potential use of recreational waterways by anglers, canoeists, naturalists, and other users with a variety of recreational interests (G.B. Ministry of Transport, 71, p. 6).[11] Beyond stating these general characteristics of recreational waterways, the paper undertook no detailed analysis of the elements that make up a system of interconnected boating waters, and almost completely ignored its spatial characteristics.

In Ontario, a study of waters suitable for recreational boating drew no a priori distinction between recreational waterways and others (Dominion Consultant Associates, 53). It included discussion of the Welland Canal, a largely commercial waterway, on the same basis as other waterways with a more obviously recreational function. The purpose of that study was to assess the potential for recreational boating, and therefore the analysis is of potential recreational waterways rather than those in which recreation was already established. In suggesting action that would be needed to make the existing waterways into recreational waterways, or to improve them as recreational waterways, the study necessarily made explicit or implicit reference to an idealized concept, or model, of what constitutes a recreational waterway (Dominion Consultant Associates, 53, pp. 6-13). The ideal is not made explicit in the study, but it is possible to infer some of its characteristics from the nature

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[10]This was noted earlier by the British Waterways Board (13, p. 38).
[11]This was noted earlier by the British Waterways Board (13, pp. 35-36).

of the recommendations. The implied characteristics of recreational waterways are in some ways similar to those described in the preceding paragraph, the emphasis being on the availability of facilities that would permit a waterway to perform a recreational function (*e.g.*, marinas, intermittent harbours, etc.). An adequate standard of navigability in all parts of a waterway is an essential consideration. For most pleasure boats, this criterion excludes the larger bodies of water. Other attributes relate to the recreational potential of the lands surrounding a waterway, the quality of the recreational environment (especially the cleanliness of the water), and the need for some form of subsidy in order for a recreational waterway to be economically viable.

On the related questions of waterway structure and boat traffic patterns, the study mentioned two conditions which help to elaborate the nature of the implied recreational waterway concept. By suggesting possible new links within and beyond the waterways, the study identifies interconnectivity as one of the elements of the recreational waterway concept. Secondly, the study noted a discrepancy between an actual situation in which boating activity peaks strongly at certain points and a norm of traffic uniformity:

> "The present traffic pattern along the marine highway shows anything but an even flow. Clearly the ideal situation would be to have an even distribution of boats throughout the waterways all following a predictable movement pattern. Services, harbours, recreational facilities and locks could then be organized to operate with the utmost efficiency" (Dominion Consultant Associates, 53, pp. 11-12).

Where an independently conceived norm, such as this one, is at variance with the facts concerning recreational waterways, it is clear that the latter provide a better descriptive model than the former. In fact, one who proposes a prescriptive model of a phenomenon would do well to investigate a descriptive model of it first and to seek out its explanation before presuming to alter it! The present study aims to provide such a descriptive model, as a basis for explanatory and prescriptive models which others may seek to devise.

From the United States, the nearest approach to a general statement concerning the nature of recreational waterways appears in a short conference paper (Lifton, 99, pp. 182-186). As in the case of the Ontario study, this paper implies the elements of an ideal recreational waterway model, by pointing out ways in which existing non-recreational waterways could have their recreational potential realized. The essence of the model consists of a sheltered natural watercourse, made navigable through artificial improvements,[12] and used primarily by pleasure boats, but also by other users (for fishing, swimming, or picnicking) both in the water and on the adjacent land. In order for a body of water to serve as a recreational waterway, certain standards of water quality need to be met. Unlike the preceding two studies, this paper claims that recreational waterways are economically viable.

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[12] A minimum depth of about 5 feet is suggested (Lifton, 99, p. 183).

Although it is not a central concern of this thesis, the economics of planning recreational facilities on a system-wide basis has also been considered in the literature. There have been proposals, for example, to link individual water bodies artificially together so that their economic potential for recreation might be enhanced, and they might, in effect, become parts of a recreational waterway (e.g., in Michigan and in Southwestern Ontario).

The Outdoor Recreation Resources Review Commission in the United States devoted an entire volume to the recreational use of water. Its exhaustive treatment served to confirm what had already been pointed out by Campbell, that "most recreation sites in the United States contain, or are based upon, some hydrographic feature or features. The importance of water to recreation cannot be overemphasized (Campbell, 34, p. 66). As a result, that volume (O.R.R.R.C., 116) is devoted very largely to problems of classifying recreational waters. This problem, as it applies to lakes in Wisconsin, had already been attacked by Threinen (137). A more recent attempt at classifying recreational lakes (in Ohio) is that by Lentnek, et al. (95). The recognition of an interconnected system of water bodies as a "recreational waterway," by that name or any other, seems to have been overlooked in these studies.

An attempt to create a model of a particular class of recreational waterway, that of scenic rivers, has been made by Leopold (96). His model has been applied elsewhere in Canada in a study of the recreational potential of Wild Rivers in the Yukon Territory, but such rivers, as pointed out in Chapter 8, are beyond the scope of this study.

Other studies, idiographic in nature, have been done of particular recreational waterways, apart from the descriptions of the Trent-Severn Waterway which are discussed in Chapter 2.4.[13] These studies relate to examples in Europe (including France, West Germany, Holland, and the British Isles) and North America (including, among others, the Potomac, Hudson, Illinois, Tennessee, Rideau, and Grand Rivers, Lakes Simcoe, Huron, and Superior, the east and west coasts, and various other inland lakes and systems of lakes). Some of them, particularly the British ones, consist essentially of mile-by-mile route guides. Others consist of an inventory of the recreational resources along the waterways. Only two or three of them (especially Mortimer, 105 and Timme, 138) make any detailed analysis of boat traffic patterns. None of them provides even as cursory a description of the essence of recreational waterways as do the three mentioned in the preceding paragraphs (G.B. Ministry of Transport, 71; Dominion Consultant Associates, 53; and Lifton, 99). Only Wyatt's work (Wyatt, 164) recognizes certain spatial peculiarities in a recreational waterway. He notes that the resources along the Rideau Waterway arrange themselves into a corridor, and that within it there are "nodes" of greater resource concentration, and "linkages which are continuous sections of lesser intensity of resources linking the resource nodes" (Wyatt, 164, p. 130). No attempt, except the

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[13]See, for example, Bourke, 11; British Waterways Board, 13-30; Brown, 32; Fodchuk, 58; Fraser, 61, especially pp. 356-415; Hogg, 79; Johnston, 86; Klopchic, 91; Legget, 94; Lewis, 98, p. 23; Mortimer, 105; O.R.R.R.C., 116, pp. 3-4; O.R.R.R.C., 117, pp. 19-21; State of New York, 131, 132; Tennessee Valley Authority, 136; Timme, 138; U.S. Army Corps of Engineers, 145; U.S. Department of the Interior, 146; Van Doren, 147, and Wyatt, 164.

three mentioned above, has been made in any study to generalize from the particular cases in question to a representative model of recreational waterways. In that respect, this study differs from the rest.

There have been several other studies made of recreational waters that consist of single lakes, rivers, or reservoirs. Others have compared a number of lakes which do not form single interconnected units and therefore can not be regarded as recreational waterways. In either case, their contribution to a conceptual model of recreational waterways is minimal.

CHAPTER TWO

THE GEOGRAPHIC CONTEXT OF THE STUDY

2.1 THE TRENT-SEVERN WATERWAY

Any description, analytical or otherwise, of the Trent-Severn Waterway presupposes that the area to be described is a recognizable unit. Although part of the aim of this study is to establish the extent of the Trent-Severn as a recreational waterway, it is necessary to have from the outset an idea of the area within which the study is to take place, by way of an operational definition. The spine of the waterway is the Trent Canal, a system of artificially interconnected bodies of water extending between, but not including, the Bay of Quinte (Lake Ontario) and Georgian Bay (Lake Huron) in southern Ontario, Canada (see Figure 1). This system, despite its official name,[14] is a canal, i.e., an "artificial watercourse for inland navigation" (Fowler and Fowler, 60, p. 171), along only about 33 of its 240 miles of main river and lake channel (Walsh, 150, p. 1). For this reason, it is preferable to refer to it by the term Trent-Severn Waterway, which is also used on some official documents (Canada Department of Transport, 36, inset map). The name "waterway" conforms to the terminology adopted elsewhere in reference to artificially interconnected water bodies.[15] The hyphenated

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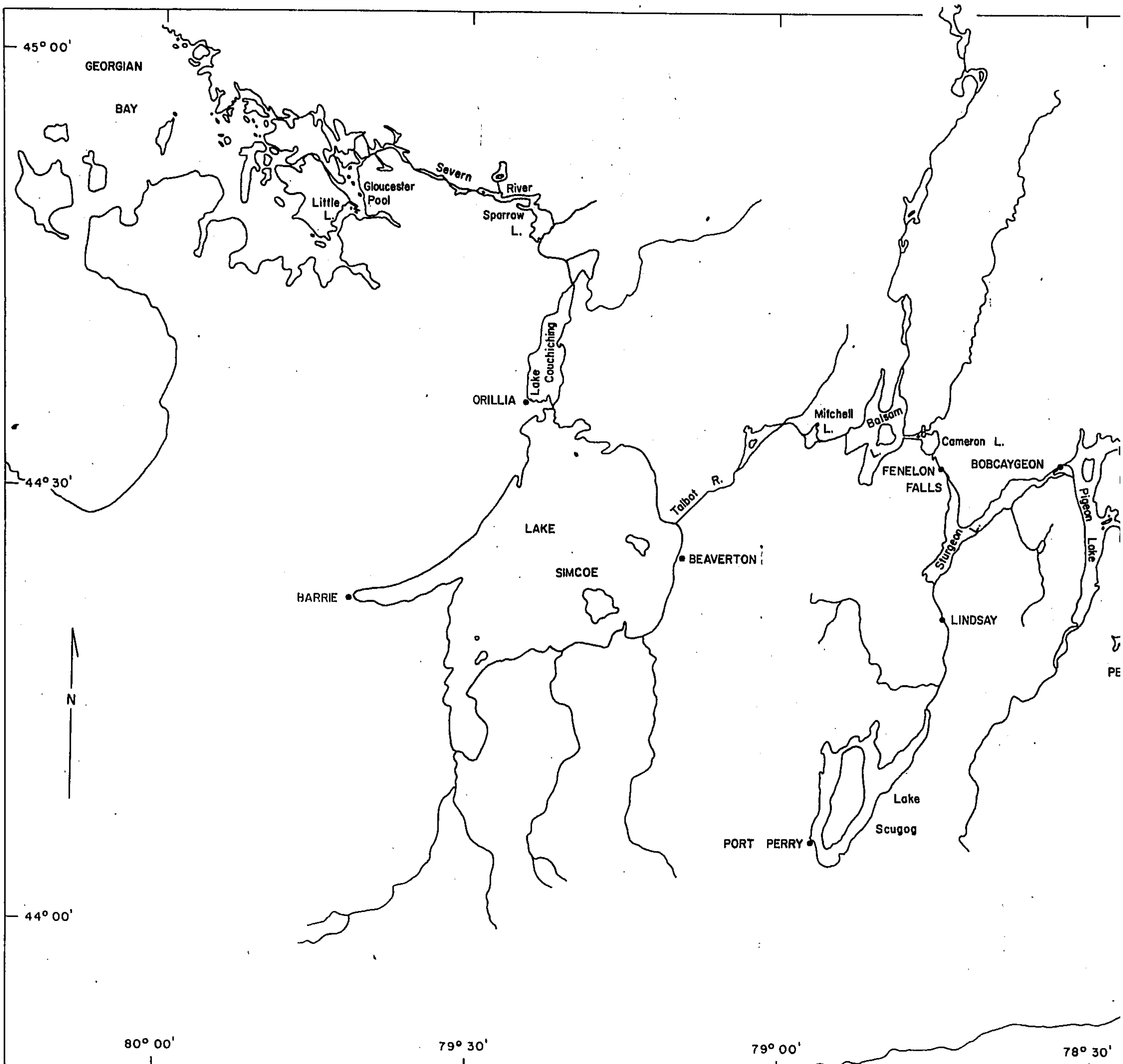
[14]as given in most government documents, for example, Canada Department of Transport, 38.

[15]In reference to the Rideau Waterway, Johnston states, "It is not a canal in the engineering sense, but a canalized river system, hence the term waterway is more appropriate" (Johnston, 86, pp. 11-12). Legget also proposes the term "waterway" rather than "canal" because the latter connotes "murky industrial traffic" as opposed to a "chain of rivers and lakes, linked by small locks and winding channels" (Legget, 94, p. 3). Veatch and Humphrys draw no such distinction between recreational or commercial uses of waterways, or between natural and artificial waterways (Veatch and Humphrys, 148, pp. 345-346).


45° 00'
GEORGIAN
BAY
Severn
River
Gloucester
Pool
Little
L.
Sparrow
L.
Lake
Couchiching
ORILLIA
Mitchell
L.
Balsam
L.
Cameron L.
FENELON
FALLS
BOBCAYGEON
44° 30'
Talbot R.
LAKE
SIMCOE
BEAVERTON
Sturgeon L.
Pigeon Lake
BARRIE
LINDSAY
N
PE
Lake
Scugog
PORT PERRY
44° 00'
80° 00'
79° 30'
79° 00'
78° 30'

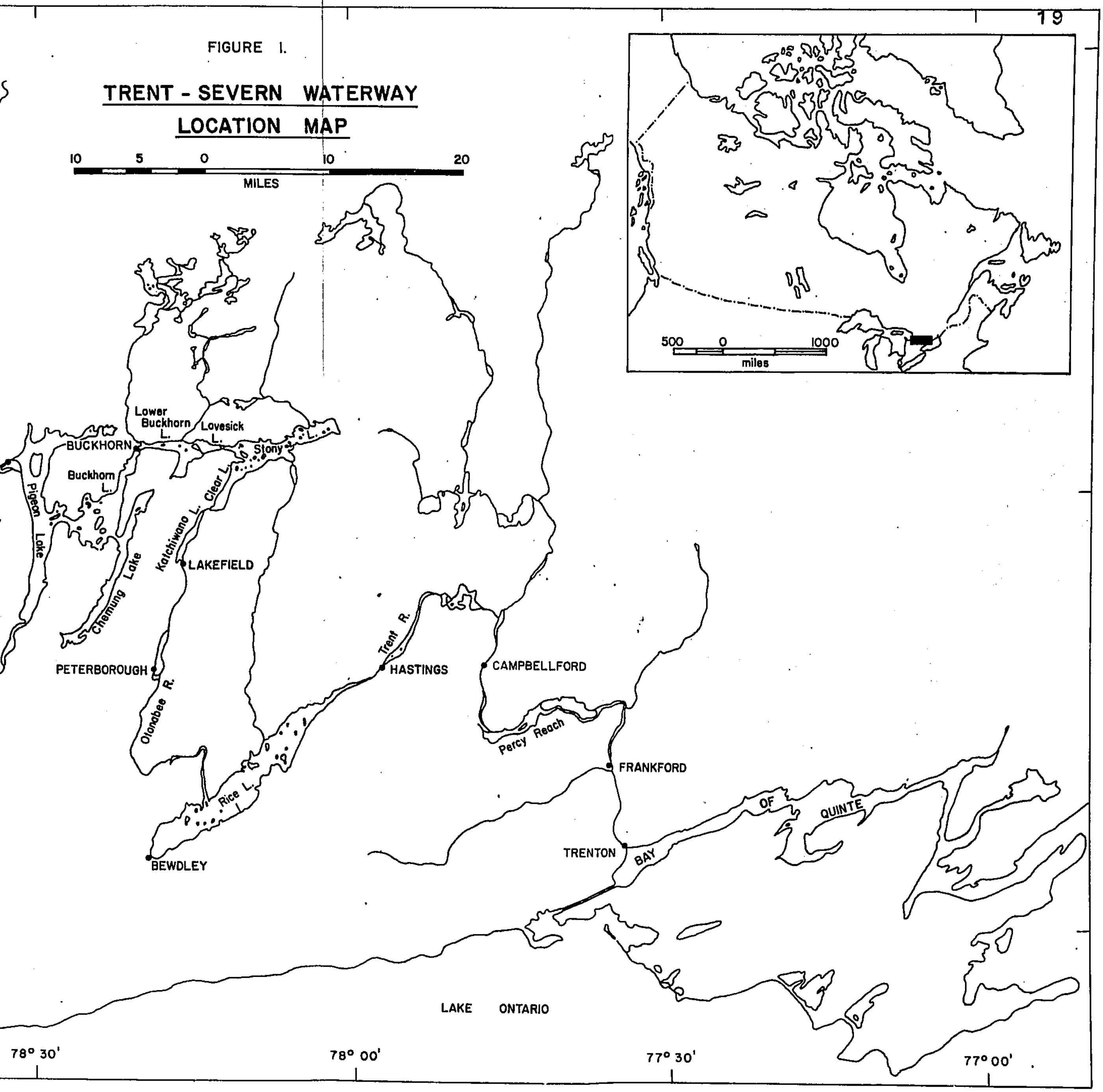


FIGURE 1.
TRENT - SEVERN WATERWAY
LOCATION MAP
10 5 0 10 20
MILES
500 0 1000
miles
Lower Buckhorn L.
Lovesick L.
BUCKHORN
Stony L.
Buckhorn L.
Pigeon Lake
Clear L.
Katchiwano L.
Chemung Lake
LAKEFIELD
Trent R.
PETERBOROUGH
HASTINGS
CAMPBELLFORD
Otonabee R.
Percy Reach
Rice L.
FRANKFORD
BEWDLEY
TRENTON
BAY OF QUINTE
LAKE ONTARIO
78° 30'
78° 00'
77° 30'
77° 00'

term including both "Severn" and "Trent" clearly encompasses the western as well as the eastern section of the system.

The natural bodies of water along the main channel of the Waterway are as shown in Table 1.

Trent River (including Percy Reach and Mud Lake)	draining eastward
Rice Lake	
Otonabee River	
Katchiwano Lake	
Clear Lake	
Stony Lake[16]	
Lovesick Lake	
Lower Buckhorn Lake[17]	
Buckhorn Lake	
Pigeon Lake	
Sturgeon Lake	
Cameron Lake	
Balsam Lake	summit level (841.0' A.S.L.)
Mitchell Lake	
Talbot River	draining westward
Lake Simcoe	
Lake Couchiching	
Severn River (including Sparrow Lake, Gloucester Pool, and Little Lake	

Table 1. Lakes and Rivers Comprising the Trent-Severn Waterway (Main channel, from east to west).

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[16] The spelling of "Stony Lake," often a point of controversy, is the official spelling, although it is given as "Stoney" in the Gazetteer of Canada (Canada Department of Mines and Technical Surveys, 35, p. 534); the latter is a typographical error, according to the Secretary of the Canada Permanent Committee on Geographical Names (Delaney, 52).

[17] shown on some maps as a westward extension of Lovesick Lake, but officially having a name of its own and separated from Lovesick Lake by a dam and a lock, with a vertical drop of 3½ feet.

In addition to these, there are marked channels, navigable for all craft capable of using the main system, to the west end of Rice Lake (6.3 miles), towards the east end of Stony Lake (5.5 miles), into Chemung Lake[18] off Buckhorn Lake (15.0 miles), into Lake Scugog via the Scugog River off Sturgeon Lake (35.0 miles), into the Gull River off Balsam Lake (6.3 miles), and into Cook Bay (including the lower Holland River) and Kempenfelt Bay of Lake Simcoe (60.8 miles). By virtue of a series of 43 locks, navigation is possible throughout this system for boats with a maximum draught of 6' 0", with the exception of a point on the Severn River, referred to as Big Chute, where a marine railway restricts passage to craft not exceeding 4'0" in draught. In this study, these water bodies, plus other adjacent ones to which boat or canoe access is feasible, and all of their adjacent lands, are considered to form the Trent-Severn Waterway. The nucleus of this system is recognized widely as a waterway unit,[19] and therefore forms a convenient and appropriate unit for study. It should be noted that the study area so designated is considerably broader than the central set of lakes and rivers, which are often referred to by the same name.

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[18]The official spelling, "Chemung Lake," is taken from the Gazetteer of Canada (Canada Department of Mines and Technical Surveys, 35, p. 100), and is used on all maps of the National Topographic Series except the 1:50,000 sheet, 31 D/8 West Half, 1956 edition, which uses the spelling "Chemong Lake." The latter spelling is also used in some documents and maps of the Department of Transport (now the Ministry of Transport).

[19]See, for example, Wells, 152; Canada Department of Transport, 36; Canada Department of Transport, 38; Dominion Consultant Associates, 53, pp. 17-19; Canada-Ontario Rideau-Trent-Severn Study Committee, 42 (this study, referred to in this thesis and elsewhere as the C.O.R.T.S. Report, also includes the Rideau because of its similar problems and potentials and its identical philosophy of development which make the whole system "a single recreational resource," p. 5, i.e., a uniform region, but it deals separately with a distinct Trent-Severn sector, whose nodal characteristics form the object of this study); and many others.

2.2 THE GEOGRAPHICAL SETTING

In very broad terms, the Trent-Severn Waterway marks the boundary between the Precambrian bedrock of the Canadian Shield and the Palaeozoic (Ordovician) bedrock immediately to the south of the Shield.[20] Stony Lake,[21] Lovesick Lake, Lower Buckhorn Lake, Buckhorn Lake, Pigeon Lake, and Lake Couchiching have outcrops of both kinds of rocks on their shores and may therefore be classed as glint-line lakes (Monkhouse, 104, pp. 157-158). The Severn River flows through the granitic rocks of the Canadian Shield along almost all of its course. From Lake Simcoe to Sturgeon Lake and downstream from Clear Lake, the Waterway lies entirely on Palaeozoic rock, principally limestone.

Much of the area traversed by the Waterway has only a thin layer of overburden, or none at all. The numerous rocky outcrops along the Severn River and on the shores of Lower Buckhorn any Stony Lakes have enhanced the reputation of those areas for scenic beauty.[22] Islands of bare rock and rocky shoals which hinder navigation are particularly prevalent in Gloucester Pool, in Buckhorn Lake (Powell, 121, pp. 28-29), and in Stony Lake (Powell, 121, pp. 28-29). These lakes may therefore be referred to as "holm lakes" (Veatch and Humphrys, 148, p. 144).

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[20] A map which clearly shows the edge of the Shield in the area concerned is contained in the endpapers of Beards (5). The map is entitled "Palaeozoic Stratigraphy of Southern Ontario" (1": 16 miles).

[21] Wolfe states erroneously that Stony Lake is completely on the Shield (Wolfe, 157, p. 150).

[22] See, for example, the descriptions in Wells (152, pp. 60 and 95-97) and in Hogg (79, pp. 79 and 84).

In other places, particularly downstream from Clear Lake and from Lake Couchiching to Buckhorn Lake, there are varying thicknesses of glacial till and clay covering the bedrock. In these areas, the topography reflects neither the flatness of the limestone bedrock surface nor the rolling nature of the Precambrian bedrock, but rather the effects of glacial and postglacial deposition. This has resulted in low or moderate relief except in the Peterborough Drumlin Field and at the eastern end of the Oak Ridges Interlobate Moraine.[23]

That portion of the Waterway which drains eastward (see Table 1) is often referred to in its upper reaches as the "Kawartha Lakes." These bodies of water are thought to occupy preglacial drainage channels that have been broadened by glacial scouring and are blocked at their southwesterly extremities by the configuration of the Palaeozoic bedrock and by glacially deposited materials. The connections among them, though established before the Wisconsin glaciation, represent a former spillway called the Algonquin River (Canada Department of Transport, 37, p. 4) through which the waters of glacial Lake Algonquin for a short period drained into glacial Lake Iroquois, the predecessor of Lake Ontario (Tate, 135).[24] To-day the water which maintains these lakes and their poorly developed connections is supplied chiefly from a large poorly drained area of the

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[23]These physical features are described in Chapman and Putnam (45, especially pp. 276-287) and in Gravenor (69, pp. 10-13).

[24]In very general terms, this explanation was offered earlier by Chapman and Putnam (45, pp. 44 and 158-160). Gravenor does not share this view of the origin of the Kawartha Lakes, but rather attributes them entirely to glacial plucking (Gravenor, 69, p. 13).

Canadian Shield with hundreds of small lakes and swamps and no major rivers. Many of the headwater lakes have been dammed to permit the retention of water surpluses which occur in spring for use in maintaining flows in the Waterway during periods of low water. The westward flowing portion of the Waterway also follows a poorly developed outlet, but the area of Lake Simcoe is much greater than that of any of the Kawartha Lakes, so the seasonality of its outflow through the Severn River is much less pronounced.

The Trent-Severn Waterway is affected by climate through both temperature and precipitation. There are nine places along the Waterway where long-term temperature records have been kept.[25] In every case, the months from April to November inclusive have mean daily temperatures of over 32°F., the warmest month being July, with a mean daily temperature of within two degrees of 68.4°F. January, the coldest month at most stations, has a mean daily temperature of twelve to seventeen Fahrenheit degrees below the freezing point of water. The mean daily temperature for the year varies from the low forties in the north to the mid-forties elsewhere. Precipitation data are available for sixteen places in the Waterway. The average annual precipitation is 33.31 inches, of which 7.43 inches falls as snow. An analysis of monthly precipitation totals shows no strong concentration in any single season.

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[25]All climatic data are taken from Temperature and Precipitation Tables for Ontario (Canada Department of Transport, 39) unless otherwise stated.

Because of the low winter temperatures, all bodies of water in the Waterway, except in a few swiftly-flowing sections, become covered with ice for a period of weeks.[26] The ice cover develops in late December, or sometimes early January,[27] and remains until after the flow of water begins to increase, which is usually about March 10. The actual break-up of the ice occurs at widely fluctuating dates from year to year. It may take place as early as March 15 or as late as the end of April. It precedes the period of peak spring flow, which occurs, on the average, on April 20.

The entire area lies in the Great Lakes - St. Lawrence Forest Region (Innis, 83, p. 53). The original climax forest was dominated by White Pine (Pinus strobus) and hardwoods, but most of the pine was cleared through lumbering and fires between 1872 and 1913 (Howe and White, 81, passim, but especially p. 9). Second growth forest, dominated by maple, beech, oak, elm, hemlock, cedar, and pine, exists to-day along almost the entire Severn section and the section from Pigeon Lake to Clear Lake. Elsewhere, pasture and other agricultural land, varying in quality from good to sub-marginal and abandoned, occupies most of the area, but along the shores of the lakes a nearly continuous band of mixed woodland exists and forms a setting for cottage and other recreational land uses.

On the shores of the Waterway are six moderately large towns and cities, whose economy is characterized by light manufacturing (see Figure 1 and Table 2):

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[26] The information on ice conditions was supplied by Mr. Featherstone, in the office of the Canal Superintendent, Ministry of Transport, in Peterborough. It is based on a 60-year period of records.

[27] Freeze-up occurs earlier on the lakes than on the rivers. Bourke gives a date of December 14 for Lake Simcoe (Bourke, 11, p. 46).

Name	Population[28]
Trenton	14,003
Campbellford	3,332
Peterborough	55,341
Lindsay	11,975
Barrie	26,233
Orillia	21,153

Table 2. Towns and Cities along the Trent-Severn Waterway

In addition, there are seven villages located directly on the Waterway (see Figure 1 and Table 3).

Name	Population[28]
Frankford	1843
Hastings	858
Lakefield	2079
Bobcaygeon	1272
Port Perry	2827
Fenelon Falls	1464
Beaverton	1249

Table 3. Villages along the Trent-Severn Waterway

The rural areas of the Waterway, as defined by the C.O.R.T.S. Committee, occupy part or all of 47 townships, and the entire area had a population of 252,000 in 1969 (C.O.R.T.S. Report, 42, p. 35).

2.3 THE HISTORICAL BACKGROUND

The area of the Trent-Severn Waterway has a history too rich in detail to be summarized adequately here.[29] Only the history of navigation is of major concern to this thesis. The chain of lakes and rivers between Georgian Bay and Lake Ontario and associated portages constituted an important canoe route for the various tribes of Indians who occupied

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[28] Population data are taken from the 1971 official road map (Ontario Department of Highways, 108) and accord with those reported in the C.O.R.T.S. Report (42, pp. 63-64).

[29] For the eastern section, see Guillet (73, pp. 216-228) and Boyce (12, pp. 167-171). A brief summary of the history and prehistory of the entire Waterway is contained in the C.O.R.T.S. Report (42, pp. 30-33).

the area prior to its settlement by Europeans (C.O.R.T.S. Report, 42, pp. 30 and 33; Boyce, 12, p. 167; Fraser, 61, p. 245). Steamboats and other craft larger than canoes began to use some of the limited navigable stretches of the Waterway almost from the moment of the first European settlement. Thus, as shown in Figure 2, the sections from Rice Lake to Peterborough, from Chemung Lake to Pigeon Lake, and from Lake Simcoe to Lake Couchiching were in use by steamboats by the end of 1833, without any artificial improvements to navigation in the form of locks (C.O.R.T.S. Report, 42, p. 33; Guillet, 72, p. 150). By 1872, the construction of several locks had made it possible to navigate 171 miles of the Waterway, but in disconnected portions, as shown in Figure 2. The system extended no farther east than Healey Falls[30] and no farther west than Lake Couchiching, and was interrupted by four unnavigable stretches: between Peterborough and Lakefield, between Burleigh Falls and Buckhorn, at Fenelon Falls, and between Balsam Lake and Lake Simcoe (C.O.R.T.S. Report, 42, p. 33). These four obstacles were overcome by 1907, with the result that 176 miles of the main channel and an additional 27 miles to Lake Scugog were open for continuous

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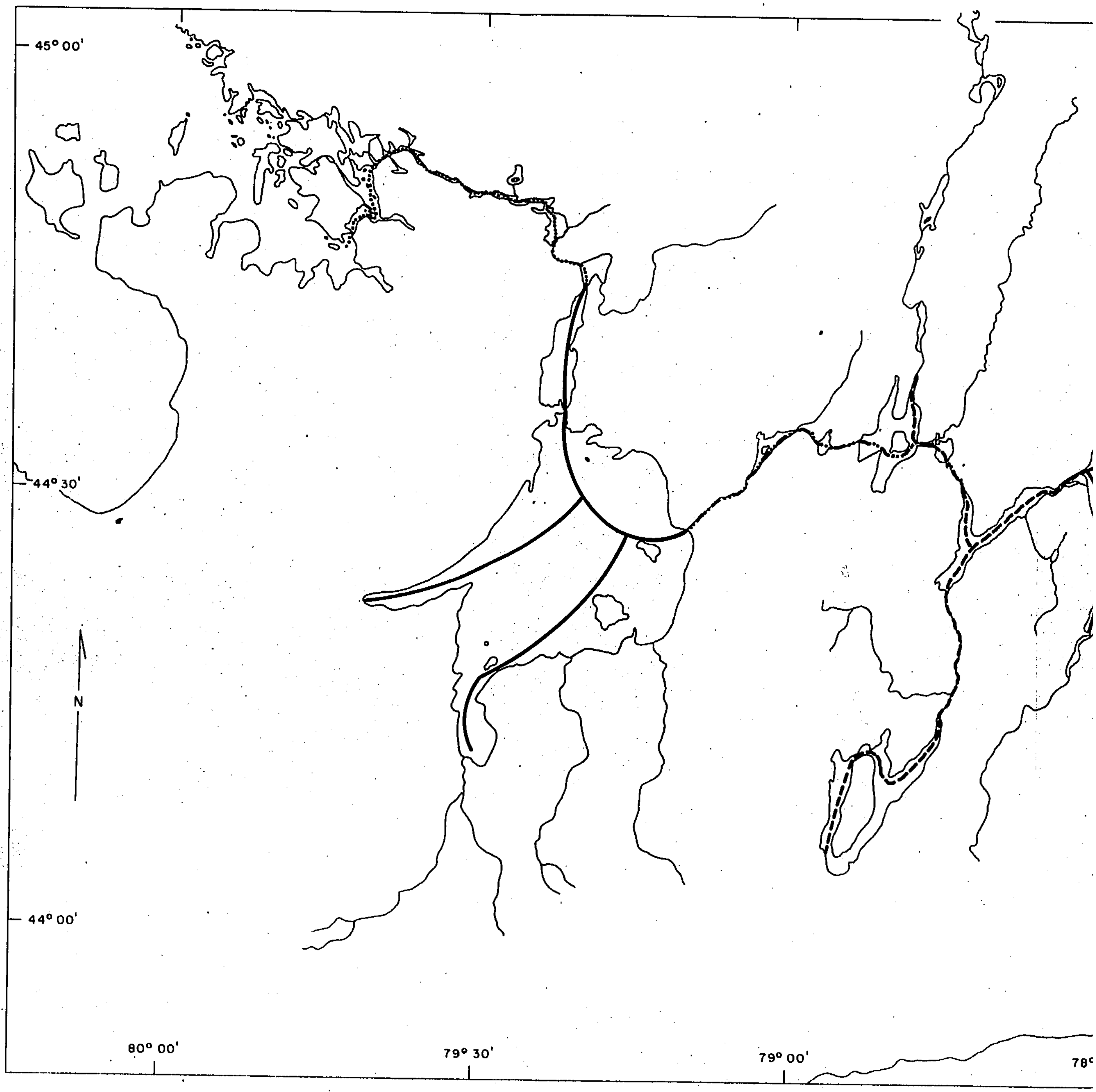
[30] The official spelling, "Healey Falls," is taken from the Gazetteer of Canada (36, p. 236), and is used on the 1:50,000 sheet, 31 C/5 West Half, of the National Topographic Series. The spelling, "Heeley Falls," is used on the 1:250,000 sheet, 31C, of the National Topographic Series, and "Heely Falls" is used on some Department of Transport documents and by Wells (152, pp. 33, 38, 39, 106, 118). These and other spellings are used in Guillet (73), e.g., pp. 185, 201, 226, 230, where four different versions appear.



45° 00'
44° 30'
44° 00'
N
80° 00'
79° 30'
79° 00'
78°

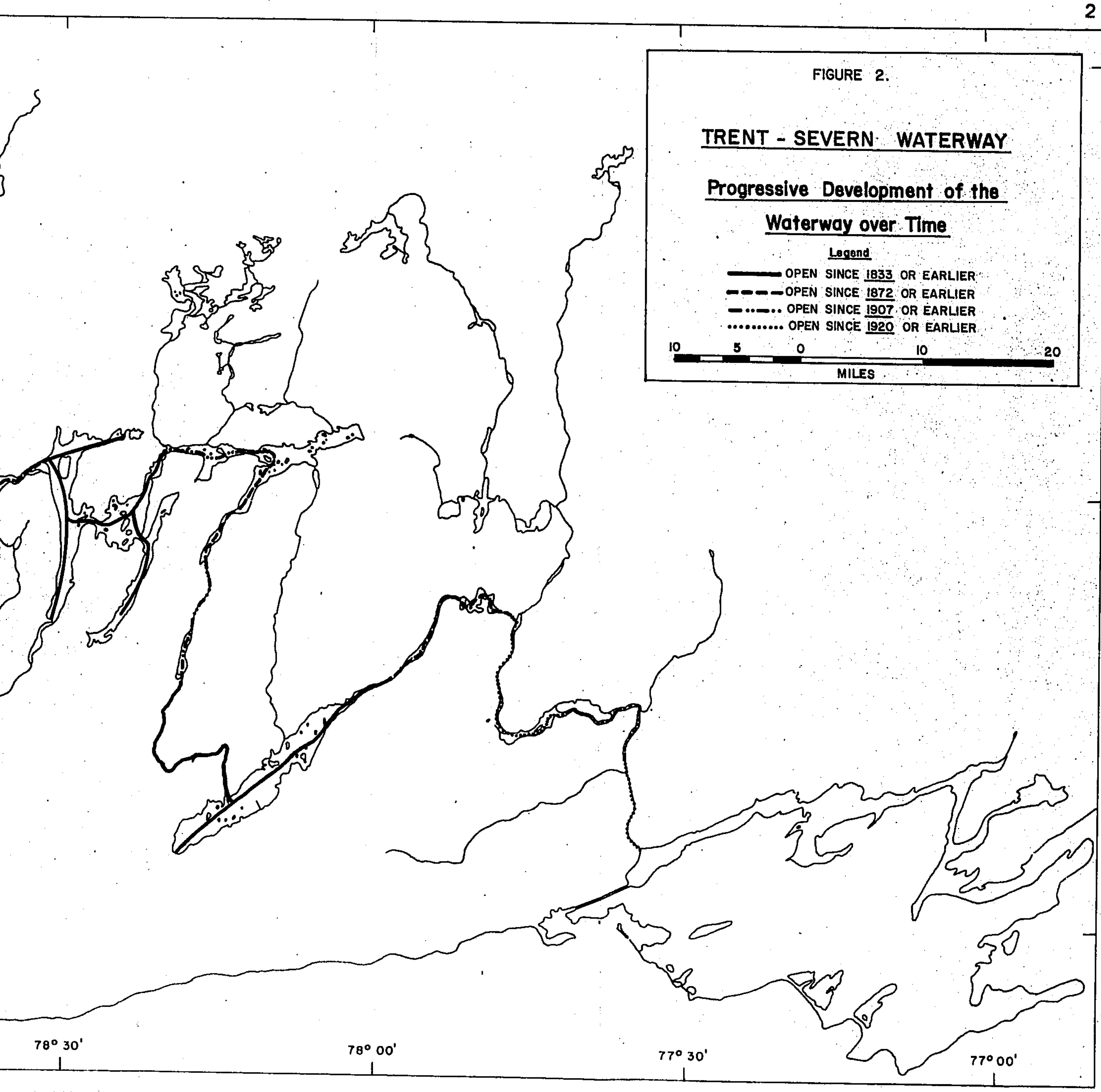


FIGURE 2.
TRENT - SEVERN WATERWAY
Progressive Development of the
Waterway over Time
Legend
OPEN SINCE 1833 OR EARLIER
OPEN SINCE 1872 OR EARLIER
OPEN SINCE 1907 OR EARLIER
OPEN SINCE 1920 OR EARLIER
10 5 0 10 20
MILES
78° 30'
78° 00'
77° 30'
77° 00'

navigation (C.O.R.T.S. Report, 42, p. 33). There was no connection with the Great Lakes until 1918, when the Lake Ontario-Rice Lake connection was made, and in 1920 the link between Lake Couchiching and Georgian Bay was completed (C.O.R.T.S. Report, 42, p. 33).[31]

The original motive for the development of a continuous waterway in the eastern section was to facilitate settlement of the pioneer "front" in the early decades of the Nineteenth Century, and to provide a means for transporting timber, the basic product of the region, to its markets (with the military advantage of bypassing the international border as a secondary consideration) (Guillet, 73, pp. 131, 146-147, 158-159, 182-183, 193-195, 216; Canada Department of Transport, 37, p. 4; Boyce, 12, p. 167; Fraser, 61, p. 245). To aid the movement of timber, "slides" were constructed at a number of rapids, but these did nothing to aid navigation. The timber trade represented the bulk of the traffic in the eastern section of the Waterway for many years until that industry faded as the result of resource depletion (Boyce, 12, p. 170). With regard to the western section, a number of early proponents of a continuous waterway linking Lake Ontario and Georgian Bay had argued that an important justification of such a waterway would be the traffic to and from the West that would use this route to bypass

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[31] It should be noted that slightly different dates are given by other sources (Boardman, 9, p. 109; Canada Department of Transport, 37, p. 3; Boyce, 12, p. 170; Fraser, 61, p. 245).

the circuitous and dangerous route through Lake Erie and the Erie Canal.[32] At an official level, this suggestion never received much support, and it was the apathy and ambivalence of first provincial and later federal politicians that gave rise to the protracted delay in the completion of a Waterway that had been begun almost a century earlier (Craig, 50, pp. 140-143; Wells, 152, pp. 5-7). By the time it was completed, the Trent-Severn Waterway was obsolete for its intended purpose (Guillet, 73, p. 131), the road and railway networks having long since superseded canals for most commercial transportation functions (Canada Department of Transport, 37, p. 4; Hogg, 79, p. 71). Even before through-navigation was made possible, the use of the Waterway for commercial purposes had almost ceased. "For awhile there was so little traffic on the Trent that trees grew out of the lock walls, and the bushes out of the lock gates" (Wells, 152, p. 7). In 1946, the Waterway was called by one writer "the white elephant of the taxpayer" (Ainslie, 2), and about 1950 it was planned to close the canal for navigation. That plan was set aside when it was determined that the locks would still be needed for flood control and that the operating costs would remain at 75% of their existing level.[33]

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[32] notably N.H. Baird (Guillet, 73, pp. 159-160 and 181-182).

[33] D.A.H. Farmer, Chief, Canals Division, Ministry of Transport, speaking to the annual meeting of the Kawartha Tourist Association, Lindsay, Ontario, October 13, 1971.

Not all of the Trent-Severn Waterway fell into disuse when commercial traffic ceased to exist. "Lake Scugog boasted its own steamship over a hundred years ago," whose function was a recreational one that persisted for several decades (Wolfe, 157, p. 172). In a delightful account of steamboat navigation between Rice Lake and Stony Lake, Craig documents extensive summer use of that portion of the Waterway for recreational purposes as early as the 1860's (Craig, 50, pp. 86-87). Group excursions from Peterborough took place down the Otonabee to Rice Lake, and sometimes included dancing on a scow towed behind the boat (Gruber, 72, p. 11). Such trips also occurred on Rice Lake and the Trent River (Gruber, 72, p. 11). Wolfe has suggested that, "It is possible that Rice Lake was put to intensive recreational use earlier than any other inland body of water in Ontario" (Wolfe, 157, p. 146). Similar excursions, as well as canoe outings, took place at the southern entrance to the Waterway at the beginning of this century (Boyce, 12, p. 171). Resort hotels came into existence at many points between Lakefield and Bobcaygeon during the 1860's. The first recorded summer cottages were built on Lake Katchewanooka,[34] Clear Lake, and Stony Lake in the 1870's and by the early years of this century Sturgeon Lake and Stony Lake were surrounded by cottages (Wolfe, 157, p. 152). Extracts from the daily records of the Trent Valley Navigation Company of the mid-1880's show about an equal distribution of commercial and excursion trips, the latter almost entirely in the Sturgeon Lake and Pigeon Lake area.[35]

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[34] a commonly used local name for Lake Katchiwano.

[35] A selection of allegedly random items from these records is quoted by Craig (50, pp. 90-91).

The tourist traffic between Lakefield and Lower Buckhorn Lake, as well as on the lower Otonabee River and the rest of the Kawartha Lakes, had grown by the 1890's to the point where it was the primary activity (Craig, 50, pp. 123-126). In these areas, and elsewhere on the Trent-Severn Waterway, recreational activity has continued to increase right up to the present time in response to increases in population, leisure time, income, and mobility. To-day, navigation on the Trent-Severn Waterway consists almost exclusively of private recreational traffic (98.66% in 1969). More vessels are passing through each of the lock stations each year than at any previous time.

2.4 EXISTING LITERATURE

The literature on the recreational use of the Trent-Severn Waterway is all fairly recent, and not all of it concerns boat traffic. Popular accounts of pleasure boat traffic are to be found in Craig's description, which is historical in its treatment of the subject (Craig, 50), in Wells' book, which is intended as a boaters' guide to the Waterway and contains many inaccuracies (Wells, 152), and in other books dealing not exclusively with the Trent-Severn Waterway or with only parts of it (Ainslie, 2; Hogg, 79; Wells, 152). The firm of Dominion Consultant Associates Ltd. was retained by the Department of Tourism and Information of the Government of Ontario in 1964 to study all facets of recreational boating in Ontario (Dominion Consultant Associates, 53, pp. 17-19 and 55-58; Dominion Consultant Associates, 54, pp. 24-26, 65-68, 71-73, 99-100). Because of its broad scope and because it dealt with an area much larger than the Trent-Severn Waterway, this study is too general to be of value in quantifying the spatial relationships within the Waterway. The Canada Department of Transport (now the Ministry of Transport), which has responsibility for navigation in the Waterway, has published several charts and descriptions of the Waterway, intended to aid boaters in navigational problems (Walsh, 150, pp. 4-6). To some of these reference has already been made. The same agency also collects boat traffic data at each of its lock stations on the Waterway. Summaries of these data have been printed from time to time as statistical handbooks (e.g., Trudel, 141). Since 1969, these data have been recorded and coded in the field on a "Canal Station Activity Report," which is designed for easy transcription to computer storage. As yet, there has been little published analysis of these data.

In 1967, a federal-provincial committee was appointed which has studied the recreational use of the Rideau and the Trent-Severn Waterways. The work of this committee has given rise to a number of special studies of recreation in the Trent-Severn Waterway. Among those, of particular relevance to this thesis are Klopchic's economic evaluation of tourist boating (Klopchic, 93), Swierenga's land tenure survey (Swierenga, 133), Ambrose's study of natural areas for public recreation (Ambrose, 3), Crone's marina study (Crone, 51), Jaakson's study of water level control and its effects on shoreline use (Jaakson, 84), and the Trent University survey of boaters discussed in Chapter 3.5 (Trent University, 139 and 140). All of these reports have been incorporated in the Report of the Canada-Ontario Rideau-Trent-Severn Study Committee, the C.O.R.T.S. Report (42). None of them aims to establish the nature of the Waterway as a recreational system or to determine its extent.

The C.O.R.T.S. Report itself contains one section of six chapters devoted exclusively to the Trent-Severn Waterway, as well as maps and statistical appendices dealing partly with it. It describes in moderate detail the geographic and historic environment, the extent of public and private ownership and development of shoreline areas, and the various recreational resources that exist and their present and potential use. In describing the areas as an "environmental corridor" (C.O.R.T.S. Report, 42, p. 27), it attempts to treat the area as a recreational system in which use of the land and use of the water interact, but it defines the intensity of those uses and their interaction in only the loosest of terms.

The localization of recreational use within the Waterway is dealt with only superficially by an arbitrary division of the Waterway into fifteen sub-units or segments "for the purpose of facilitating the planning process" (42, p. 28), as shown in Table 4.

1. Trenton
2. Campbellford
3. Warkworth
4. Rice Lake
5. Otonabee-Peterborough
6. Burleigh Falls
7. Bobcaygeon
8. Sturgeon
9. Rosedale
10. Scugog
11. Kirkfield
12. Lake Simcoe
13. Couchiching
14. Severn
15. Gloucester Pool.

Table 4. Segments of the Trent-Severn Waterway Used by the Canada-Ontario Rideau-Trent-Severn Study Committee

It is apparent from Map 1 in that Report, on which these segments are shown, that the regionalization of the Waterway was done with a view to avoiding the fragmentation of individual lakes and to differentiating them from each other. There appears to be no rationale for this breakdown, and the descriptive summaries of the agricultural, forestry, and recreational capability sectors of the Canada Land Inventory (C.O.R.T.S. Report, 42, pp. 36-38), in which the only extensive use is made of this breakdown, provide little basis for the discrimination among adjacent segments. Statistical information on the recreational use of those segments is entirely lacking, the only numerical data consisting of approximate mileages of mainland and island shoreline per segment and number of islands per segment (C.O.R.T.S. Report, 42, p. 28). Data on recreational use are provided on a different geographical base altogether. Campers and other visitors are recorded, along with acreage and number of campsites, for each provincial park and reserve (C.O.R.T.S. Report, 42, p. 39). The number of boats in transit is recorded for each lock on the Waterway (C.O.R.T.S. Report, 42, p. 40). Other information on recreational use of the area (marinas, tourist accommodation, cottages, canoeists, day users, hunting, fishing, etc.) is provided only in non-quantitative terms or for geographical units that do not coincide with the fifteen segments. Thus, while the selection of segments might prove to be justifiable, their differentiation from each other remains to be documented statistically.

Three theses have been written that deal largely with one or another aspect of outdoor recreation in parts of the Trent-Severn Waterway. Gerald Romsa's study (Romsa, 123) encompasses the largest area (upper Trent River to upper Talbot River), but is largely restricted to cottagers with only a minimal reference to other recreational users. Harold Gruber's thesis (Gruber, 72) deals with several facets of outdoor recreation but in an area confined even more narrowly to the shores of Rice Lake and the Otonabee River up to one-half mile upstream from the lake. Neither of the above theses attempts any regionalization of their respective areas or of the entire Waterway, except to the extent that the selection of a study area represents regionalization. Ronald Powell's thesis (Powell, 121) deals with that section of the Waterway from Balsam Lake to Rice Lake. By evaluating the status of the 43 marinas in that area on the basis of the extent to which they provide all 34 of the different types of marina services, he is able to demonstrate convincingly that there is a difference between the portions of the Waterway lying on the main channel and those lying off it (Powell, 121, pp. 44-45). Willard Lindley at one time undertook to study "marine traffic patterns" on the Waterway from a historical point of view, and hoped to document the transition over time from commercial to pleasure traffic. The variation in the time of that transition, from one part of the Waterway to another, was to have been one element in his study, which was never completed and has since been abandoned.[36]

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[36]Willard Lindley, Department of Geography, University of Cincinnati, personal correspondence, September 19, 1970 and August 30, 1971.

CHAPTER THREE

THE PRIMARY DATA FOR THE STUDY

> Even in the best of worlds there would still be data that one would like to have but cannot get, . . . but a good deal more information is available than appears on the surface; it has to be dug for.
>
> \- Roy I. Wolfe (158, p. 221)

3.1 TWO TYPES OF DATA

The graph-theoretic approach to an interpretation of the Trent-Severn Waterway, which is used in this study, requires the selection of a number of points on the Waterway, among which certain interrelationships can be designated as lines.[37] There is, of course, an infinite number of points on the Waterway, and therefore an infinite number of lines. To construct a model, it is necessary either to make a selection of some points and lines to the exclusion of others or to generalize points or lines, letting one represent many. These alternatives are imposed upon the researcher both by the nature of models (Chorley and Haggett, 46, pp. 22-23) and by the practical constraints of data availability.

A search for connecting links that tend to unify the Waterway into a region focuses very quickly on two forms of links. In the first place, there is a physical connection that makes the entire Waterway a continuous body of water, its components being joined through natural and artificial watercourses. Secondly, there are boat movements among all parts of the Waterway, which are both the most obvious and the best

[37]For an elaboration of this, see, for example, Harary, et al. (77, p. 22).

documented dynamic phenomenon unifying the Waterway. Information on these two forms of links provides the basis for much of the analysis which constitutes this study.

3.2 ESTABLISHING PHYSICAL UNITY

That there is a continuous navigable course through the Trent-Severn Waterway betwen Lake Ontario and Georgian Bay has already been pointed out. Its existence is the result of a number of rivers, lakes, and navigational aids such as canals, and therefore it exists only seasonally; the period when the locks are operative (generally mid-May to mid-October) represents the critical constraint rather than the somewhat longer period when the water is free of ice. The general location of the channel from Lake Ontario to Georgian Bay is dictated by the position of those rivers, lakes, and canals, as shown on any of a number of maps whose scale and detail may be quite small. The precise location of the channel (i.e., within the lakes and rivers) is governed by the bathymetry of those water bodies and by the draught of the particular vessel using the Waterway. The necessary bathymetric data for determining the location of the channels are printed on a series of navigational charts of the Trent-Severn Waterway published by the Ministry of Transport at a scale of 1:20,000 (in most cases, with some at a smaller scale and inset maps at a scale of 1:10,000 (Walsh, 150, p. 5). These charts show, both by bathymetric contours and by spot soundings, that for craft with a maximum draught of four feet (which is the limiting depth imposed by the marine railway at Big Chute), there is an infinite number of possible channels through a particular lake or river. For the sake of simplifying the model of the Waterway, these have been generalized into single channels, whose course is indicated on the charts by a solid red line. The maps also show, by means of dotted red lines, alternate courses, many of which enter bays, or rivers and lakes off the main track. In this study, these alternate courses are recognized as forming part of the fully navigable Waterway only if the charts show them to be marked by beacons, buoys, or other similar devices. The depth data on the same charts have been used for determining the partly navigable channels as defined in Chapter 4.3, but these, too, have been generalized so that only a single path is shown from one end of a lake or river to the other, except where a large island has a partly navigable channel on both sides of it. Fluctuations in water levels do not greatly affect the reliability of these sources, because almost all of the routes in question are artificially maintained in a navigable condition by the release of water from the headwaters.

Other types of data sources have been used for establishing the physical continuity of the Trent-Severn Waterway as it relates to canoe traffic. Those routes which are either partly or fully navigable for larger vessels are obviously within the range of waters accessible by canoe. The accessibility of additional routes is presumed to be governed by the distance over which portaging is necessary in order to overcome shallow water, drainage divides, rapids, or other obstructions. In this study, any single enforced portage of 1000 yards (a figure which is based on my own experience) is considered the limit beyond which canoeing waters are presumed to be inaccessible from the Trent-Severn Waterway.[38] The identification of canoe routes by this criterion has been done from a number of sources, including personal field experience in a few cases. The Ontario Department of Lands and Forests has produced several mimeographed descriptions of canoe routes, which include the lengths of the portages (Ontario Department of Lands and Forests, 109, 110, 111, and 112). A selection from these descriptions, made on the basis of the above criterion, shows that canoe routes listed in other sources for the same area (C.O. R.T.S. Report, 42, pp. 41-42 and Map 12; Romsa, 123, p. 96; Wells, 152, p. 94; Ambrose, 3, p. 31) do fall within the definition in every case but one, and therefore the reliability of those listings for other areas in the Waterway is assumed, even though detailed descriptions are

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[38] The criteria suggested by E.M. Cressman, cited in and incorporated by Brown (32, pp. 48-49), are somewhat different in that they relate to the length of uninterrupted water rather than the length of the portages themselves. However, Brown's standards are intended for evaluating canoe <u>tripping</u> as opposed to "casual canoeing", and the standards for the former seem to be more rigid than for casual canoeing in that they would exclude many of the routes which are included in this study. Although Brown states that "casual canoeing ....usually has ubiquitous resources" (Brown, 32, p. 48), the ubiquity of canoeing waters does not necessarily provide the continuity which is sought in the present study, and for which the criterion of portage length is more suitable.

lacking. A further check on these sources, as well as a source of other canoe routes not listed elsewhere, is the National Topographic Series of maps at a scale of 1:50,000. With the help of all of the sources mentioned in this and the preceding paragraph, the infinity of lines (connecting links) on the Trent-Severn Waterway has been reduced to three finite sets of lines for the purposes of subsequent graph theoretic analysis, and the physical unity of the Waterway at several levels of navigability can be established.

3.3 A SEARCH FOR FUNCTIONAL UNITY: CANAL STATISTICS

More important to the purpose of this study is an analysis of the functional unity, or disunity, of the Waterway, as illustrated by boat movements from place to place on the Waterway. There is no reliable estimate of the number of boats using the Waterway, nor any practical way of obtaining such a figure.[39] Individual boats may enter and leave the Waterway at many places and go undetected by any of the counting mechanisms in use at the present time. The only occasion on which boats are subjected to a systematic and system-wide counting procedure in the Waterway is when they enter one of the 43 locks or the marine railway, and this is restricted to registered boats, thereby excluding the majority of canoes. There is evidence that many boats that regularly ply limited parts of the Waterway never pass through any of the locks, and that many others do so on a minority of their trips. Despite

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[39] Powell (121, p. 6) quotes a Peterborough Chamber of Commerce estimate of some 500,000 water travellers annually.

these shortcomings, the counts of boats made at the lock stations are the best available source of information on boat movements, and they form the basis of several other studies as well as this one (*e.g.*, Klopchic, 93, Canada Ministry of Transport, 40, 41; and relevant portions of Dominion Consultant Associates, 53). An estimate of the degree to which these data underrepresent the total boating population could be made by sampling incoming boaters at a variety of marinas, public launching points, etc.[40] and inquiring as to which, if any, of the locks they had used on the trip just concluded. Since the registration numbers are recorded when boats pass through locks, it would be possible to determine which boats using a given lock appear in a given shore sample, and which ones either return through the same lock or pass on through the next. Any discrepancy between the actual shore sample and that which was anticipated (by virtue of not having reappeared elsewhere) could provide a measure of the sampling ratio at each shore sampling point. That ratio could then be applied to those boats which reported not having passed through any lock, to determine the *total* number of boats that are missed by the lock counting procedure. In this study, the data used were obtained from the lock station counts; to estimate in the above way the degree of underrepresentation was beyond the resources of the writer.

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[40] A great many trips originate from and return to private docks at cottages and similar places, and it would be quite impractical to sample at all such places.

The Ministry of Transport compiles boat traffic statistics from 42 stations on the Trent-Severn Waterway. The marine railway at Big Chute is one station, and the other 41 consist of the 43 locks, which in two cases (numbers 11-12 and 16-17) are paired into flight locks and constitute single stations (see Figure 3). Although these recording stations are spatially punctiform, they function in this study not as the "points" which need to be selected for a graph theoretic analysis, but rather as the "lines" which connect points. There are two reasons for this, one theoretical and the other practical.

The theoretical consideration is that the points of origin and destination for the vast majority of boats lie on the lakes and river segments, rather than at the locks. The marinas, the cottages, the launching points, and all the other places which boaters normally use as their "base" are almost all away from the locks, on one side or the other. On those few occasions when a boat trip does end at a lock, it is often not a recreational trip anyway, but a shopping or other business trip, for several of the locks are located adjacent to towns.[41] Therefore boat trips from lock to lock, even if they could be recorded, would form a false picture of the recreational boating traffic on the Waterway.

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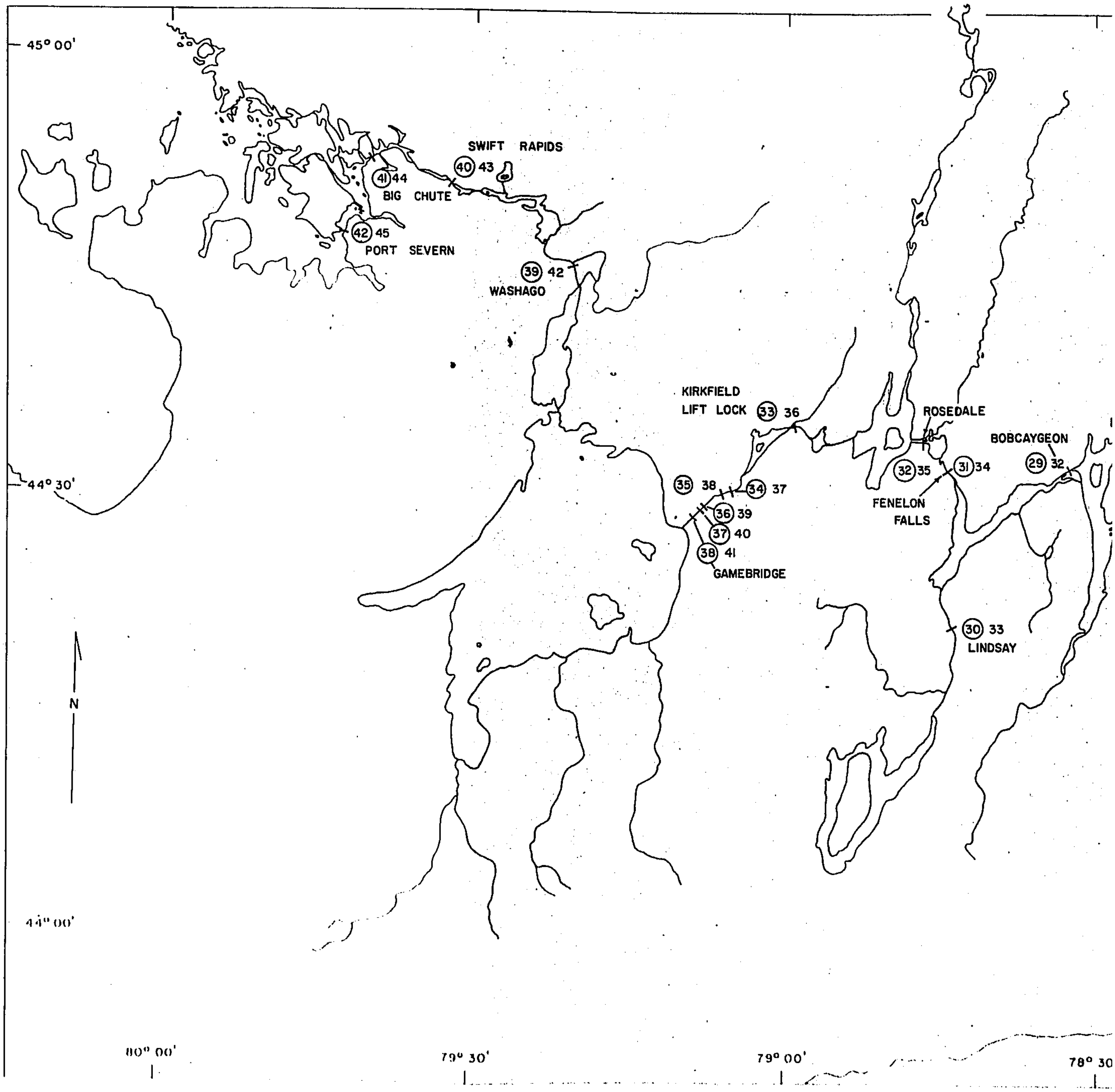
[41] One of the few exceptions to this is the marine railway at Big Chute, which, as discussed in Chapter 5.6, does constitute a recreational destination.


45° 00'
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N
SWIFT RAPIDS
40 43
41 44
BIG CHUTE
42 45
PORT SEVERN
39 42
WASHAGO
KIRKFIELD
LIFT LOCK
33 36
ROSEDALE
BOBCAYGEON
29 32
32 35
31 34
FENELON
FALLS
35 38
34 37
36 39
37 40
38 41
GAMEBRIDGE
30 33
LINDSAY

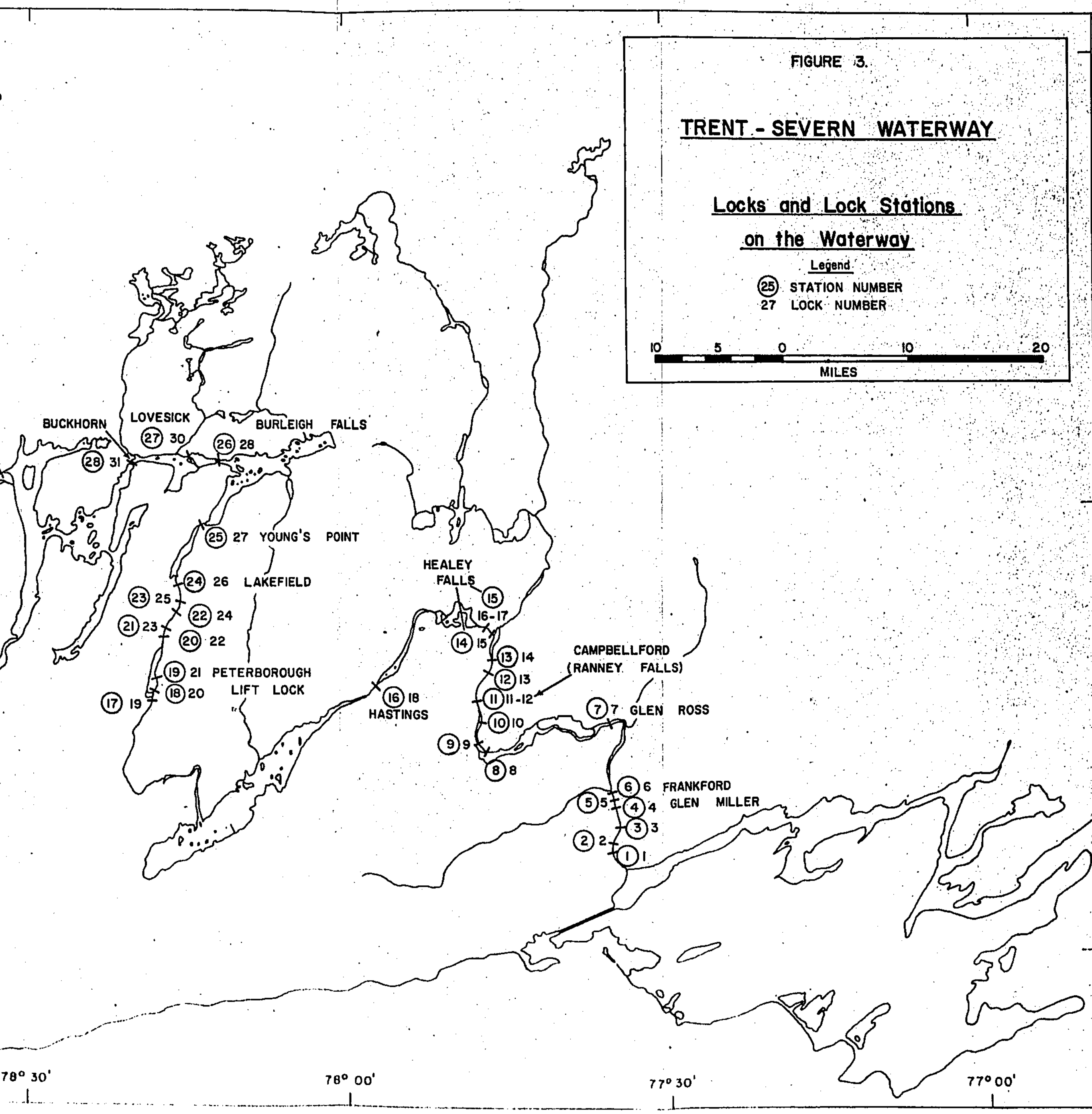
FIGURE 3.
TRENT - SEVERN WATERWAY
Locks and Lock Stations on the Waterway
Legend
25 STATION NUMBER
27 LOCK NUMBER
10 5 0 10 20
MILES
BUCKHORN
LOVESICK
BURLEIGH FALLS
YOUNG'S POINT
LAKEFIELD
PETERBOROUGH LIFT LOCK
HEALEY FALLS
HASTINGS
CAMPBELLFORD (RANNEY FALLS)
GLEN ROSS
FRANKFORD
GLEN MILLER
78° 30'
78° 00'
77° 30'
77° 00'

On the practical side, there is, in fact, no existing procedure for counting and recording boats that begin or terminate a trip at a given lock. In order to be recorded, a boat must actually pass through the lock. Thus, the available data relate to boat movements from lake to lake or from river segment to river segment. The lakes and river segments become the "points" in the analysis, and the links among them are represented by the recording stations. Hence, the problem of coping with an infinite number of points on the Waterway has had a de facto solution imposed upon it by the limited number of recording stations. In other words, it has been made necessary to generalize each portion of the Waterway (whether lake or river segment or some combination thereof) into a single point; and this was one of the alternatives presented at the beginning of this chapter. Unfortunately for the purposes of this thesis, there are a few uninterrupted stretches of the Waterway where several lakes (e.g., Pigeon, Chemung, and Buckhorn) have had to be generalized into a single point, because of the absence of a data gathering point between them. It may be, as Wolfe suggests, that "the differential availability of data can . . . warp the pattern that emerges after study" (Wolfe, 158, p. 221), but the danger is minor in this study because the adjacent lakes, by virtue of their very contiguity, tend to have similar, if not identical, boating populations. The worst effect is likely to be a greater degree of underrepresentation (as discussed above) than would be the case if traffic between all lakes could be counted. With the sole exception of Lake Scugog, which is linked to the rest of the "points" through the lock at Lindsay and through

Sturgeon Lake, the lakes and river segments linked by the 42 recording stations form a linear system, where each "point" (*i.e.*, lake or river segment) has a link to no more than two other "points". Thus, there are 43 "points" used in this analysis. Lake Ontario and Georgian Bay constitute two of them, and the other 41 are intermediate (see Figure 4).

3.4 DETAILS OF CANAL STATISTICS

The duties of the lockmasters at the 42 stations include recording information concerning every boat that passes through the lock and reporting it on a "Daily Lock and Bridge Report" and on a "Canal Station Activity Report." The latter is pre-coded to facilitate transcription to computer cards. Not all of the information on these reports is of value to this study. That which is relevant consists of several items in addition to a raw count of boat traffic. Boat movements at each lock are differentiated into upbound and downbound traffic. Each boat is identified on the form by a vessel number (its registration number), which can be used in conjunction with the foregoing directional information and the date to trace its passage on any given trip from its point of origin to its point of destination.[42] In addition, there is information on the size of the boat, and its type and nationality. The size categories are as follows:

18' or less in length (runabouts, etc.),
over 18' and up to 40' in length (small and medium cruisers),
over 40' in length (yachts).

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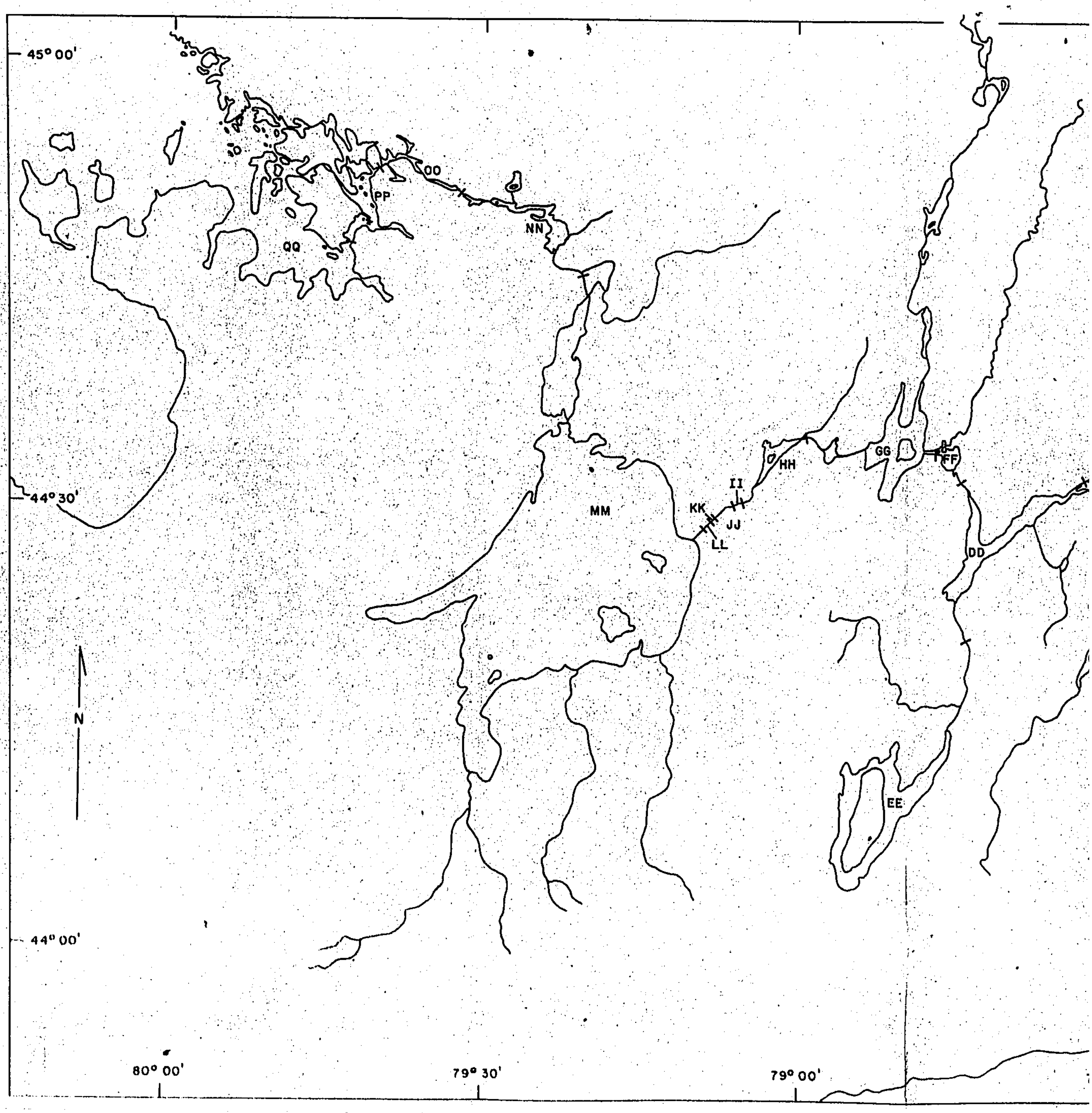
[42]The registration numbers could also be used in the manner suggested by Wolfe (158, p. 223) for the use of automobile license-plate numbers, *viz.*, to identify the home locations of recreational participants. However, because boat registrations, unlike automobile license-plates in much of North America, are not renewed from year to year, and because registration is often done near the boating waters rather than near the boaters' homes, and because a relatively higher proportion of boats than of cars belong to, and are registered under the address of, someone other than the boater, the use of boat registrations for this purpose is probably less valid than in the case of automobile license-plates.



45° 00'
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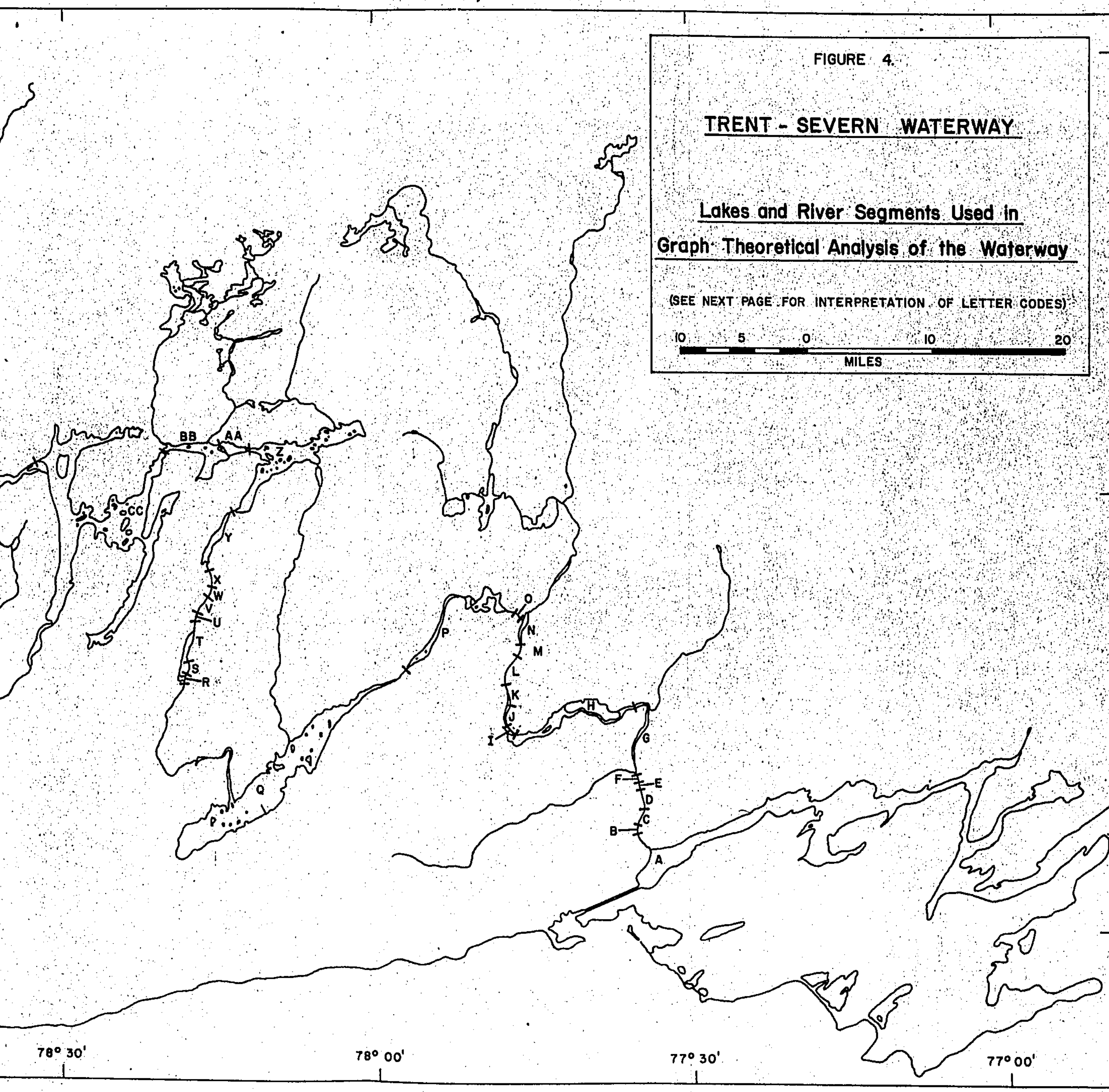
FIGURE 4.
TRENT - SEVERN WATERWAY
Lakes and River Segments Used in Graph Theoretical Analysis of the Waterway
(SEE NEXT PAGE FOR INTERPRETATION OF LETTER CODES)
10 5 0 10 20
MILES
BB
AA
Z
CC
Y
X
W
V
U
T
S
R
Q
P
O
N
M
L
K
J
I
H
G
F
E
D
C
B
A
78° 30'
78° 00'
77° 30'
77° 00'

Key to Lakes and River Segments Shown in Figure 4

A - Lake Ontario (Bay of Quinte)
B - Trent River between Lock 1 (at Trenton) and Lock 2 (at Highway 401)
C - Trent River between Lock 2 (at Highway 401) and Lock 3 (at Glen Miller)
D - Trent River between Lock 3 (at Glen Miller) and Lock 4
E - Trent River between Lock 4 and Lock 5
F - Trent River between Lock 5 and Lock 6 (at Frankford)
G - Trent River between Lock 6 (at Frankford) and Lock 7 (at Glen Ross)
H - Percy Reach segment of Trent River, between Lock 7 (at Glen Ross) and Lock 8
I - Trent River between Lock 8 (at upper end of Percy Reach) and Lock 9
J - Trent River between Lock 9 and Lock 10
K - Trent River between Lock 10 and Locks 11-12 (at Ranney Falls)
L - Campbellford segment of Trent River, between Locks 11-12 (at Ranney Falls) and Lock 13 (above Campbellford)
M - Trent River between Lock 13 (above Campbellford) and Lock 14
N - Trent River between Lock 14 and Lock 15 (below Healey Falls)
O - Trent River between Lock 15 (below Healey Falls) and Locks 16-17 (at Healey Falls)
P - Trent River between Locks 16-17 (at Healey Falls) and Lock 18 (at Hastings)
Q - Trent River above Lock 18 (at Hastings), Rice Lake, and Otonabee River below Lock 19 (at Peterborough)
R - Little Lake
S - Trent Canal between Lock 20 (at inflow to Little Lake) and Lock 21 (Peterborough Lift Lock)
T - Trent Canal between Lock 21 (Peterborough Lift Lock) and Lock 22 (on Otonabee River above Nassau Mills)
U - Otonabee River between Lock 22 (above Nassau Mills) and Lock 23
V - Otonabee River between Lock 23 and Lock 24
W - Otonabee River between Lock 24 and Lock 25
X - Otonabee River between Lock 25 and Lock 26 (at Lakefield)
Y - Katchiwano Lake
Z - Clear Lake and Stony Lake
AA- Lovesick Lake
BB- Lower Buckhorn Lake
CC- Buckhorn Lake, Chemung Lake, and Pigeon Lake
DD- Sturgeon Lake and Scugog River below Lock 33 (at Lindsay)
EE- Scugog River above Lock 33 (at Lindsay), and Lake Scugog
FF- Cameron Lake
GG- Balsam Lake, Mitchell Lake, and Trent Canal between Balsam Lake and Lock 36 (Kirkfield Lift Lock)
HH- Canal Lake
II- Talbot River between Lock 37 and Lock 38
JJ- Trent Canal between Lock 38 and Lock 39
KK- Trent Canal between Lock 39 and Lock 40
LL- Trent Canal between Lock 40 and Lock 41 (at Gamebridge)

MM- Trent Canal between Lock 41 (at Gamebridge) and Lake Simcoe, Lake Simcoe, Lake Couchiching, and Trent Canal between Washago and Lock 42

NN- Severn River between Lock 42 and Lock 43 (at Swift Rapids) and Sparrow Lake

OO- Severn River between Lock 43 (at Swift Rapids) and Marine Railway (at Big Chute)

PP- Severn River and Gloucester Pool between Marine Railway (at Big Chute) and Lock 45 (at Port Severn)

QQ- Georgian Bay

The type of boat is given as private, commercial, or government, a classification system which aids in establishing the recreational nature of Waterway use, and the nationality is given as Canadian or "other". The statistical data are stored on computer tapes in the Computer Services Division of the Ministry of Transport. The data used in this study are from the year 1969, so that they represent the same population as that which was sampled in another study which also forms a major input to this thesis.

Unfortunately, the stored data contain many errors. They apparently are introduced at various stages in the preparation of the data for storage (e.g., original field recording, key-punching, etc.). In a number of cases, one can readily detect and correct the errors. In other cases it is possible only with a great deal of time-consuming effort, or not at all. Approximately 10% of the recorded passages through a lock were found to contain errors in registration number, dàte, direction, or some other item. To rectify the detectable errors required several weeks of continuous and tedious work. It is likely that an additional 5% of the data items remain incorrect.

3.5 1969 BOATER SURVEY

During the summer of 1969, the author supervised the administration of a structured interview to a sample of 2134 boaters at five lock stations on the Trent-Severn Waterway. This study was conducted under the auspices and direction of the Parks Branch of the Ontario Department of Lands and Forests (Trent University, 139 and 140). It was designed, *inter alia*, to gain a more precise knowledge of boat traffic and boater characteristics, and certain of the findings provide useful elaborations of the basic information collected by the Canal authorities, the form of the data being at least partly compatible between the two sources (see Chapter 6.3).

The structure of the interviewing schedule was established in such a way as to combine a certain degree of representativeness with the other *desideratum* of obtaining as large a sample size as possible. In some respects (*e.g.*, the avoidance of rainy days), an unbiased sample was deliberately sacrificed for the sake of a large sample, while in other (most) respects an unbiased sample was regarded as more desirable than a large one. Interviews were conducted with a sample of boaters as their craft passed through the locks at one or another of five selected sampling sites. Each interviewed boater was given a numbered identification sticker on the first occasion when he was interviewed. On subsequent occasions, the oral interview was abbreviated and those data which remained constant (*e.g.*, length of boat) were extracted from the original interview.

The five sampling sites were Locks 11 and 12 (one site), 23, 32, 41, and 42 (see Figure 3). For convenience, these are referred to, in discussion of this survey, as Campbellford, Peterborough, Bobcaygeon, Gamebridge, and Washago, respectively. The selection of sites was made not primarily so as to maximize the sample size, but so as to provide representation of several major sections of the Waterway, whose boating populations were thought to differ in several respects.

The boating season (the period during which the locks on the Waterway were open) lasted from May 16 to October 15, 1969. In order to differentiate between peak periods of traffic and other times, the boating season was divided into four time periods:

1. May 16 to June 19;
2. June 20 to July 26;
3. July 27 to September 1;
4. September 2 to October 15.

With the exception of holidays (of which there was one in each time period), the number of sampling days in periods 2 and 3 was exactly double the number in periods 1 and 4. Also with the exception of holidays, the number of weekend sampling days was exactly equal to the number of midweek sampling days. Each site was sampled on twelve weekend days, two holidays, and twelve other days, or twenty-six days all together. Within each time period, some attempt was made to avoid clustering the sampling days at the beginning or the end of the period. There was a conscious attempt to concentrate sampling days on days of fine weather and to avoid days when boat traffic was expected to be light because of either poor weather or high water (a condition which forced several locks to suspend operations for a few weeks early in the season). The number of sampling hours per sampling day corresponded closely to the hours when the locks were in operation. In periods 1 and 4, interviewing took place from 9 a.m. to 5 p.m., and in periods 2 and 3, from 8:30 a.m. to 8:30 p.m.

The response rate (number of boats sampled/number of boats locking through) varied considerably from day to day. It depended ultimately on the willingness of individual boaters to undergo whatever delay and/or inconvenience was involved. When traffic was light, this meant their pulling in to shore when it would not otherwise have been necessary for them to do so. (On such days it is often possible to sail directly into the locks.) On the other hand, when traffic was heavy, several boats went through the locks at once and the boaters, having completed the lockage, were obviously reluctant to undergo any further delay while waiting their turn to be interviewed. In such circumstances (*i.e.*, with a choice of boats to be sampled), the interviewers used a randomizing technique to make their selection. Other factors affecting the response rate were the weather, the co-operation of the lockmasters, and the number of boats being sampled for the second, third, or more time. It should be noted that the sample is biased in favour of those boaters who spent a long period of time on the Waterway and who thereby increased their probability of being sampled. On many occasions, interviews were only partly completed. To cite one reason, an efficient lock operation allowed the interviewers insufficient time to complete their interviews during the lockage. Moreover, some boaters were reluctant or unable to answer certain questions. The total sample, including both complete and incomplete interviews, consists of 2134 boats, broken down as shown in Table 5.

	May 16 to June 19	June 20 to July 26	July 27 to September 1	September 2 to October 15	Total
Washago	29	238	358	43	668 (31.3%)
Gamebridge	21	147	297	14	479 (22.4%)
Bobcaygeon	92	193	148	46	479 (22.4%)
Peterborough	12	135	120	14	281 (13.2%)
Campbellford	10	108	101	8	227 (10.6%)
Total	164	821	1024	125	2134(100.0%)

Table 5. Sample Size of 1969 Boater Survey, by Location and Time Period

Seldom does the processing of parts of the survey involve the complete sample. In addition to the deficiencies of incomplete questionnaires, there was a slight error factor introduced during the process of transcribing the data onto computer cards. Whatever information was available was processed, but the sample size for any particular part of the analysis is almost invariably less than 2134.

Not all of the information obtained in this survey is useful to this study. Those items which complement the canal statistics are shown in Appendix 1. In addition to those, sundry other information was sought that was less factual in nature, such as opinions on the facilities available to boaters, or their propensity to engage in ancillary activities (e.g., swimming, camping, picnicking, etc.), or their preference for overnight accommodation.

3.6 OTHER SURVEYS

Both of the above sources of primary data deal exclusively with boaters. There are much less satisfactory sources of primary data on other users of the Trent-Severn Waterway. During the period June 27 to August 2, 1970, the National Parks Service of the Canada Department of Indian Affairs and Northern Development conducted interviews with 1584 parties of short-term (day-use) visitors at the nine selected lock stations shown in Table 6 (Good, 68, pp. 19-29).

Lock No. 1	Trenton
Lock No.21	Peterborough Hydraulic Lift Lock
Lock No.28	Burleigh Falls
Lock No.32	Bobcaygeon
Lock No.34	Fenelon Falls
Lock No.35	Rosedale
Lock No.36	Kirkfield Hydraulic Lift Lock
Lock No.41	Gamebridge
Lock No.44	Big Chute Severn Marine Railway

Table 6. Sampling Sites for National Parks Service 1970 Survey

These stations were selected from among 695 summer day use sites identified in the study as falling within the "environmental corridor" of the Canada-Ontario Rideau-Trent-Severn Study, the "area within which recreation activities, available and participated in, can be considered as accruing to or motivated by features of the waterway" (Good, 68, p. 5). The interviewed parties were selected on the basis of a carefully stratified sample which permitted complete coverage where the total number of parties visiting the site was known to be small, and a proportionate sample elsewhere and on weekends (Good, 68, pp. 26-28).

The information collected in that study which has a bearing on this thesis is shown in Table 7.

- Number of party visitors at each site
- Nationality of visiting parties (Canadian, U.S.A., foreign)[43]
- Origin of the parties at each site (0-5 miles; 5 miles+)
- Length of stay (½ hour; 1 hour; 1½ hours; 2 hours; 2½ hours; 3 hours; 3½ hours; 4+ hours)
- Participation in outdoor recreation activities (angling; boating; camping; environmental enjoyment; hiking and walking; nature study; outdoor sport; picnicking; sightseeing; swimming; other; comfort stop)
- Party size
- Age group of party (adults only; adults and children; children only)
- Means of access to site (private auto; truck; bus; bicycle; boat)

Table 7. Relevant Aspects of National Parks Service 1970 Survey.

In general, the group of recreationists sampled in that study consisted of sightseers, that activity being the one most often recorded at each of the nine lock sites (Good, 68, p. 49).

Over a four-day period (September 2, 3, 5, and 6, 1971), the author conducted a cursory random survey of 28 parties of swimmers, 30 parties

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[43] This breakdown seems to be a perfect example of creeping continentalism, not as a threat, nor as a boon, but as an incipient fact.

of fishermen, 48 parties of boaters, and 20 parties of sightseers at a wide variety of places from one end of the Waterway to the other. The purpose of these interviews was to gain personal familiarity with the day use population of the Waterway, and for this the procedure was very effective. He also hoped that the author could elicit a measure of the extent to which persons using the water for recreation also make use of the land. There is no statistical reliability to the results of that survey, but in the absence of any other data at all, they may be of passing interest.

In the summer of 1969, the author organized and carried out a survey among several different groups of recreationists in the Peterborough area, as well as a sampling of area residents. The purpose of these interviews was incidental to this thesis, but certain elements of the survey are used herein to throw further light on the problems under consideration, specifically a set of questions concerning the areas to which people go for water-oriented recreation.

CHAPTER FOUR

THE WATERWAY CONCEPT IN TOPOLOGICAL TERMS

4.1 GRAPH THEORY IN THE ANALYSIS OF GEOGRAPHICAL NETWORKS

Waterways are one of a class of geographical phenomena that can be generalized, without radical distortion, into a system consisting of points and lines. Therefore, they lend themselves to an analysis of the abstract interrelationships of their constituent points and lines, i.e., to an analysis of their topological properties. It has come to be recognized in recent years that the topological properties of certain phenomena may be the core of their geographic reality, and are at least a useful surrogate for that reality. Topological models built from dynamic components are particularly apt, but the static topology of certain geographic features is by no means an inappropriate approach to their analysis or interpretation. The analysis of topological networks,[44] such as have been identified by geographers, makes use of a branch of mathematics known as graph theory. The advantages and disadvantages of this type of analysis in Geography are discussed briefly by Haggett and Chorley (76, p. 7).

Because of the two-dimensional nature of geographic space, most geographic research using graph theory has involved planar nets, in which all points (or vertices) lie on the same plane, usually the surface of the earth, and consequently the connecting lines (or links) also lie on that plane. Examples of geographic applications of graph

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[44] Technically, finite sets of points and lines are known as "nets", of which "networks" are a special case (Harary, et al., 77, pp. 408-409).

theory are most abundant in the analysis of transport networks. The pioneer study, by Garrison, undertook to show how graph theory could be used to analyze and describe a highway network in a portion of the U.S.A. (Garrison, 63). In a parallel type of study, Burton described the highway network of Northeastern Ontario (Burton, 33). More advanced applications, but still in the field of highway, railway, or airline networks, have been demonstrated by Garrison and Marble (64), Werner (154), Kansky (87), Gauthier (66), Nordbeck (106), Kissling (88), and Haggett and Chorley (76). Garrison and Marble elaborated on their earlier work by factor analysing the connection matrix of a non-planar network, the air transport system in Venezuela (Garrison and Marble, 65). A more sophisticated extension of these largely descriptive analyses has been provided by Nystuen and Dacey, who have used graph theory to identify the nodal structure of a region and its sub-regions (Nystuen and Dacey, 107). A related set of spatial problems not treated in any of these references, or in this discussion, concerns the optimal angles at which the routes in a planar network should meet. Other uses of graph theory and related methods in the analysis of regional form and structure have occupied the interest of Werner *et al.* (155) and Haggett (75, pp. 50-52). Pitts conducted a study of the historical variation of locational advantage in Russia by reducing the network of towns and trade routes to a planar graph (Pitts, 120). In a study which can be considered marginally geographical, Huff used directed graphs to isolate the more significant elements affecting consumer space preferences (Huff, 82). Sochava has demonstrated how graph theory can help to "understand the significance of vegetation in the dynamics of the natural environment and the relationships between geobotanic, biogeocenotic, and landscape categories" (Sochava, 128, p. 614). Within the field of recreational geography, a series of simple models of a state park system (including also counties of origin of visitors and highway intersections) was constructed for the State of Michigan by Milstein (103, pp. 6.4-6.8).

In the development of network models in geography, the most significant improvements have occurred whenever measured values have been placed on the links in the network. The original studies did nothing more than record the presence or absence of a connecting link between points in the network. Subsequently, the intensity of flow over each link has been quantified, to the great advantage of the graph theoretic models.[45] The present study proceeds from the initial stage of studying the physical unity of a network (i.e., the presence or absence of links) to the more advanced stage of studying its functional unity using quantitative measurements of a flow phenomenon.

4.2 THE TOPOLOGY OF CANALS

There appears to have been no study of canals or other waterways using graph theoretic analysis; yet the parallelism between highways and waterways is obvious. Both are quasi-linear transportation routes

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[45]The quantification of traffic flows is not confined to graph theoretic studies. In the field of recreational geography, for example, Wolfe (159) and Ellis (56) and Ellis and Van Doren (57) have created and tested models for predicting recreational traffic on the part of campers, cottagers, and resort guests (Wolfe) and of campers (Ellis and Ellis and Van Doren).

between two end points and usually serving one or more intermediate points. Both may be interconnected with other routes of the same kind so as to form a network with points and lines. Both carry varying amounts of traffic over their entire routes as well as portions of the routes, and both may carry recreational traffic as well as other forms. A "waterway" has been defined as "a navigable body of water . . .which serves as a water highway or water road" (Veatch and Humphrys, 148, p. 345). Mary Ainslie, referring to the Trent-Severn Waterway, has expressed the analogy thus, "A highway need not be made of macadam, cement or steel to carry traffic to the hinterlands" (Ainslie, 2). In a historical reference to the Severn Waterway in England, East referred to it as "one of the king's highways" (East, 55, p. 91).

The absence of graph theoretic analyses of canals and waterways may be attributed to their superficial simplicity of form. The engineering costs of linking points by canal are so much greater, in most circumstances, than the costs for a land route, that very few complex networks of canals exist. Indeed, a great many canals, including the major ones of the world, perform no function other than to carry traffic between the water bodies at the two terminal points, and they are connected to no other waterways at all. In fact, this statement can be applied with reasonable validity to each of the individual canalized portions of the Trent-Severn Waterway, if they are considered separately. In terms of graph theory, such a canal consists only of two vertices and one link, and is not worthy of further analysis (see Figure 5.a). Many other canals deviate from this ultra-simplicity only by virtue of serving one or more intermediate points, without departing from their linearity. Such

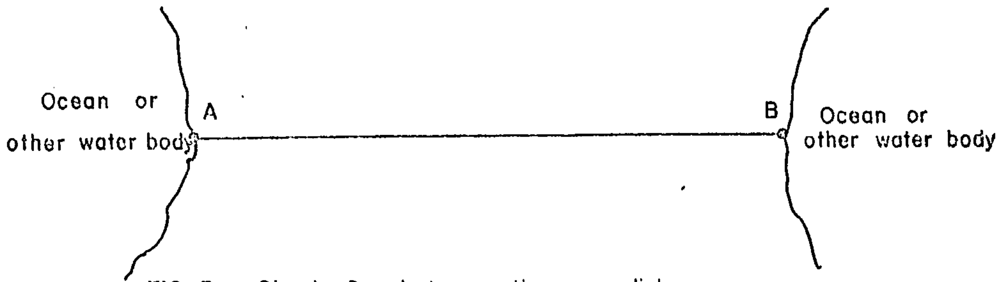

FIG. 5a. Simple Canal: two vertices, one link.

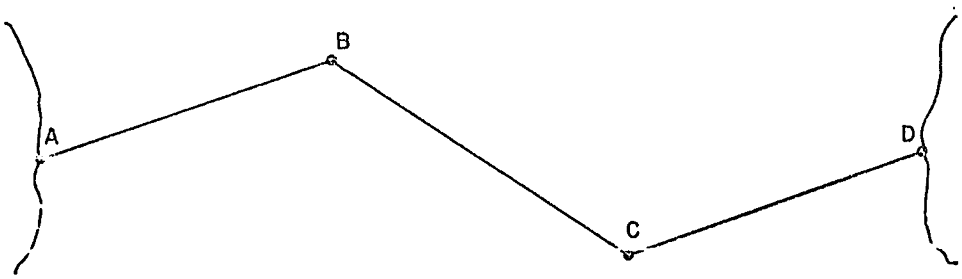

FIG. 5b. Single Lane Canal: n vertices, n-1 links.

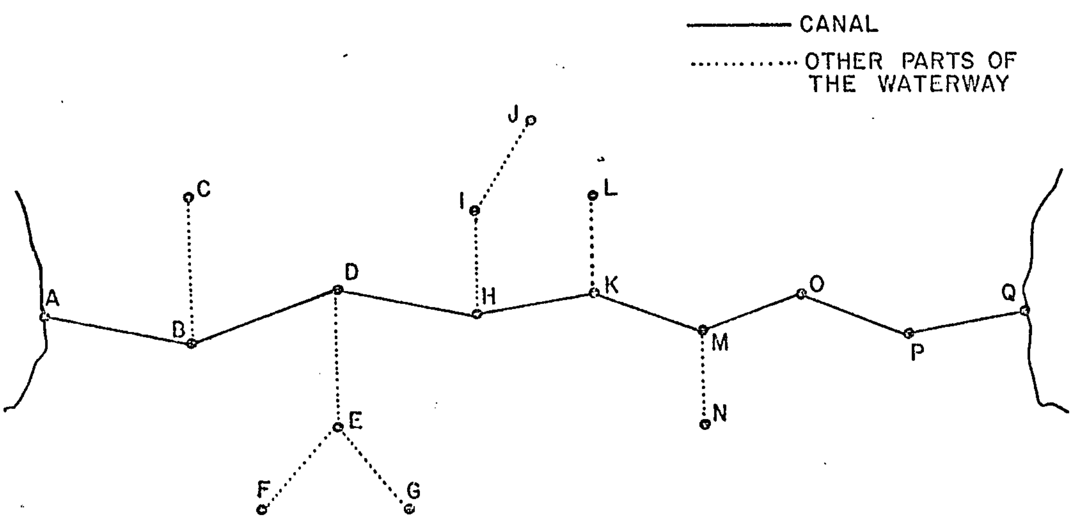

FIG. 5c. Topological Tree: n vertices, n-1 links.

Figure 5. Topology of Canal Types

single lines, as shown in Figure 5.b, contain n vertices and n-1 links, and fail to "provide much scope for worthwhile analysis,"[46] even allowing for variations in flow direction and flow intensity. Most commonly, the traffic on such canals is dominated by through traffic, and therefore the topological structure of such canals approximates that of the more simple case with just two vertices.

The term "canal" connotes to many people a form no more complex than either of those described above. The frequent use of that word in reference to recreational waterways gives a misleading impression of their form and structure, and fails to do justice to the complexities of the traffic patterns that occur on recreational waterways. Recognition of the true boat traffic patterns on the Trent-Severn Waterway comes often as a surprise. The number of boaters who use the Waterway as a simple canal, i.e., as a route between Lake Ontario and Georgian Bay without any side trips, is a small minority, as will be shown in Chapter 5. The scope for exploring portions of the Waterway off the main channel is great, and is not overlooked by the boating public, whose purpose is to seek recreation rather than to overcome distance (Walsh, 150, p. 8). Moreover, the vast majority of boaters neither begin nor terminate their trips at either Lake Ontario or Georgian Bay, but confine their travels to limited portions of the Waterway between these end points.

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[46] Peter Haggett, "Network Models in Geography" (Chorley and Haggett, 46, p. 610).

4.3 THE CONNECTIVITY OF THE TRENT-SEVERN WATERWAY

The distinction between (1) a single line canal connecting Lake Ontario and Georgian Bay and all the intervening bodies of water, and (2) the actual Trent-Severn Waterway system, can be illustrated by using a number of measures of connectivity drawn from graph theory. The calculation of these measures of connectivity necessitates the arbitrary selection of a number of points on the Waterway which can be treated as vertices. The links will then be defined by these vertices and by the existence of physical connections (i.e., navigable or partly navigable water) between them.

The Trent-Severn Waterway has earlier been defined to include bodies of water other than those having channel markers. Thus, the Waterway exhibits a form referred to in topological terms as a "tree" (Ford and Fulkerson, 59, pp. 173-174; Berge, 6, p. 152; Blackett, 8, p. 165). Such networks are defined as having no circuits, and a single line canal is obviously a particular case of a tree. Those portions of the Waterway which depart from the marked channel are analogous to the branches of a topological tree, as shown in Figure 5.c. The only instances where the Trent-Severn Waterway fails to conform to the definition of a tree are where there are alternative channels around large islands. The channels listed in Table 1 are generally those which are accessible to boats of up to four feet in draught.

There are numerous other bodies of water in the Trent-Severn Waterway which have more difficult, but still partly navigable connections with those mentioned earlier (Canada Department of Transport, 37, pp. 5-6), the degree of their connection being contingent on the various interpretations of navigability used by the operators of various types of craft[47] and on the amount of drawdown from the reservoir lakes.[48] For runabouts and smaller vessels (with a maximum draught of three feet), there is access, without portaging, to all of the places listed in Table 8.[49]

Route Description	Mileage off the Marked Channel
the east end of Back Channel off the Trent River around Wilson Island	0.9
Blind Channel off the Trent River around Hickory Island	2.2
the lower end of the Indian River off Rice Lake	2.8
around White Island in Rice Lake	3.8
the east end of Stony Lake	2.8
Upper Chemung Lake off Chemung Lake	4.9
the Pigeon River off Pigeon Lake	12.9
Little Bald Lake and Big Bald Lake off Pigeon Lake	8.5
the Bobcaygeon River off Sturgeon Lake	1.3
Emily Creek off Sturgeon Lake	7.0
Mariposa Brook off the Scugog River	2.0
the Burnt River off Cameron Lake	12.0
Pefferlaw Brook off Lake Simcoe[50]	2.0
the Black River off Lake Simcoe[50]	2.0
the Holland River off Cook Bay in Lake Simcoe[50]	3.8
the Schomberg River off the Holland River[51]	3.8
the east branch of the Severn River upstream to Severn Bridge	3.2
West Bay off Sparrow Lake[52]	1.6
Wood Bay off the Severn River	0.8
Lost Channel off the Severn River	2.5
Copp Bay off the Severn River	1.1
Tea Lake off the Severn River	2.3
Pretty Channel off the Severn River	0.5
Six Mile Channel off the Severn River	1.2
Little Go Home Bay off Gloucester Pool	3.5
MacLean Lake off Gloucester Pool	2.8

Table 8. Portions of the Trent-Severn Waterway Accessible to Boats Drawing up to Three Feet

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[47] Veatch and Humphrys point out that "navigable" is a term that is highly variable in meaning (Veatch and Humphrys, 148, pp. 211-212).

[48] For a discussion of water drawdown on the Trent-Severn Waterway, see Jaakson, 85 and C.O.R.T.S. Report 42, pp. 57-58.

[49] The criterion of 3' draught is suggested by Brown (32, p. 47).

[50] Bourke states, "The mouths of many of the smaller rivers (emptying into Lake Simcoe) have been dredged and enlarged to form sheltered harbours" (Bourke, 11, p. 46).

[51] shown on navigation charts as the main branch of the Holland River.

[52] shown on navigation charts as "Deep Bay."

Because of the capability for portaging canoes, accessibility to adjoining water bodies by canoe is virtually unlimited, even where (as in the case of Six Mile Lake) those waters belong to a different drainage basin. There are some canoe routes, of the many which connect with the main channel, which seem more feasible than others. They are listed in Table 9.[53]

Cold Creek off the Trent River
Rawdon Creek off the Trent River
the north side of Wilson Island in the Trent River
the Crowe River to Belmont Lake
from Belmont Lake (on the Crowe River system) through Otter Creek to Round Lake and the North River.
from Crowe Lake through Beaver Creek to Limerick Lake
the Ouse River
the Indian River
Eels Creek to Apsley
Eels Creek to Big Cedar Lake and Coon Lake, and on to Deer Bay Creek
Deer Bay Creek to Stoplog, Compass, Loucks, and Long Lakes
Mississagua River to Mississagua and Catchacoma Lakes, Bottle Creek, Bottle Lake, and Sucker Lake
from Loucks Lake to Cox Lake
from Stoplog Lake (or Loucks Lake) to Cherry and Triangle Lakes
from Gold Lake to Cavendish, Beaver, and Catchacoma Lakes
from Gold Lake to Anstruther, Wolf, Crab, Poplar, and Cox Lakes
from Anstruther Lake to Rathburn Lake, Anstruther Creek, Copper Lake, Serpentine Lake, Anderson Lake, and back to Copper Lake, with an alternative route from Rathburn Lake to North Rathburn Lake
the Pigeon River
the Burnt River
the Gull River to Boshkung Lake
the Talbot River where it has not been canalized
the Black River upstream from Washago
the east branch of the Severn River from Severn Bridge to Washago
the Kahshe River
Morrison Lake
Lost Channel (downstream from the narrowing of the channel)
Pretty Channel (downstream from the dam)
Baxter Lake off Litte Go Home Bay

Table 9. Canoe Routes Linked to the Trent-Severn Waterway

[53] The selection is made on the basis of the criteria discussed in Chapter 3.2.

All of the routes described in the above lists are shown, though not in all cases named, on Figure 6. It is evident that, as a network of vertices and navigable links, the Trent-Severn Waterway, with all of its branches, can be considered to have varying degrees of connectivity corresponding to the extent to which its various parts are navigable. Thus, several distinct networks are superimposed on each other, which lend themselves to comparative study.

For the type of comparison contemplated here, the selection of vertices is inconsequential, provided that the same vertices are selected in each case, and that the set of vertices includes all intersections and terminal points of the Waterway and its branches. If we exclude as being too complex and too variable the canoe route network, there are 68 vertices which are required to satisfy these minimum conditions for the rest of the system. They are numbered from 1 to 68 and plotted on Figure 7.[54] This map is obviously much more detailed than Figure 4, which shows only those vertices separated by a canal recording station. For the following analysis it is not necessary to be confined by the data constraints that gave rise to the set of vertices shown in Figure 4, and therefore the more extensive network is used in this chapter.

Table 10 shows the results of calculations that summarize the topological properties of the "large boat" network and the "small boat" network, and compares them with the stereotype of the Waterway as a single line canal. The indices used for the comparison have been selected in most cases from a number of alternatives described by Kansky as being suitable for comparing total networks (Kansky, 87, pp. 10-31).

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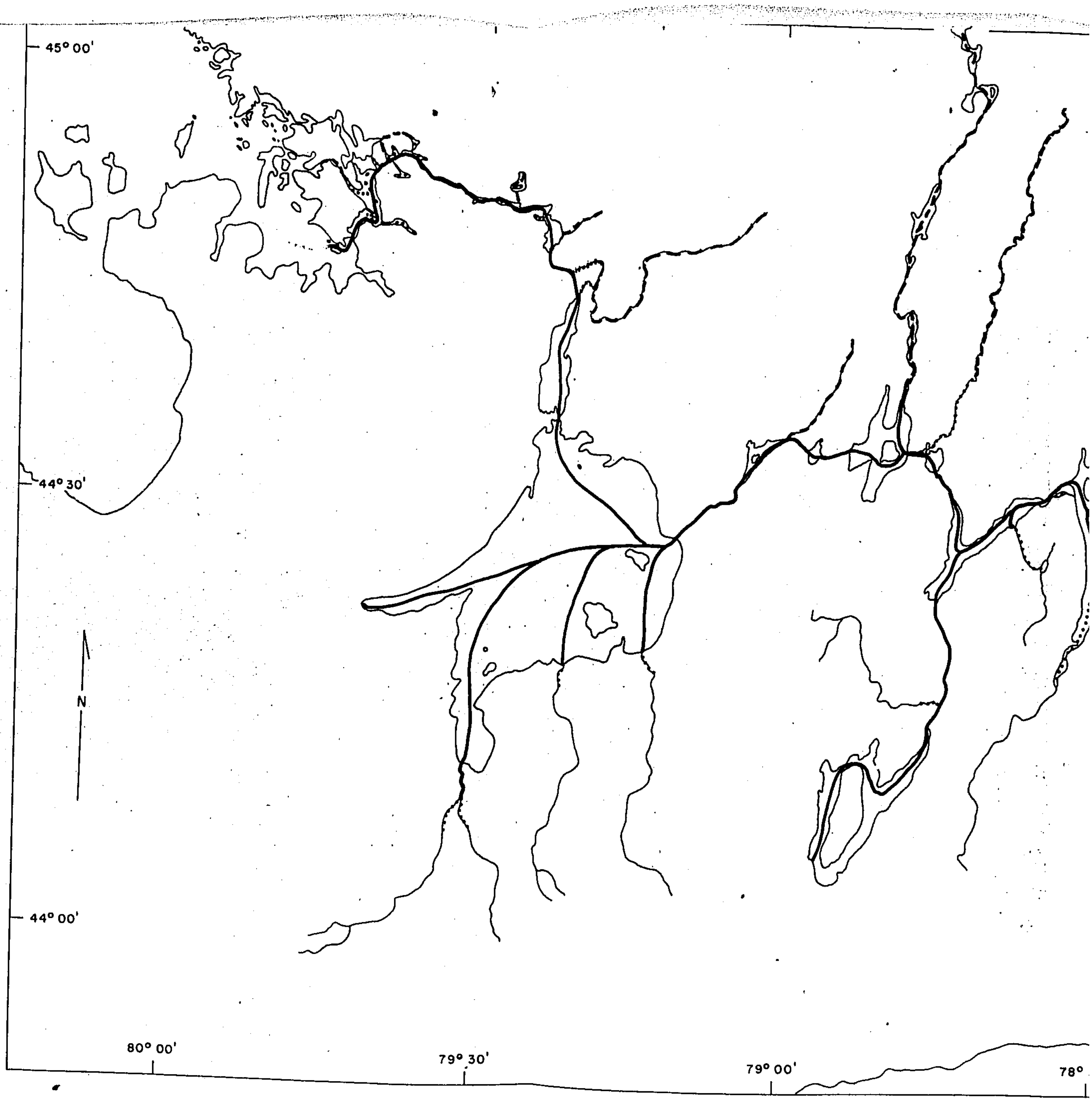
[54]It will be noted that, in a few cases, it has been necessary to establish vertices for no other purpose than to differentiate between alternative channels around islands, where otherwise there would be two links between the same two vertices. Lake Simcoe, because of its size, has also been given extra vertices.



45° 00'
44° 30'
44° 00'
N
80° 00'
79° 30'
79° 00'
78°

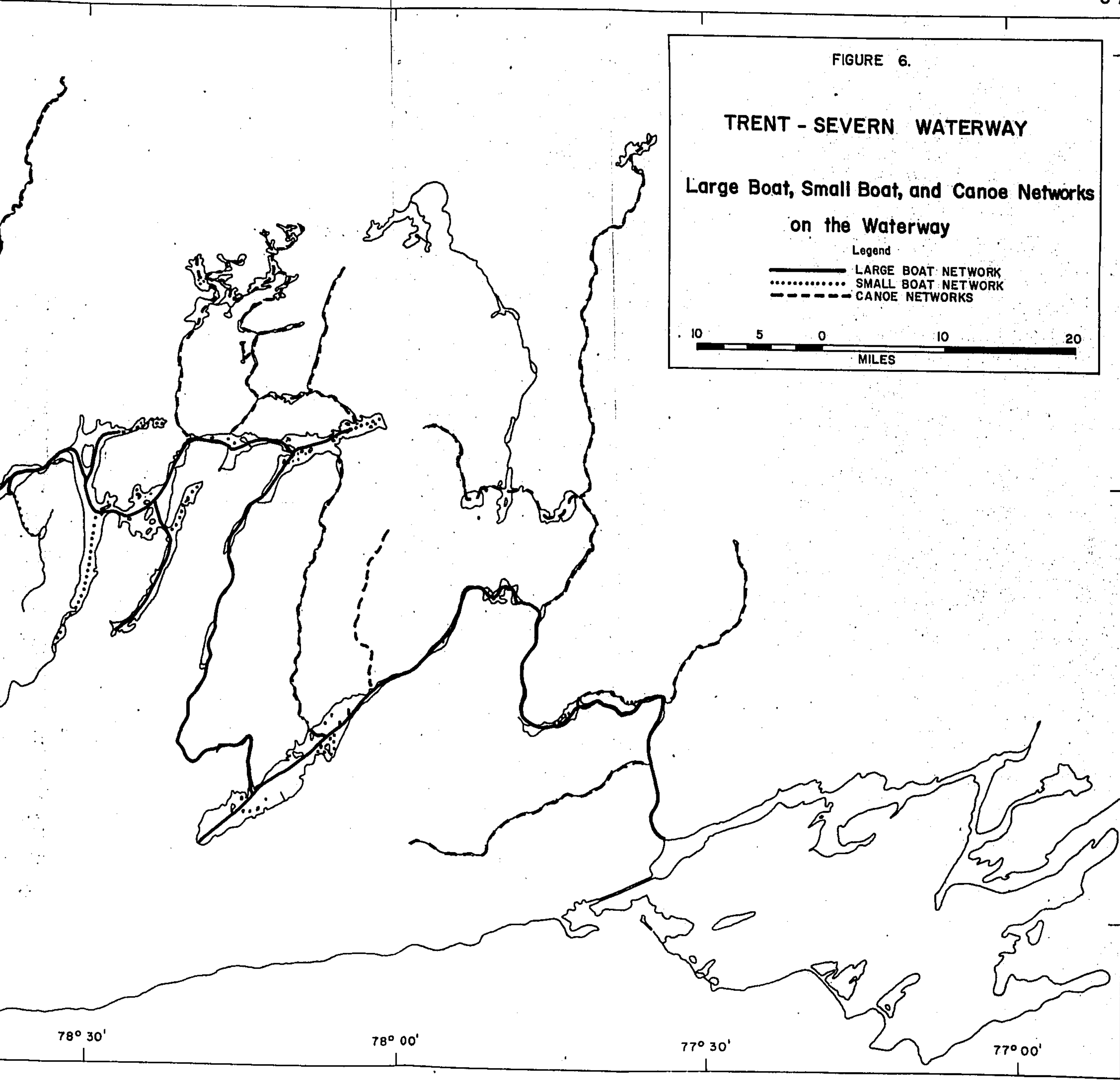
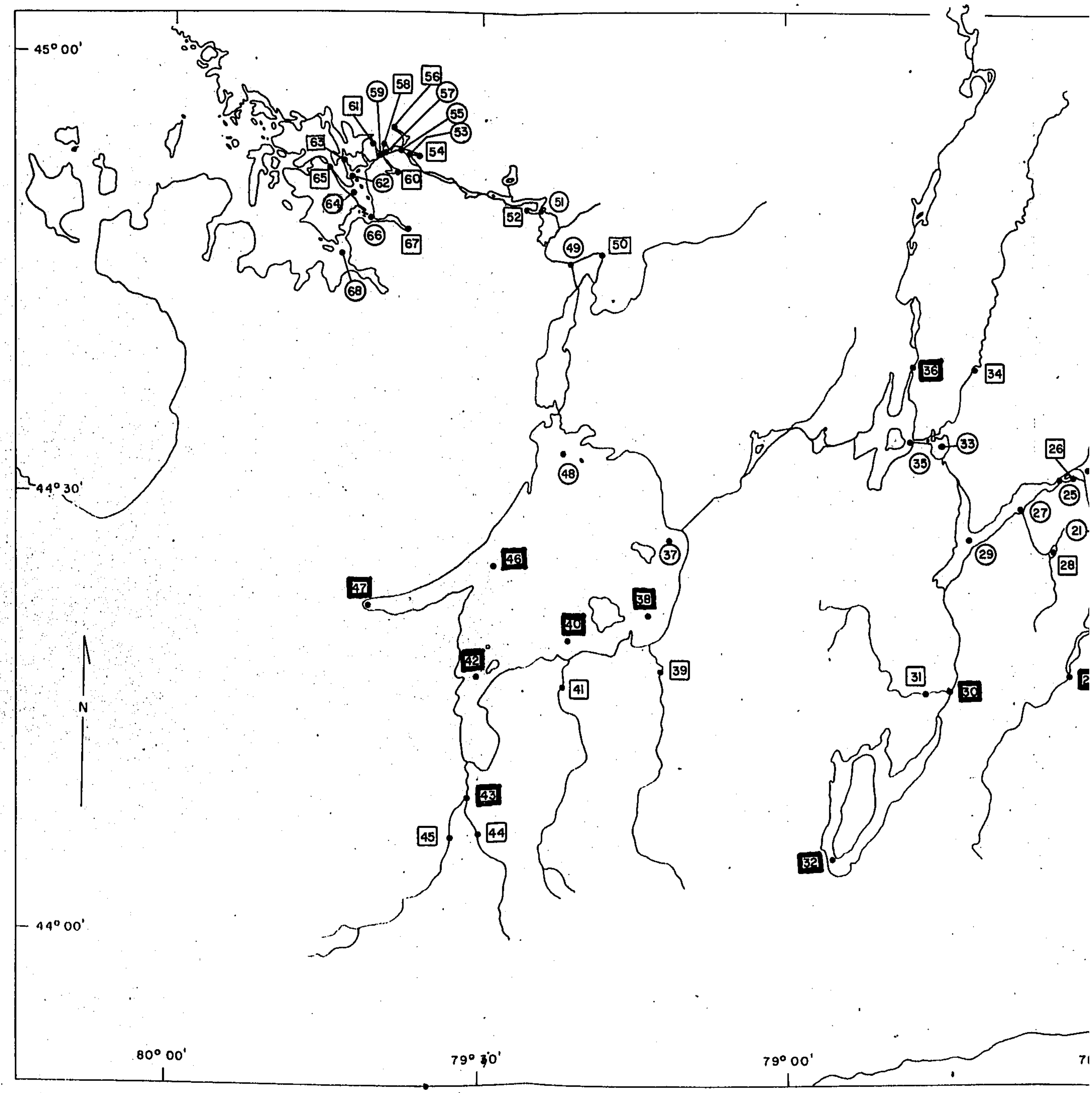


FIGURE 6.
TRENT - SEVERN WATERWAY
Large Boat, Small Boat, and Canoe Networks on the Waterway
Legend
LARGE BOAT NETWORK
SMALL BOAT NETWORK
CANOE NETWORKS
10
5
0
10
20
MILES
78° 30'
78° 00'
77° 30'
77° 00'



45° 00'
44° 30'
44° 00'
80° 00'
79° 30'
79° 00'
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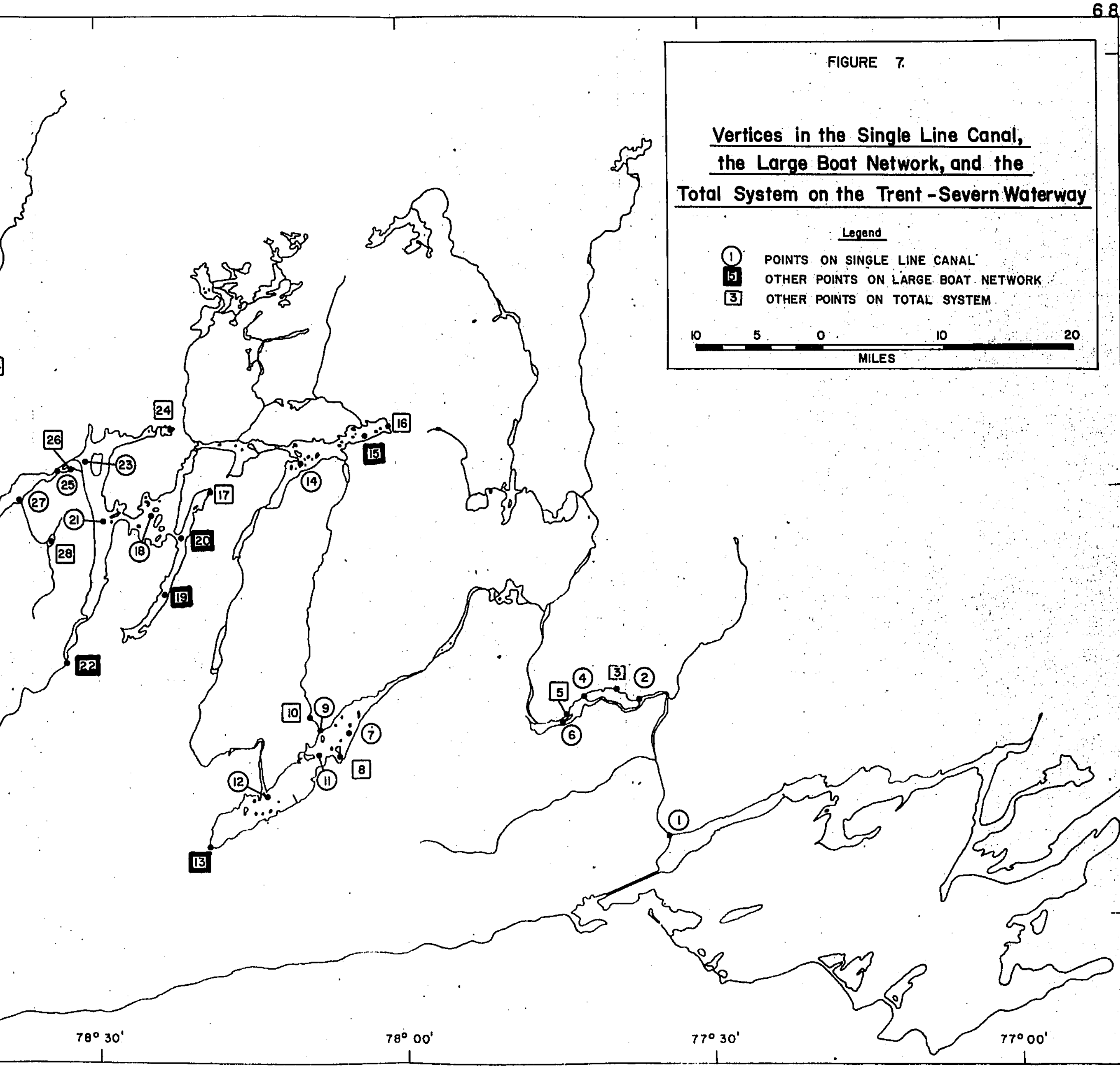

FIGURE 7.

Vertices in the Single Line Canal, the Large Boat Network, and the Total System on the Trent - Severn Waterway

In the process of abstracting these topological properties from the real world of the Waterway, certain simplifying assumptions have to be made. It has already been pointed out that the links which connect the various vertices are generalized routes from point to point. In fact, within the confines of the Waterway, there are many alternative paths between most pairs of points, some of which are more circuitous, or more aesthetically pleasing, or more hazardous than others. In a lake with many small bays and islands, for example, as well as in the larger lakes, there is great scope for varied travel without leaving the lake at all. A further assumption is that the various links are of equal topological "value". There are many portions of the Waterway which occupy critical positions in maintaining its continuity. Any vertex adjacent to such a link constitutes an "articulation point" (Berge, 6, p. 196). Should one such link become obstructed, or otherwise rendered unnavigable, the entire network would be separated into two (thereby becoming an "inadequate" network[55]), and the various indices presented in Table 10 would be drastically altered. The "value" of such links, of which the Otonabee River is an example, is clearly much greater than the value of a relatively isolated link such as the Gull River. Shimbel has referred to the "value" that is thereby attached to certain portions of the network as their "stress", and has suggested a way by which it may be quantified (Shimbel, 127, p. 507). The indices used in Table 10 employ no weighting to adjust for variable topological

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[55]This terminology has been suggested by Shimbel (126, p. 173).

Topological Index	Single Line Canal	"Large Boat" Network (up to 4' draught)	"Small Boat" Network (up to 3' draught)
Number of vertices in the total system	68	68	68
Number of vertices in the principal sub-graph	29	43	68
Number of links in the principal sub-graph	28	43	70
β-index of the principal sub-graph	0.97	1.00	1.03
Mean local degree	1.93	2.00	2.06
β-index of the total system	.41	.63	1.03
Diameter of the principal sub-graph	28	28	28
Ratio of $\frac{p}{d}$	1.0	1.5	2.5
% connectivity of the principal sub-graph	0%	2.5%	4.42%
Dispersion (of total system)	8480	17041	48205
π of the total system	1.00	1.53	1.92

Table 10. A Comparative Topological Analysis of the Single Line Canal, the Large Boat Network, and the Small Boat Network (See text).

values. The links also vary in physical length, and this variation is not considered in the calculation of most of the indices. Only in the case of the π-index does the length of the links affect the calculated values. In general, it is assumed that the links are of equal length. A final assumption underlying this topological description of the Waterway is that of reflexiveness. It is assumed, in other words, that where a link exists between two vertices it represents navigability in both directions. Since these figures concern powered vessels, and the water current is nowhere very swift, that assumption is a valid one.

Table 10 differentiates between the "total system" and the "principal sub-graph" for each network, and these terms require clarification. The "total system" consists of all 68 vertices which are required to portray the most complex of the three networks being compared, viz., that which represents navigability by the smallest of powered craft, those with a maximum draught of 3 feet. The vertices of that network, being points in geographic space rather than relationships, remain fixed in number even when the other less complex networks are considered, though in these latter circumstances some of the vertices, being inaccessible to larger boats, cease to be linked to any other vertex or to the rest of the system. Unlike the vertices, the links are variable in number, even when the total system is being considered, since they represent relationships that may or may not exist. The term, "principal sub-graph," is used here to denote only those vertices which are linked to other vertices in such a way that the combined group of interconnected vertices is larger than any other such group. In practice, the principal sub-graph coincides with the total system in the case of the small boat network, because, by definition, all the vertices of the total system are accessible to all the others by small boat. However, in the case of the large boat network, only 43 vertices of the total 68 are accessible to each other, and in the case of the single line canal the number of interconnected vertices comprising the principal sub-graph is further reduced to only the 29 through which a boat must pass if it travels the Waterway from one end to the other. Both of the latter networks, having more than one sub-graph, are therefore "inadequate" networks (see above). Those vertices which are isolated from large boats or from the canal are omitted from their corresponding sub-graphs. Figure 7 differentiates between the vertices of the total system and those of the two principal sub-graphs that depict the single line canal and the large boat network. The complexity of the large boat network, as measured by the number of vertices, is 45% greater than that of the single line canal, and the complexity of the total system is 134% greater than that of the single line canal.

The minimum number of links (p) in any graph, if no vertices are isolated, is V-1, where V is the number of vertices. It can be seen from Table 10 that in the case of the single line canal, the number of links corresponds to the minimum possible number. If any link were omitted, the Waterway would cease to exist as a single unit. Every vertex except the two end ones is an articulation point, and the average "stress" is high. This is not so in the case of the large boat network or the total system, where the numbers of links exceed the minima by 1 and 3, respectively. The deviation from the minimum number of links in both of these cases is slight indeed, and fails to discriminate clearly among the three networks as a measure of connectivity. Nor can it be argued that the number of links and the number of vertices represent two discrete indicators of dissimilarity among the three networks. One is largely a function of the other, and a high degree of covariance between them is to be expected. The beta index, expressed as $\beta = \frac{p}{v}$, where p is the number of links and v the number of vertices, is a way of expressing this covariance in a manner that permits comparison of the shapes of the networks. It can be seen from Table 10 that the shapes of the three networks are basically similar, each having a tree-like structure with very few or no circuits, a result of the linear configuration of the Waterway. This similarity is also shown by the mean local degree, the average number of links incident at each vertex.[56] The calculation of beta using the total system as a value for v reveals, through low beta values, the isolation of some vertices and the resultant discontinuity between the canal and the large boat network on the one hand and some of the vertices in the total system on the other hand.

The linear extent of the Waterway, in topological terms, is its diameter, "the maximum number of edges in the shortest path between each pair of vertices" (Kansky, 87, p. 12).[57] That the diameter of all

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[56]See Shimbel (127, p. 501) and Haggett and Chorley (76, p. 38). Webb implies that the Trent-Severn Waterway cannot be considered a true network because the values of the mean local degree are too low (Webb, 151, p. 284).

[57]The term, "edges", is synonymous with "links".

three networks is identical reflects the fact that both of the end points, Lake Ontario and Georgian Bay, are accessible to all sizes of vessels and are also on the canal. By itself, the diameter of these three networks provides no discrimination among them and suggests that they have a comparable degree of linearity. However, when the number of links (p) is expressed as a ratio of the diameter (d), the contrast among the networks is striking. This ratio, which is not one of the indices used by Kansky (nor, to the author's knowledge, by anyone else), indicates that the true Waterway is not just a linear feature, but has considerable breadth to it as well. When highway networks, in their developmental sequence, begin to assume certain breadth, they typically acquire lateral interconnections at the same time (Taaffe, _et al._, 134, pp. 503-505). The beta value associated with such networks is considerably higher than the beta values shown in Table 10 for the Waterway, whose lateral interconnections are almost totally absent. As an alternative indication of this overall low connectivity, and for the sake of providing a better comparison than the beta index permits, Table 10 also presents the percentage connectivity of the three networks. This measure expresses, for each network, the relative position between minimum connectivity for that network (0%) and maximum connectivity (100%), as suggested by Garrison (63, p. 129) and Kansky (87, pp. 29-30) in a modification of the method originally proposed by Prihar (122, pp. 929-930).

The above discussion suggests that the Trent-Severn Waterway as a physical entity is decidedly different from the single line canal concept. The basis of this distinction is the large number of vertices which are, to a greater or lesser degree, accessible to the main channel while not lying directly on it. They consist largely of rivers, lakes, and bays. Because the form of the Waterway is highly dependent on existing water bodies, these off-canal vertices are not likely to become linked any more directly than they are now. In topological terms, the Waterway must therefore be a "tree", or nearly so, with few or no circuits in the network. The topological differences between the single line canal and the actual Waterway networks do not lie in their basic structures, which in both cases approximate trees. Consequently, a measure must be sought which illustrates their relative complexities without reference to interconnectedness in circuits. For this purpose, the dispersion index (D) is suitable (Shimbel, 127, pp. 501-502). It is calculated by the formula

$$D = \sum_{i=1}^{n} \sum_{j=1}^{n} d(i,j),$$

where d is the number of links required to travel from vertex i to vertex j by the minimum distance path.

In order to apply the formula, it was necessary to construct, for each of the three networks, a symmetric matrix that represented, for each pair of vertices, the number of links in the shortest path between them (see Prihar, 122, p. 932). The rows are summed, and the totals are accumulated to give the values shown in Table 10. It is apparent from the wide range in values of D, and bearing in mind that the diameters remain constant, that the Waterway networks are indeed much more complex than a single line canal, despite their similarity of topological structure.

To refine still further the comparison among the three networks, the index pi (π) has been calculated, so as to take into account the actual physical distance involved in the various links. As described by Kansky (87, pp. 20-23), it is the ratio of the total mileage in the network to the total mileage of the diameter of the network, which, in this example, remains constant:

$$\pi = \frac{C}{d},$$ where C is the total mileage of the network, and d is the mileage of the diameter of the network.

The inclusion in Table 10 of a calculation based on mileage rather than on numbers of links serves to illustrate that the distinction between the Waterway and a single line canal is not purely the result of the extreme abstraction required for the use of graph theory. The Trent-Severn Waterway, in truth, is not "a 240-mile waterway," and much less a "240-mile canal" as it is often called (e.g., Good, 68, p. ii). In terms of small boat accessibility, which boats represent an overwhelming majority of those using the Waterway, its length is almost double the figure usually quoted. The importance of the overall length of a recreational waterway should not be underestimated, as pointed out by Perloff and Wingo (118, p. 89).

4.4 FURTHER TOPOLOGICAL STUDY

The preceding discussion of the topological structure of the Trent-Severn Waterway is far from complete. The field of graph theory presents endless scope for possible ways of analysing the networks that have been presented. Moreover, the single line canal and the two above boat networks themselves are not the only ones appropriate to a description of the configuration and extent of the Waterway. A description has already been given of a much more extensive waterway network representing actual or potential canoe routes. The vertices and links in this network are known (see Figure 6), but their analysis is beyond the scope of this thesis. Had the canoe route network been included in the comparative analysis of Table 10, there would have been a much larger number of vertices and links in the total system, and there would also have been concomitantly high values for the other indices. Another network that could aid in defining the extent and configuration of the Waterway, if the vertices and links were known, is that which represents movement on land of people engaged in water-oriented recreation.

Throughout this discussion, it has been implicit that the Waterway, having been brought to a certain standard of navigability remains so continuously thereafter. This is not so, for the existence of many of the links ceases abruptly in mid-October every year when the lock operations are discontinued. From then until freeze-up, the Waterway becomes a disconnected network (an "inadequate" one) containing upwards of forty sub-graphs. In effect, the Trent-Severn Waterway becomes, for a few months, a Rice Lake Waterway, a Sturgeon Lake Waterway, a Lake Simcoe Waterway, a Gloucester Pool Waterway, etc. The values for the various indices applied to the system during the summer months are very much altered in the off-season, and even more so in the dead of winter.
The time dimension could be incorporated into this analysis in yet another way. The connectivity of the Waterway for canoe travel has not, apart from the periodic seasonal fluctuation, changed significantly in the four centuries since the pre-Champlain era when the system figured in

the travels of Indians. For larger vessels, however, the progressive development of navigational improvements over time, as shown in Figure 2, lends itself to a comparative network analysis using the same indices as have been applied in the preceding pages, or other ones. Except for canoes, the Trent-Severn Waterway did not assume its present form, with its present diameter, until 1920. A historical treatment of this subject using the present methodology, while interesting, would add little to the interpretation of the recreational waterway concept, and is therefore considered to be beyond the scope of this thesis.

Also ultra limites of this study, though more properly appropriate to the nature of the topic, would be an investigation of the topological effects of establishing links with other waterways that are at present separated from the Trent-Severn Waterway. The outstanding case of a potential for such a marriage exists at Morrison Lake, by which access could be gained to a whole system of water bodies known as the Muskoka Lakes (see Figure 8).[58] The latter constitute a discrete recreational waterway in themselves, having a fairly complex topology, and if the two waterways were artificially connected, the topology of the whole would become very much more complex, with Morrison Lake serving as an articulation point.[59]

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[58]In the terminology of Veatch and Humphrys, the Muskoka Lakes could be classed as either a "chain of lakes" (Veatch and Humphrys, 148, p. 61) or a "gang of lakes" (Veatch and Humphrys, 148, p. 133). Brown suggests the possibility of a future connection between the two systems "via the Pine, Muldrew and Morrison Lakes" (Brown, 32, pp. 107-108).

[59]Shimbel has suggested a way of comparing the topological effectiveness of Morrison Lake and of other possible water connections as links between the two waterways (Shimbel, 127, pp. 503-506).

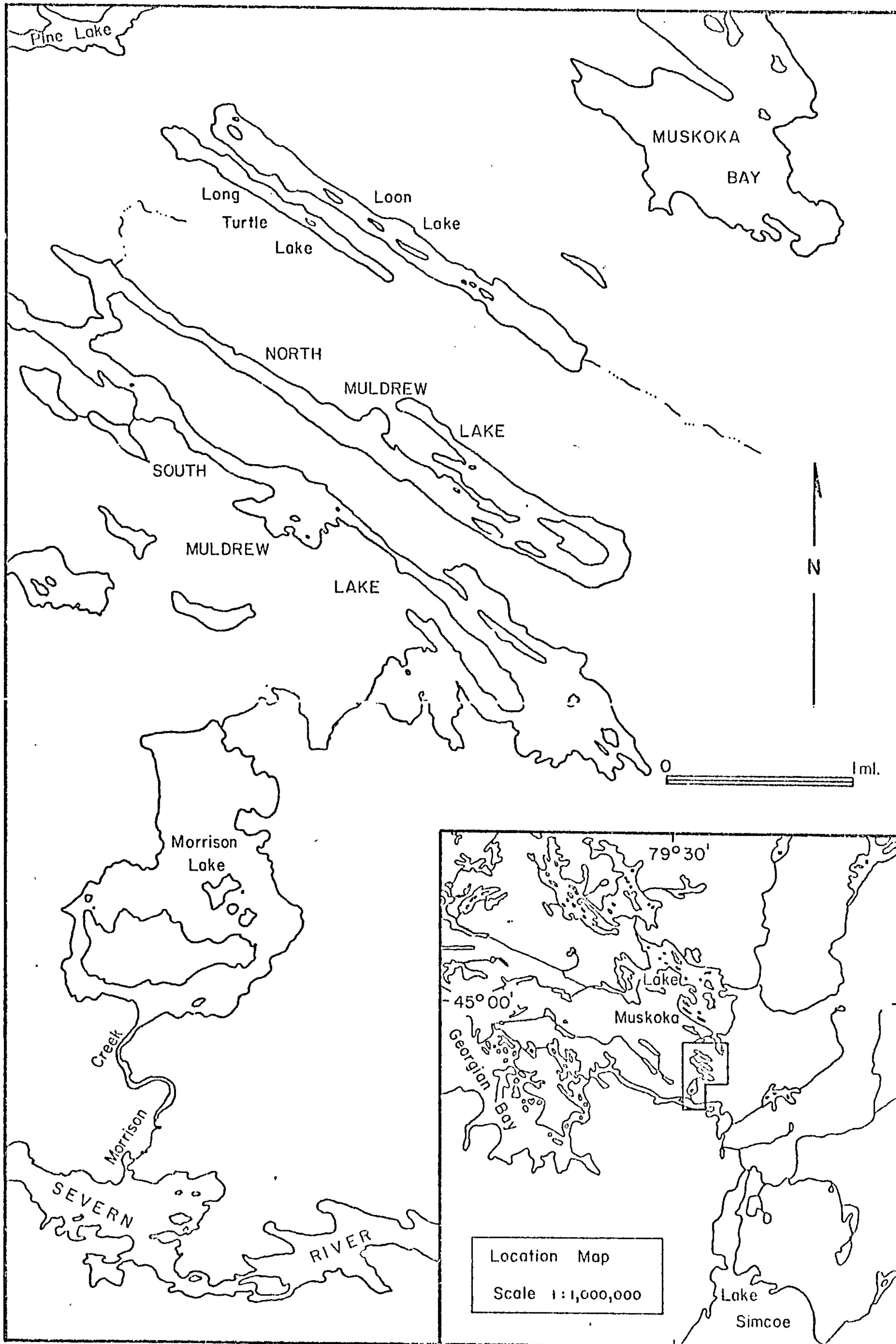

Figure 8. Water Connection between Trent-Severn Waterway and Muskoka Lakes

CHAPTER FIVE

THE WATERWAY CONCEPT IN DYNAMIC TERMS: AN ALTERNATIVE TO THE CANAL CONCEPT

5.1 THE NATURE OF BOAT TRIPS

In the preceding chapter, it has been demonstrated that in the Trent-Severn Waterway the potential exists for making use of the system for a variety of trips other than simply a trip from end to end. However, the mere existence of these varied alternatives does not indicate that the actual traffic patterns on the Waterway necessarily conform to the potentials. In this chapter, a study of the actual trips taken by boaters is described. The preceding chapter demonstrates where boats can travel; the present chapter shows where they do travel. Wolfe has stressed the central role of mobility in the geography of outdoor recreation (Wolfe, 158, p. 216), and the findings reported here justify such an emphasis.

Among the many published data concerning boat traffic in the Trent-Severn Waterway, there are vitually no data on where the traffic enters the Waterway or where it leaves the Waterway. For the purposes of this thesis, this is an important deficiency, for it is only through a study of the origins and destinations of the boats while on the Waterway that it is possible to establish the nature of the trips being taken. From the canal statistics described in Chapter 3.4, the passage of every boat using locks in the Waterway in 1969 has been traced so as to determine its point of origin in the Waterway and its destination in the Waterway.

According to the official records, there are 18,515 different boats involved in that year's lock counts, but the figure is grossly in error because of the data weaknesses described earlier. It ought probably to be reduced by at least 25%.[60] On the other hand, the actual number of records in those statistics is 156,401, since almost every boat was recorded on more than one occasion at either the same or a different lock station. This figure is probably reasonably accurate, and if anything is probably a slight underestimate.[61] The computer has sorted these 156,401 records into 18,515 groups by boat registration numbers, and for each boat has sorted the records of its passage through lock stations chronologically, thus making the origin and destination of each boat readily apparent.

Every individual record represents a passage from one lake or river segment (a) to an adjoining one (b). Typically, such a passage is found to be followed in chronological sequence by a passage from the second lake or river segment (b) to a third one (c) which adjoins the second. This is often followed by further passages to a fourth (d), or a fifth (e), or a higher order spatially sequential lake or river segment. Every such chronological sequence for a given boat that coincides with a spatially uninterrupted sequence is defined in this study as a single

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[60] The figure of 18,515 has been widely reported, and has even been used as the basis for extensive calculations of the economic impact of the Waterway (Klopchic, 93).

[61] If an error has been made in recording or transcribing information about a boat, a record will still appear among the statistics, albeit an incorrect record. Only in the case of a lock passage that has been omitted altogether (or, more rarely, recorded twice) will the mistake cause the total number of records to be distorted.

"trip", provided that the spatial sequence involves no reversal of direction in the Waterway. In fact, there are numerous instances where a reversal of direction does occur, a boat that has just traversed a given lock in one direction being next recorded at the same lock but travelling in the opposite direction. Where this occurs, a new trip is said to have begun. A large majority of the boats begin and end their records at the same lake, having made a "trip" to another lake one or more locks removed and subsequently having made a second, or return, trip through the same lock(s) in the opposite direction. The two trips that such a record represents could be described as follows:

FIRST TRIP - lake a to lake d (passing through lakes b and c)
SECOND TRIP- lake d to lake a (passing through lakes c and b)

There are shortcomings to the above definition of trips. From the point of view of the boater, when he sets out from his base on lake a and travels to lake b and then returns to his base, he has made only <u>one</u> trip, rather than two. This distinction is in the nature of a semantic difference and does not affect the results of the subsequent analysis in any way. More serious for the interpretation of the results is the occasional case where a boater on an extended trip (perhaps the entire length of the Waterway) has interrupted his passage to return to a lake through which he had already passed, before continuing in the original direction to his ultimate destination. Such a trip could be represented as follows:

a - b - c - d - e - f - <u>g - f - g</u> - h - i - j - k - l - m - n.

In this study, such a trip would be disaggregated into three trips, because of the two reversals of direction:

FIRST TRIP - lake a to lake g (passing through lakes b, c, d, e, and f)
SECOND TRIP- lake g to lake f
THIRD TRIP - lake f to lake n (passing through lakes g, h, i, j, k, l, and m).

The effect of this procedure is to reduce the number of long trips and increase the number of short trips, but it is a relatively small number of cases where this applies, certainly not enough to distort the overall picture that emerges. A third flaw in the definition is that it does not distinguish between two consecutive "return trips" from a given lake to its adjoining lakes lying in opposite directions. For example, a boat which travels from its base on lake d to lake e and back, and then at a later point in time (perhaps even on the same day) travels to lake c and back, is actually taking four trips, as follows:

FIRST TRIP - lake d to lake e
SECOND TRIP- lake e to lake d
THIRD TRIP - lake d to lake c
FOURTH TRIP- lake c to lake d.

Because there is no way of detecting from the records whether the boat actually returned to its base between the second and third trips, and because any time interval selected for distinguishing between the second and third trips would have to be an arbitrary one, and because of the complications involved in having the computer print out the actual times of passage, the second and third trips in such a case are merged into one, so that the four trips are recorded in this study as only three, as follows:

FIRST TRIP - lake d to lake e
SECOND TRIP - lake e to lake c (passing through lake d)
THIRD TRIP - lake c to lake d.

The effect of this procedure is to increase the number of long trips and reduce the number of short trips. It is impossible to know how much distortion occurs as a result, but in the opinion of the writer this is not significant.

An initial attempt was made to incorporate into the analysis every single trip, as defined above. After the trips of 3383 boats had been recorded and entered into the analysis, it proved to be neither necessary nor possible, with the resources at the disposal of the writer, to continue to aim for a 100% sampling rate of all the trips taken. Therefore, for the remainder of the trips a 25% stratified sample was taken, including only the trips beginning on the first half of every second page of the computer printout. The totals from this limited sample were multiplied by four and added to the original 100% sample of part of the data to provide the totals that form the raw data for the analysis. On this basis, a total of 56,675 trips is recorded.

Since there are 43 points (lakes or river segments) on the Waterway (see Chapter 3.3), it follows that there are 43 X 42, or 1806 possible combinations of origins and destinations. The 56,675 trips were sorted into these 1806 categories and the total for each category was entered into a "from-to" matrix with 43 rows representing points of origin and 43 columns representing points of destination (see Figure 9). The entries in the principal diagonal of this matrix are nil, since the study employed no means of counting those boats that confined their

TO

FROM	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
A	0	32	27	6	16	1	15	17	6	0	6	21	1	0	0
B	36	0	11	0	0	0	0	1	0	0	0	0	0	0	0
C	24	15	0	8	0	1	4	0	0	0	0	0	0	0	0
D	6	0	4	0	3	0	0	0	0	0	0	0	0	0	0
E	16	0	0	8	0	6	0	4	0	0	0	0	0	0	1
F	1	0	1	2	2	0	10	4	0	0	0	0	0	0	0
G	12	0	4	0	0	9	0	102	0	0	5	9	1	0	4
H	10	1	0	0	9	0	106	0	5	5	5	13	1	1	0
I	6	0	0	0	0	0	0	10	0	7	0	1	0	0	1
J	0	0	0	0	0	0	0	8	0	0	1	1	0	8	0
K	8	0	0	0	0	0	0	1	0	2	0	18	2	0	0
L	20	0	0	0	0	0	6	6	1	1	7	0	13	17	0
M	1	0	0	0	0	0	0	2	1	0	0	11	0	11	0
N	4	0	0	0	0	0	0	7	0	8	0	20	16	0	8
O	1	0	0	0	0	0	0	0	0	0	0	0	0	14	0
P	18	4	0	0	0	0	1	5	0	2	3	22	4	27	11
Q	48	0	0	0	0	0	9	1	0	0	1	17	4	31	1
R	11	0	0	0	0	0	2	9	0	0	1	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	25	1	1	0	0	0	2	0	0	0	0	0	0	0	0
U	6	0	0	1	0	0	0	0	0	0	0	0	0	0	0
V	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	7	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Z	18	0	0	0	0	0	0	0	0	0	0	0	0	1	0
AA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BB	6	0	0	0	0	0	1	0	0	0	0	0	0	0	4
CC	48	0	1	0	0	0	0	0	0	0	0	0	8	0	0
DD	29	1	0	0	0	0	1	0	0	0	0	0	0	0	0
EE	7	0	0	0	0	0	0	0	0	0	0	5	0	0	4
FF	16	0	0	0	0	0	0	0	0	0	0	1	0	0	0
GG	17	0	0	0	0	0	1	0	0	0	0	1	1	0	4
HH	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LL	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MM	86	1	0	0	1	1	1	4	0	0	0	4	0	0	0
NN	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OO	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PP	24	0	0	0	0	0	1	0	0	0	0	0	0	0	0
QQ	110	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	463	55	49	25	32	18	160	181	13	25	29	144	51	111	38

FROM	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD
A	6	50	15	0	19	8	0	0	4	7	9	9	9	36	28
B	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0
C	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	0	5	2	0	2	0	0	0	0	0	0	0	0	0	0
H	8	1	0	0	0	1	0	0	0	0	0	0	1	0	0
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
L	29	12	5	0	0	0	0	0	0	0	0	0	0	4	0
M	4	8	0	0	0	0	0	0	0	0	0	0	0	4	0
N	30	25	0	0	1	0	0	0	0	0	0	0	1	0	0
O	28	2	0	0	0	0	0	0	0	0	0	0	0	0	0
P	0	247	12	0	9	5	0	0	1	5	0	4	0	4	5
Q	267	0	513	26	211	19	6	16	4	31	27	4	8	46	22
R	12	492	0	33	282	5	13	4	0	17	34	13	17	36	38
S	0	21	37	0	35	0	0	0	0	1	10	1	4	7	5
T	3	217	295	26	0	7	0	5	0	5	9	0	0	0	0
U	1	27	2	4	19	0	11	1	0	0	0	0	0	1	0
V	0	7	5	1	0	6	0	4	2	8	1	1	0	0	1
W	0	12	8	0	6	0	10	0	11	4	0	0	8	8	5
X	0	1	4	4	0	0	5	11	0	44	17	4	13	9	0
Y	0	34	27	9	6	4	20	0	53	0	883	90	92	70	55
Z	5	43	28	1	4	0	1	4	20	809	0	647	445	428	94
AA	0	3	10	9	1	1	0	0	1	84	647	0	423	204	46
BB	0	2	38	0	4	0	0	4	5	91	450	443	0	964	75
CC	4	53	49	9	0	5	0	12	10	70	443	218	1020	0	2688
DD	1	21	33	2	0	0	1	4	1	62	133	23	80	2648	0
EE	4	18	9	4	0	0	0	0	8	16	22	1	5	116	601
FF	0	7	12	2	0	0	0	0	0	7	25	6	22	266	1103
GG	8	24	27	1	0	4	1	1	5	10	100	19	29	346	853
HH	9	8	28	2	0	0	0	0	5	9	20	10	8	71	132
II	0	0	0	0	0	0	0	0	0	0	0	1	0	2	9
JJ	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
KK	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
LL	0	0	1	1	0	0	0	0	0	5	4	0	0	8	6
MM	0	20	35	2	4	0	0	0	1	29	22	20	13	99	107
NN	0	5	17	0	0	0	0	0	0	5	11	4	0	40	36
OO	0	6	4	0	0	0	0	0	0	4	4	0	8	30	16
PP	9	8	6	5	0	0	0	0	0	0	7	0	2	38	14
QQ	0	3	12	4	0	0	0	0	1	8	21	6	6	33	56
	431	1382	1234	145	605	65	68	66	132	1331	2900	1525	2212	5525	5995

FROM	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	
A	7	22	30	9	1	0	4	8	77	24	11	37	146	722
B	0	1	0	1	0	0	0	0	1	0	1	0	5	60
C	0	0	0	1	0	0	0	0	0	1	0	0	4	60
D	0	0	0	0	0	0	0	0	0	0	0	0	0	13
E	0	0	0	0	0	0	0	0	0	0	0	0	0	36
F	0	0	1	0	0	0	0	0	0	0	0	1	0	22
G	0	0	0	0	0	0	0	0	3	0	2	0	1	161
H	0	0	0	0	0	0	0	0	0	0	0	0	0	167
I	0	0	0	0	0	0	0	0	0	0	0	0	0	25
J	0	0	0	0	0	0	0	0	0	0	0	0	0	20
K	0	0	0	0	0	0	0	0	0	1	0	0	0	34
L	5	0	0	0	0	0	0	0	3	5	0	1	0	135
M	0	0	0	0	0	0	0	0	0	0	0	0	0	42
N	0	1	0	4	0	0	0	0	1	0	0	0	0	126
O	4	0	0	0	0	0	0	0	0	0	0	0	0	49
P	4	0	4	5	0	0	0	0	4	0	0	4	0	410
Q	20	7	25	6	0	0	0	0	15	5	5	13	14	1422
R	14	15	14	22	1	0	0	4	28	10	0	2	17	1146
S	1	0	8	0	0	0	0	0	4	0	0	5	4	143
T	0	0	4	0	0	0	0	0	0	0	0	0	0	600
U	0	0	0	0	0	0	0	0	0	0	0	0	0	73
V	0	1	8	0	0	0	0	0	0	0	0	0	2	51
W	0	0	0	0	0	0	0	0	0	0	0	0	0	72
X	0	3	1	0	0	0	0	0	0	0	0	0	0	116
Y	8	10	28	12	2	0	0	0	15	12	4	0	6	1445
Z	34	44	72	23	0	0	0	1	31	17	9	2	21	2502
AA	0	16	23	6	0	0	0	1	8	4	8	0	2	1498
BB	5	23	27	13	2	0	0	0	16	0	12	1	2	2155
CC	99	259	374	70	2	1	0	10	109	30	9	42	47	5690
DD	564	1135	785	126	7	0	0	7	101	32	19	3	47	5569
EE	0	77	153	15	4	0	0	1	26	8	8	17	13	1142
FF	85	0	2418	140	5	1	0	0	60	10	8	4	23	4221
GG	139	2381	0	516	18	23	8	3	124	15	32	16	48	4775
HH	16	124	538	0	111	24	1	0	98	21	5	12	19	1274
II	0	5	16	146	0	21	4	0	31	9	0	0	2	246
JJ	0	2	38	16	5	0	26	4	35	0	4	1	4	136
KK	0	1	5	12	0	18	0	50	28	11	0	1	1	131
LL	4	1	11	5	0	0	45	0	114	9	2	4	9	233
MM	38	59	159	95	27	45	29	122	0	2547	745	360	753	5429
NN	8	19	36	24	5	1	11	2	2435	0	945	253	200	4076
OO	8	7	5	8	0	0	0	0	720	955	0	497	225	2505
PP	12	8	11	4	0	0	0	8	386	266	464	0	2215	3468
QQ	14	41	27	21	0	4	0	18	777	206	212	2235	0	3816
	1089	4265	4821	1300	190	138	128	239	5250	4198	2505	3511	3830	56675

Figure 9. Matrix of Origins and Destinations of Boat Trips on the Trent-Severn Waterway

trips to a single lake or river segment. In addition there are 1094 other empty cells in the matrix. This matrix portrays concisely almost all of the information on which the subsequent analyses in this chapter are based.

5.2 TRIP LENGTHS

A study of trip lengths reveals some interesting findings. Most of the literature about the Trent-Severn Waterway emphasizes its attractiveness as a cruising waterway and reinforces the widespread notion that the majority of trips taken on the Waterway are extended ones along either its whole length or large stretches of it. In fact, however, over 60% of the trips in this study (35,714) involve passage through only one lock station. It seems likely that at least as many trips, and probably a far higher number, are confined to a single lake or river segment, since boaters are often inclined to avoid the inconvenience of passing through a lock, if it can be avoided. The use of the Waterway as a canal connecting Lake Ontario and Georgian Bay is minimal, involving less than half of one per cent of the trips, 256 all together. Figure 10 indicates the overwhelming predominance of short trips among the 56,675 trips taken in 1969.[62] The mean trip length is 2.84 lockages, but the median and mode are both 1 lockage, the mean being raised by the considerable skewness of the distribution. Such short trip lengths are totally uncharacteristic of most commercial waterways, because the economic advantages of transporting commodities by water as opposed to land are

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[62] An alternative basis for defining trip length, the expected duration of each trip in days, was used in the boater survey described in Chapter 3.5. The results confirm the dominance of short trips (Trent University, 139, p. 7).

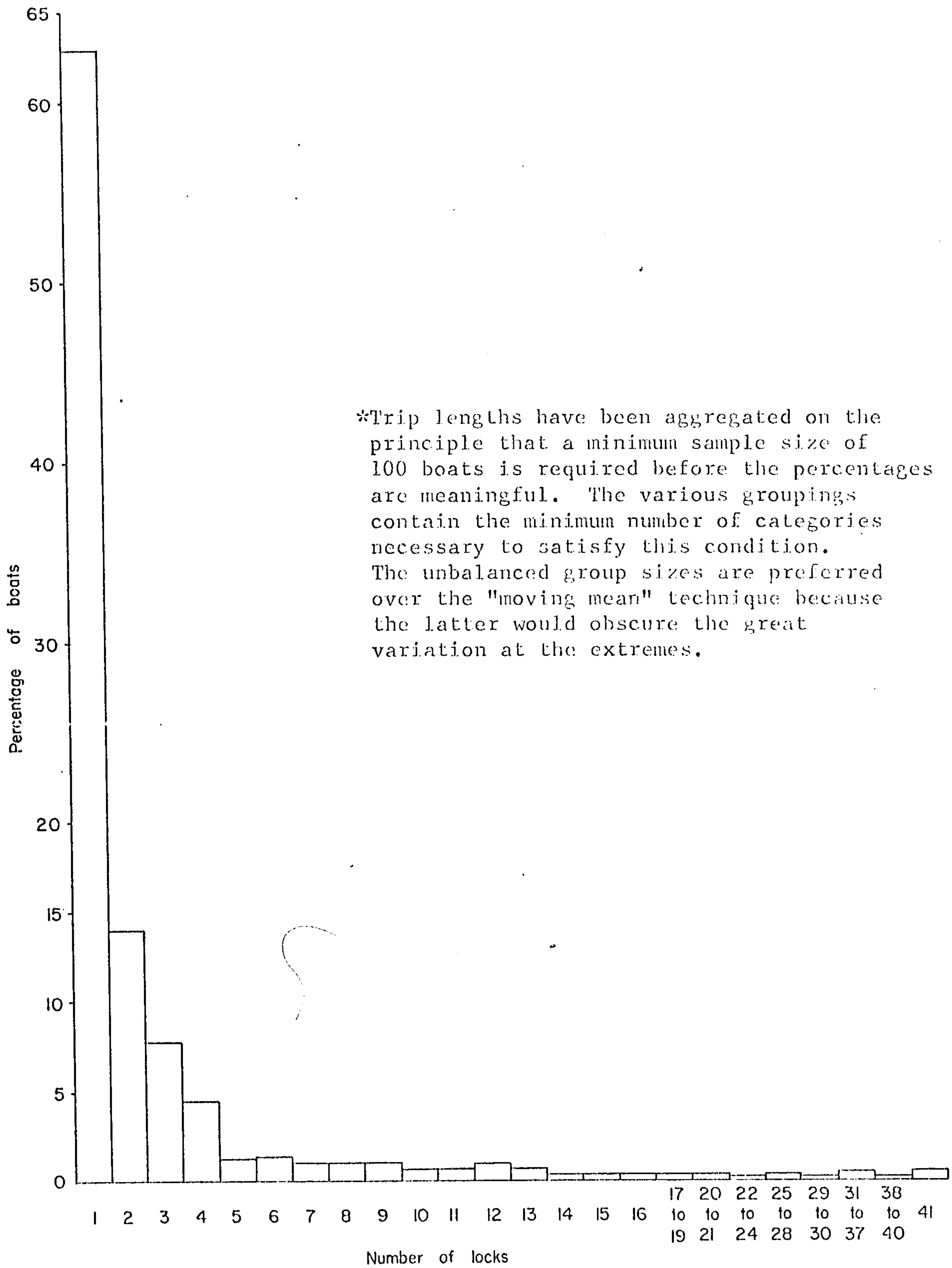

Figure 10. Trip Lengths (Number of locks passed through)*

achieved only on longer hauls (Hoover, 80, pp. 19-20). Recreational boaters, by contrast, are not seeking to overcome distance in the most economical way but are engaged in boating for its own sake. In summary, short trips constitute a significant element in the total picture of recreational waterways, as presented here.

5.3 TRIP ORIENTATIONS

A great deal of insight into the spatial dynamics of trips on the Trent-Severn Waterway can be obtained by studying their origins and destinations. Because of the very large number of return trips (i.e., pairs of reciprocal trips) between pairs of points of origin and the distribution of points of destination. The correlation coefficient (R) between these two sets of data is found to be .999. Because of this high value, much of the subsequent analysis of boat trip patterns is devoted to a study of destinations only, since a study of origins would yield comparable results and would therefore be redundant.

If the Trent-Severn Waterway is considered to have an east-west orientation (excluding the Scugog River or other branches of the Waterway), then each trip, except those between Lake Scugog and Sturgeon Lake, is either eastbound or westbound. Totalling the appropriate portions of the rows and columns of the "from-to" matrix shows no strong directional bias to the trips in their total number (27,771 eastbound, 27,739 westbound). Nor is it possible, at the various points on the Waterway, to differentiate significantly between the number of trips which originate there and proceed either east or west and the number which terminate there from the same directions. Thus, to consider Sparrow Lake by way of illustration, 2678 trips began there and proceeded east, while 2771 trips from the east terminated there; and

1398 trips began there and proceeded west, while 1427 trips from the west terminated there.

In the total sample of 43 points, the directional differences of this type are too minor to be statistically significant, when tested using "Student's t test."

There are, however, far more trips through a given lake than there are trips originating or terminating there. This is because, as pointed out already, the mean trip length of 2.84 lockages involves passage through more than two lakes. When all such trips, whether originating or terminating or just passing through a given lake, are taken into account, the average point on the Waterway is involved in 4991 trips, of which 2511 are westbound and 2430 eastbound. This directional difference, unlike the minor differences described in the preceding paragraph, is statistically significant (at the 99.9% level), and can be ascribed to the longer trips, whose passages affect the totals at a large number of lakes. There are, for example, almost 35% more westbound trips than eastbound travelling the full distance between the Lower Trent River (Glen Ross to Lake Ontario) and the portion of the Waterway west of Fenelon Falls. Where the number of local trips is limited, as in the section east of Rice Lake, the directional disparity therefore assumes even greater significance, an average of 778 westbound and 711 eastbound trips being noted in the latter area.

There is scope for a full-scale study of traffic directions in commercial canals and in waterways such as the Trent-Severn. A cursory examination of recreational waterways throughout the world suggests that, apart from seasonal or daily reversals in the dominant direction of travel,[63] the annual volume of traffic exhibits only a slight degree of imbalance between traffic in one direction and traffic in the opposite direction at any given point on the waterway. This directional balance is expressed in the number of trips taken in each direction, but comparable data on the total tonnage of boat traffic in each direction or on the number of passengers (the recreational counterpart of cargo) in each direction would almost certainly reveal an identical pattern of directional balance. Such a flow pattern contrasts markedly with the pattern of cargo flow on many of the world's commercial waterways, where a pronounced directional bias is often the most obvious characteristic. It is suggested here that a high degree of directional balance is another of the distinguishing traits of a recreational waterway.

5.4 THE BASIS FOR A SET OF FUNCTIONAL REGIONS

As shown in Figure 11, which indicates the terminal points of all the trips, there are a few points on the Trent-Severn Waterway which dominate the traffic patterns. Sturgeon Lake and the adjoining Pigeon Lake/Buckhorn Lake/Chemung Lake group together account for 20% of the destinations. Lake Simcoe, Balsam Lake, Cameron Lake, Sparrow Lake, Georgian Bay, Gloucester Pool, and Stony/Clear Lakes each account for between 5% and 10% of the total. The remaining 29% of the trips terminate in the other 34 lakes or river segments. The striking degree to which destinations are concentrated in a few points is brought out by the use of a Lorenz curve, shown in Figure 12. It has already been shown

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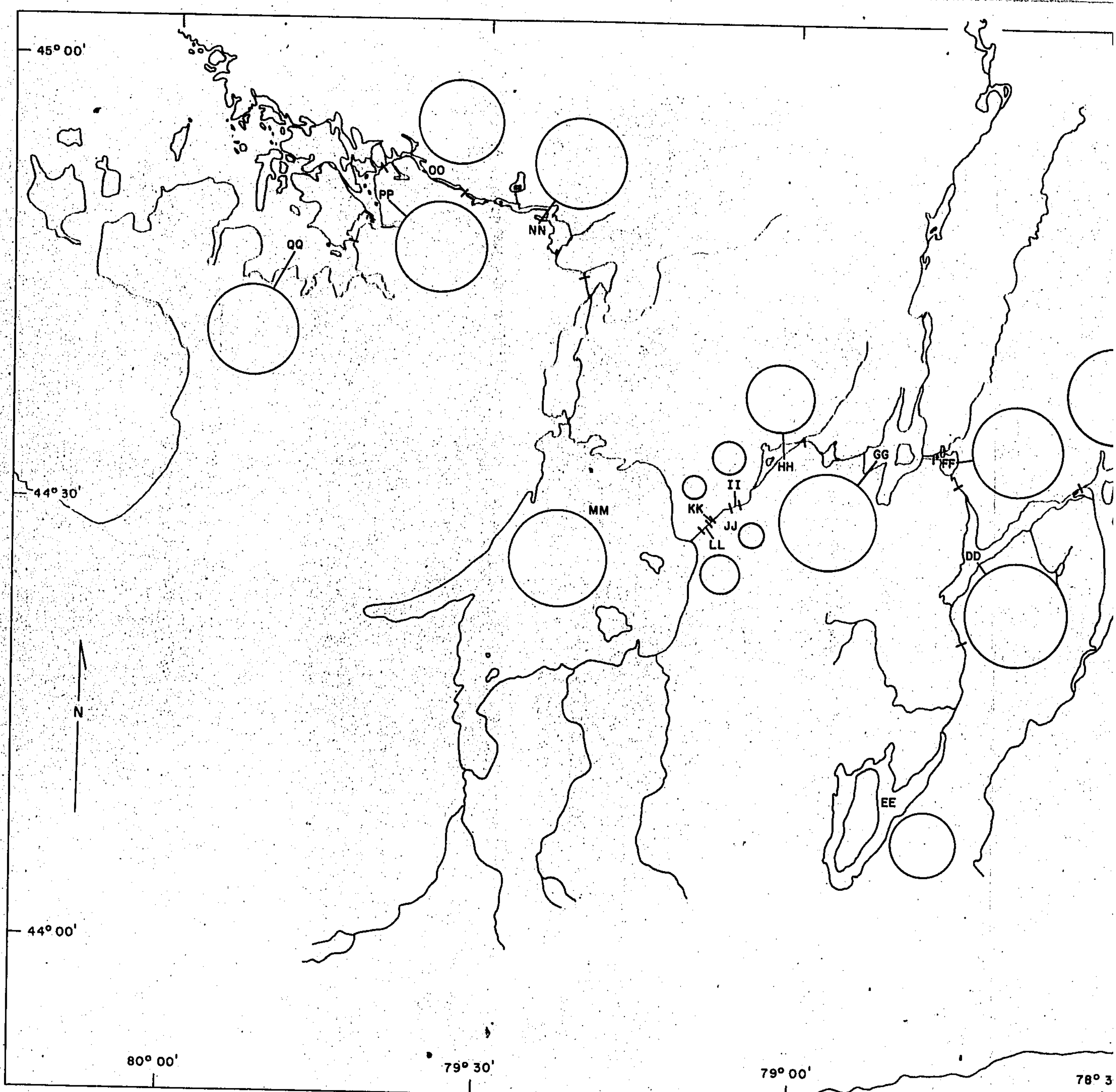
[63] Seasonal fluctuations are typical of some recreational waterways, e.g., the Intracoastal Waterway of North Carolina (Mortimer, 105, pp. 33-35).



45° 00'
44° 30'
44° 00'
80° 00'
79° 30'
79° 00'
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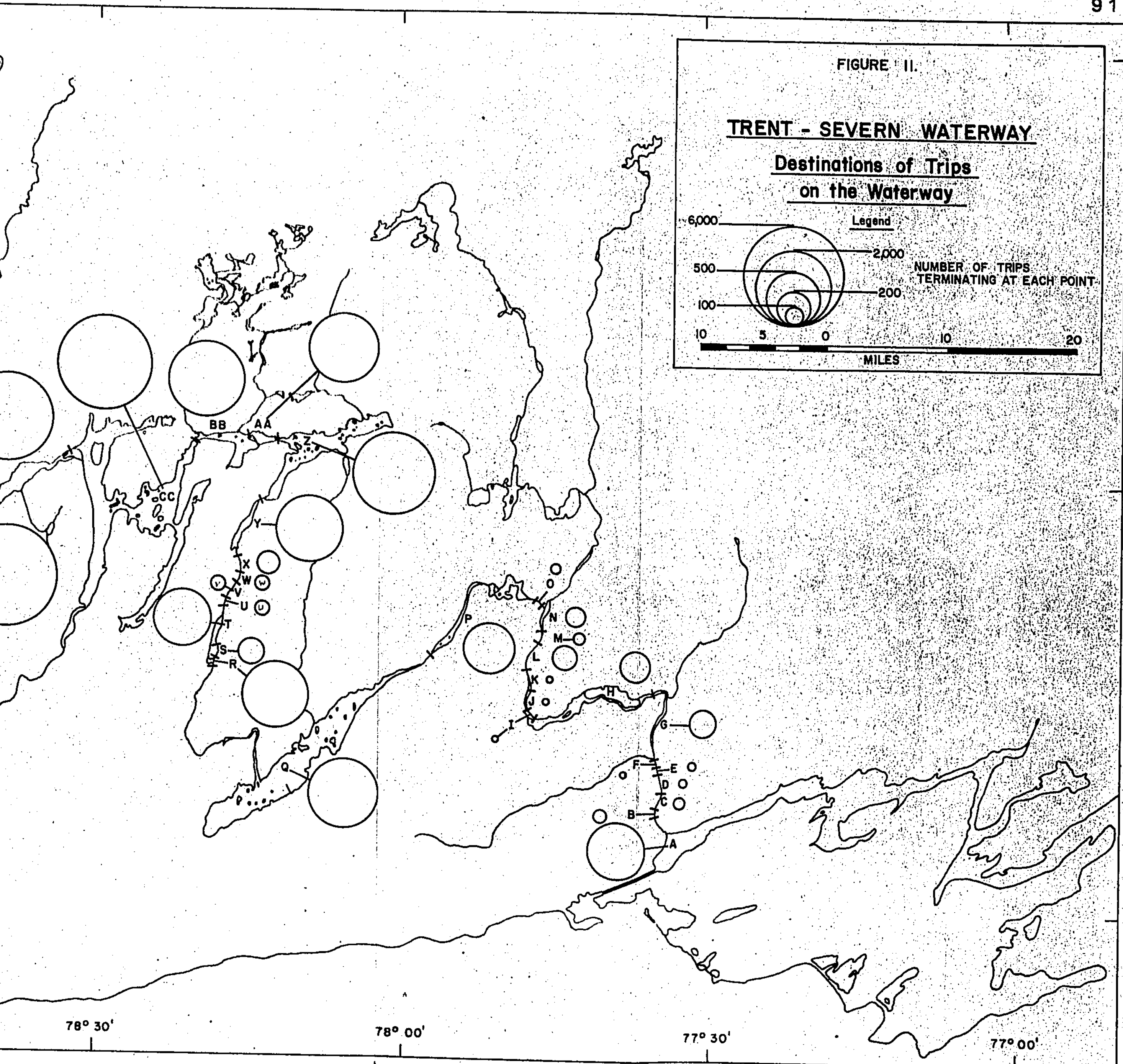
FIGURE II.
TRENT - SEVERN WATERWAY
Destinations of Trips on the Waterway
Legend
6,000
2,000
500
200
100
NUMBER OF TRIPS TERMINATING AT EACH POINT
10 5 0 10 20
MILES
78° 30'
78° 00'
77° 30'
77° 00'

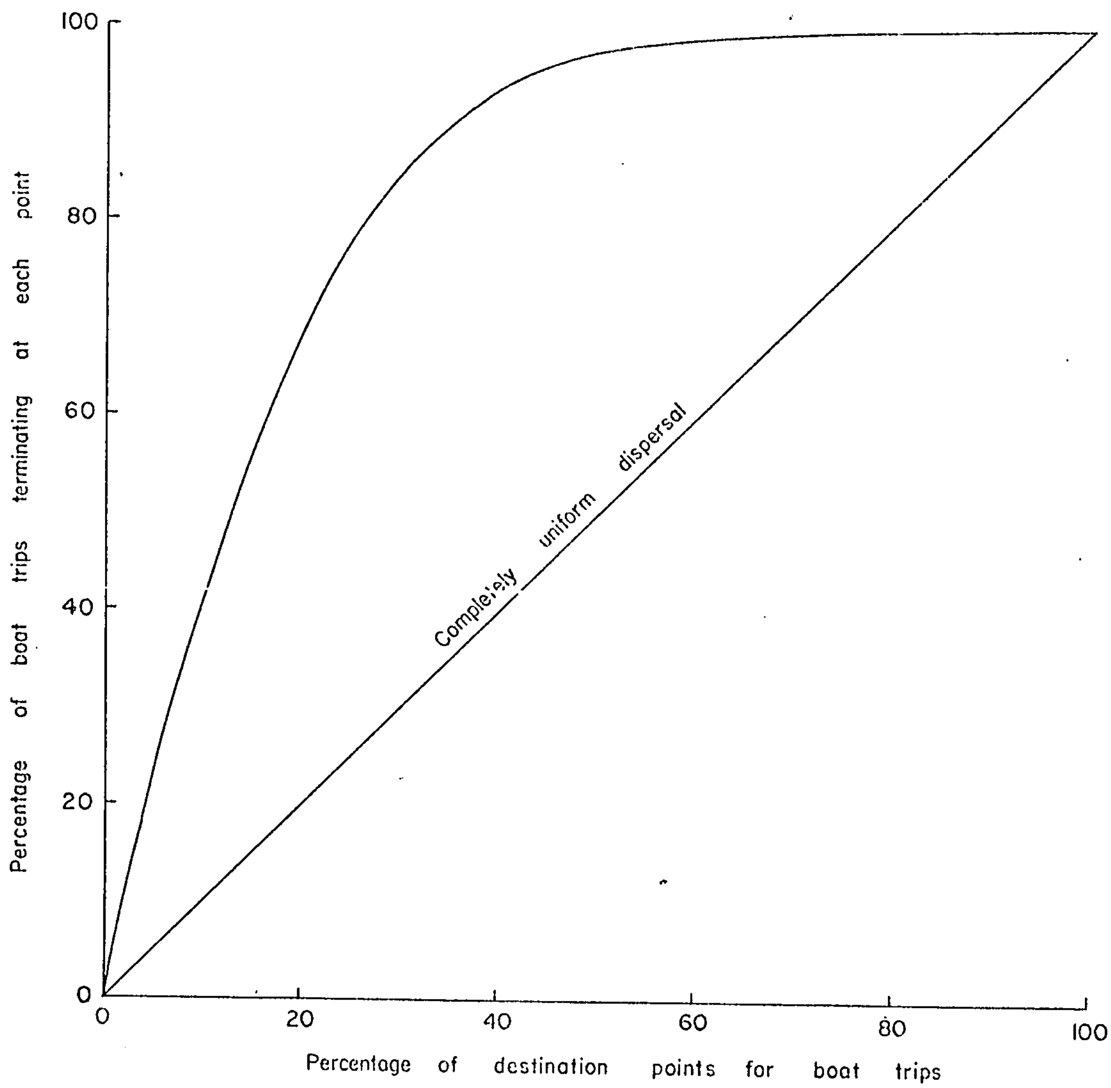

Figure 12. Lorenz Curve Showing Degree of Concentration of Boat Trip Destinations

that the pattern of trip origins is very much the same as that just described. In view of that, and in view of the preponderance of short trips, it can be confirmed that most of the traffic occurs within a few restricted portions of the Waterway, as demonstrated, albeit with erroneous data, by the C.O.R.T.S. Report (41, p. 40 and Figures 4 and 5).

The localized nature of the bulk of the traffic on the Trent-Severn Waterway is a phenomenon found also in other recreational waterways. Traffic on the Rideau Waterway in Eastern Ontario, for example, is highly localized at the Newboro lock (C.O.R.T.S. Report, 41, p. 26 and Figure 2). Timme has demonstrated the high degree of independence among the various sectors of the upper Illinois River (Timme, 138, pp. 50-51). Since this appears to be a widespread feature of recreational waterways, the methodological question arises of how best to "regionalize" a waterway so that the rather vague formulations of the preceding paragraph can be given more explicit spatial definition and so that the regions established on a formal methodological basis will preserve the integrity of those portions of a waterway which do exhibit certain unity. While others have indeed attempted to subdivide recreational waterways into sectors, as noted above, their criteria have been of the crudest nature and are hardly more useful than intuition (see, for example, Timme, 138, p. 9). The question to which this section of the study addresses itself, therefore, is to provide clear evidence of the extent to which traffic on the Trent-Severn Waterway is localized.

The basis for any set of regions varies according to the criteria arbitrarily selected for establishing them. Therefore, the validity of the regions themselves can be justified only in terms of the selection of criteria. One of the requirements postulated by Černý and Přikryl for the identification of "régions touristiques" is that there be the means for "la circulation facile à l'intérieur de (la région)" (Černý and Přikryl, 44, p. 70), and this condition, as described in the preceding chapter, is met throughout the Waterway. In this study, the criteria for sub-dividing the Waterway into regions are the data on destinations of boat trips, as already described. Trip data are classic cases of spatial interaction quantified and they serve admirably to measure the forces which give rise to interdependence among points on the Waterway. They are oblivious of geographic, historic, economic, or other similarities and dissimilarities among points on the Waterway. The regions that emerge from the analysis of the trip data will therefore be functional, as opposed to formal, regions and will, ipso facto, reflect ease of internal movement.

To analyse the trip data with a view to establishing regions, it is necessary to return to the use of graph theory. A method for applying flow data to the problem of regionalization has been suggested by Nystuen and Dacey, who established a set of regions in the State of Washington using data on inter-city telephone calls (Nystuen and Dacey, 107). The distinction between their use of graph theory and the graph theoretic analysis of the preceding chapter lies in the non-reflexive nature of the data which they used. That is, telephone calls, like boat trips on the Waterway, have a specified orientation, and the existence of a link from point a to point b (whether in the form of a telephone message or a boat trip) does not necessarily imply the existence of a link from point b to point a, as was the case in the topological study of the Waterway as a network. In the study of traffic on the Trent-Severn Waterway to be described here, the intensity of flows between reciprocal pairs of points is not identical, as illustrated by the asymmetry of the "from-to" matrix described earlier. It is possible to use this matrix, as shown by Nystuen and Dacey, to construct a directed graph[64] of the nodal structure (i.e., the system of nodes and subsidiary points) of the area in question.

The principle upon which the resultant nodal regions are based, in the present application of the technique, is that each lake or river segment serves as the destination for trips from a number of other points, and that those lakes which are destinations for a large volume of traffic are more likely to be nodes for traffic-based regions than are lakes whose volume of incoming trips is slight. The "nodality" of a lake, a measure of its importance in the system,[65] depends on the extent to which it functions as a terminal point for trips, and is shown by the column totals in the matrix. From these totals, the lakes and river segments are ranked in decreasing order of importance, as shown in Table 11.

---

[64] For a discussion of the fundamental properties of directed graphs, or digraphs, see Harary, et al. (77).

[65] Nystuen and Dacey refer to this property of a point as its "size" (Nystuen and Dacey, 107, p. 34).

Nodality Rank	Code Letters (Figure 4)	Name of Terminal Point (Lake or river segment)
1	DD	Sturgeon Lake
2	CC	Buckhorn Lake/Chemung Lake/Pigeon Lake
3	MM	Lake Simcoe
4	GG	Balsam Lake
5	FF	Cameron Lake
6	NN	Sparrow Lake
7	QQ	Georgian Bay
8	PP	Gloucester Pool
9	Z	Clear Lake/Stony Lake
10	OO	Severn River between Swift Rapids and Big Chute
11	BB	Lower Buckhorn Lake
12	AA	Lovesick Lake
13	Q	Rice Lake
14	Y	Katchiwano Lake
15	HH	Canal Lake
16	R	Little Lake
17	EE	Lake Scugog
18	A	Lake Ontario
19	T	Trent Canal between Peterborough Lift Lock and Lock 22 (above Nassau Mills)
20	P	Trent River between Healey Falls and Hastings
21	LL	Trent Canal between Lock 40 and Lock 41 (at Gamebridge)
22	II	Talbot River between Lock 37 and Lock 38
23	H	Percy Reach
24	G	Trent River between Frankford and Glen Ross
25	S	Trent Canal between Little Lake and Peterborough Lift Lock
26	L	Campbellford segment of Trent River
27	JJ	Trent Canal between Lock 38 and Lock 39
28	X	Otonabee River between Lock 25 and Lakefield
29	KK	Trent Canal between Lock 39 and Lock 40
30	N	Trent River between Lock 14 and Lock 15
31	V	Otonabee River between Lock 23 and Lock 24
32	W	Otonabee River between Lock 24 and Lock 25
33	U	Otonabee River between Lock 22 (above Nassau Mills) and Lock 23
34	B	Trent River between Trenton and Highway 401
35	M	Trent River between Lock 13 (above Campbellford) and Lock 14
36	C	Trent River between Highway 401 and Glen Miller
37	O	Healey Falls segment of Trent River
38	E	Trent River between Lock 4 and Lock 5
39	K	Trent River between Lock 10 and Ranney Falls
40	D	Trent River between Glen Miller and Lock 4 } equal
41	J	Trent River between Lock 9 and Lock 10 } inflow
42	F	Trent River between Lock 5 and Frankford
43	I	Trent River between upper end of Percy Reach and Lock 9

Table 11. Nodality Ranks of Lakes and River Segments in the Trent-Severn Waterway.

Those points ranked lower than 30 had fewer than 100 trips terminating there, and can be regarded as "trivial terminal points"[66] and subsequently ignored.

The next step towards identifying the nodal structure of the Waterway is to group the thirty terminal points that occur most frequently into categories according to the points from which the nodal flows originate. Each terminal point (j) attracts trips from a number of origins (i), but the largest flow (ij) to any terminal point (j) must come from only one source (i). For any destination (j), therefore, the maximum inflow (ij_{max}) can be termed the nodal flow,[67] and indicates an affinity between the source (i) and the destination (j). The nodal flow for any point can be determined by scanning that point's column in the matrix (Figure 9) for the highest value. The nodal flows for each of the thirty points are shown in Table 12.

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[66] The terminology is used by Nystuen and Dacey to indicate points which have no trips at all linking them to the rest of the network (Nystuen and Dacey, 107, pp. 34-35). In this study a critical level of 100 trips seems a reasonable, though arbitrary, minimum for identifying components of the graph. Cf. Chapter 5.6.

[67] Nystuen and Dacey used the term "nodal flow" to refer to the largest outflow from a point (Nystuen and Dacey, 107, p. 34) rather than the largest inflow. The resulting regional structure, in this study, would be almost identical if that approach were used here, but it seems more consistent to use inflow data throughout the analysis than to perform the ranking with inflow data and then use outflow data for grouping the points. Moreover, in this case, ambiguities in the final result are fewer when inflow data are used.

Terminal Point	Largest Number of Incoming Trips (Nodal Flow)	Origin of Nodal Flow
A	110	QQ
G	106	H
H	102	G
L	22	P
N	31	Q
P	267	Q
Q	492	R
R	513	Q
S	33	R
T	282	R
X	53	Y
Y	809	Z
Z	883	Y
AA	647	Z
BB	1020	CC
CC	2648	DD
DD	2688	CC
EE	564	DD
FF	2381	GG
GG	2418	FF
HH	516	GG
II	111	HH
JJ	45	MM
KK	45	LL
LL	122	MM
MM	2435	NN
NN	2547	MM
OO	945	NN
PP	2235	QQ
QQ	2215	PP

Table 12. Nodal Flows in the Trent-Severn Waterway.

It can be seen that, although there are thirty terminal points being considered, there are only seventeen origins, since several of them feed nodal flows to more than one terminal point. The seventeen origins of the nodal flows can be related graphically to the thirty terminal points as shown in Figure 13.

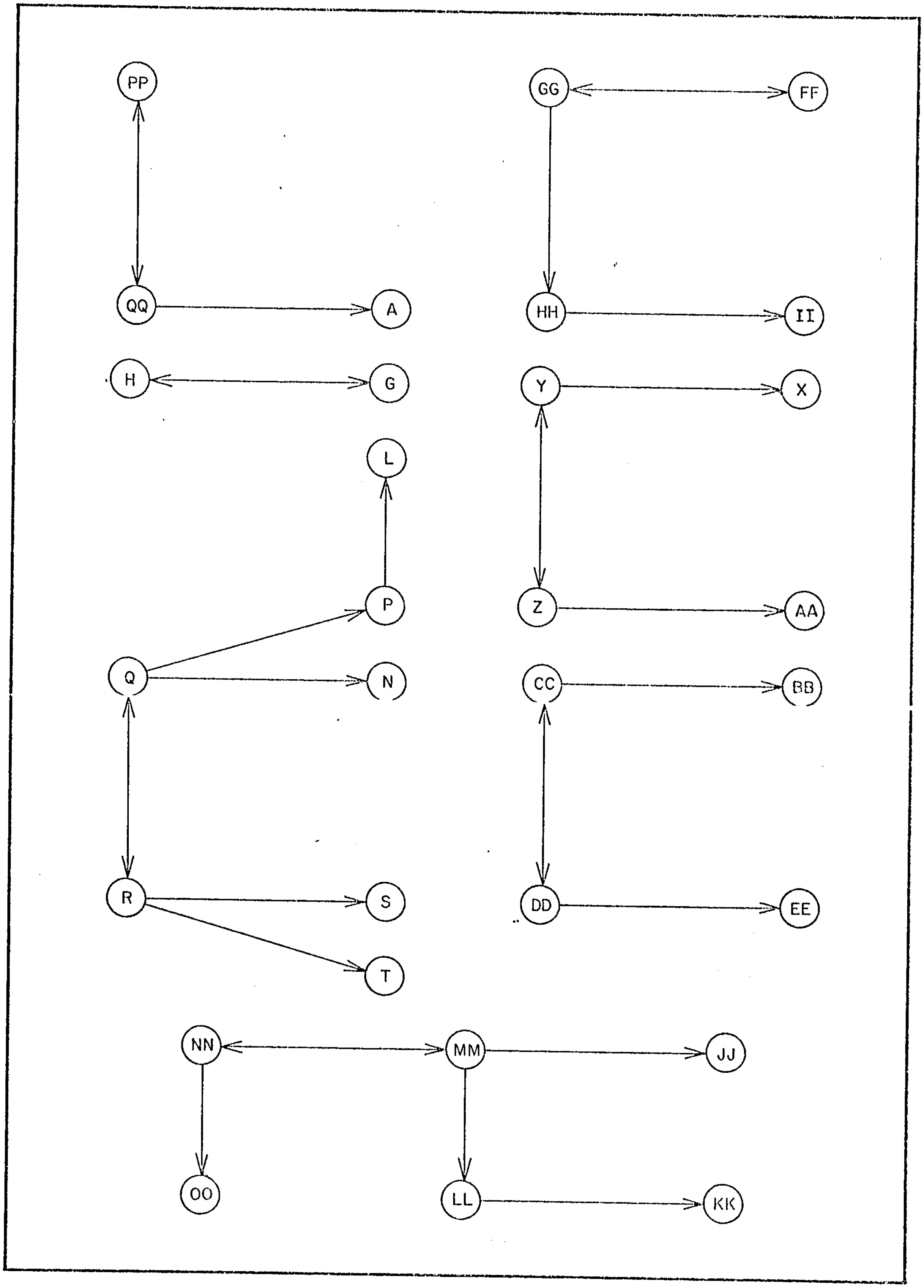


Figure 13. The Nodal Structure of the Trent-Severn Waterway (Letter code as in Figure 4)

5.5 FUNCTIONAL REGIONS WITHIN THE TRENT-SEVERN WATERWAY

There are several significant implications of the functional structure of the Trent-Severn Waterway, as shown in Figure 13. In the first place, it is worth noting that seven discrete sets of points emerge, which are functionally independent of each other, in terms of boat traffic. That this should be so is far from a foregone conclusion. To take a matrix of trip data for a hypothetical thirty-point waterway (see Figure 14) whose traffic pattern approximates that of a canal (see Chapter 4.2) and to subject it to a similar analysis yields only one set of points. Thus, the actual disaggregation of the Trent-Severn Waterway into a form quite different from that of a canal is confirmed by boat traffic data. Furthermore, it is highly improbable that the thirty terminal points should become aggregated into such clearly defined sets that no ambiguities arise about the placing of any of the points. This is illustrated by the analysis of another hypothetical thirty-point waterway (see Figure 15) for which the trip data are selected from a table of random numbers. In this case there are several points whose position in the structure is in doubt because of ambiguities.

Whether the seven sets of points in the Trent-Severn Waterway constitute valid regions depends on the extent to which their functional organization coincides with their spatial organization. A map of the thirty terminal points shows that there is indeed a spatial regularity to the seven sets of points, and that they <u>are</u> geographic as well as mathematical regions, in that it is possible to circumscribe each set without overlapping any of the others (see Figure 16). If the

FROM \ TO	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD
A	0	4	2	14	3	6	3	11	2	2	2	9	3	0	0	4	20	2	1	1	0	5	0	0	1	28	1	1	0	499
B	5	0	1	3	2	0	1	1	0	1	0	3	0	0	0	0	5	1	0	0	0	0	0	0	0	6	0	0	0	1
C	2	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1
D	11	3	0	0	0	0	0	10	1	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	0
E	3	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1
F	6	0	0	0	1	0	2	6	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
G	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
H	12	0	1	9	0	1	0	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0
I	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
J	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
K	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	3	0	0	0	0
L	10	0	0	1	0	0	0	6	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	1
M	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0
N	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
O	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1
P	4	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Q	15	0	1	3	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
S	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	1
T	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
U	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	2	0	0	0	0
V	6	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
W	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
X	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0
Y	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Z	30	2	0	0	0	0	2	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
AA	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
BB	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	0	0	0	1
CC	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
DD		0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	2	0	0	0	0	3	0	0	0	3	0	0	0	0
	616	18	6	37	8	9	9	54	7	5	2	26	8	0	0	15	44	5	1	1	0	16	0	0	1	76	1	1	0	518

Figure 14. Matrix of Origins and Destinations on a Hypothetical Canal

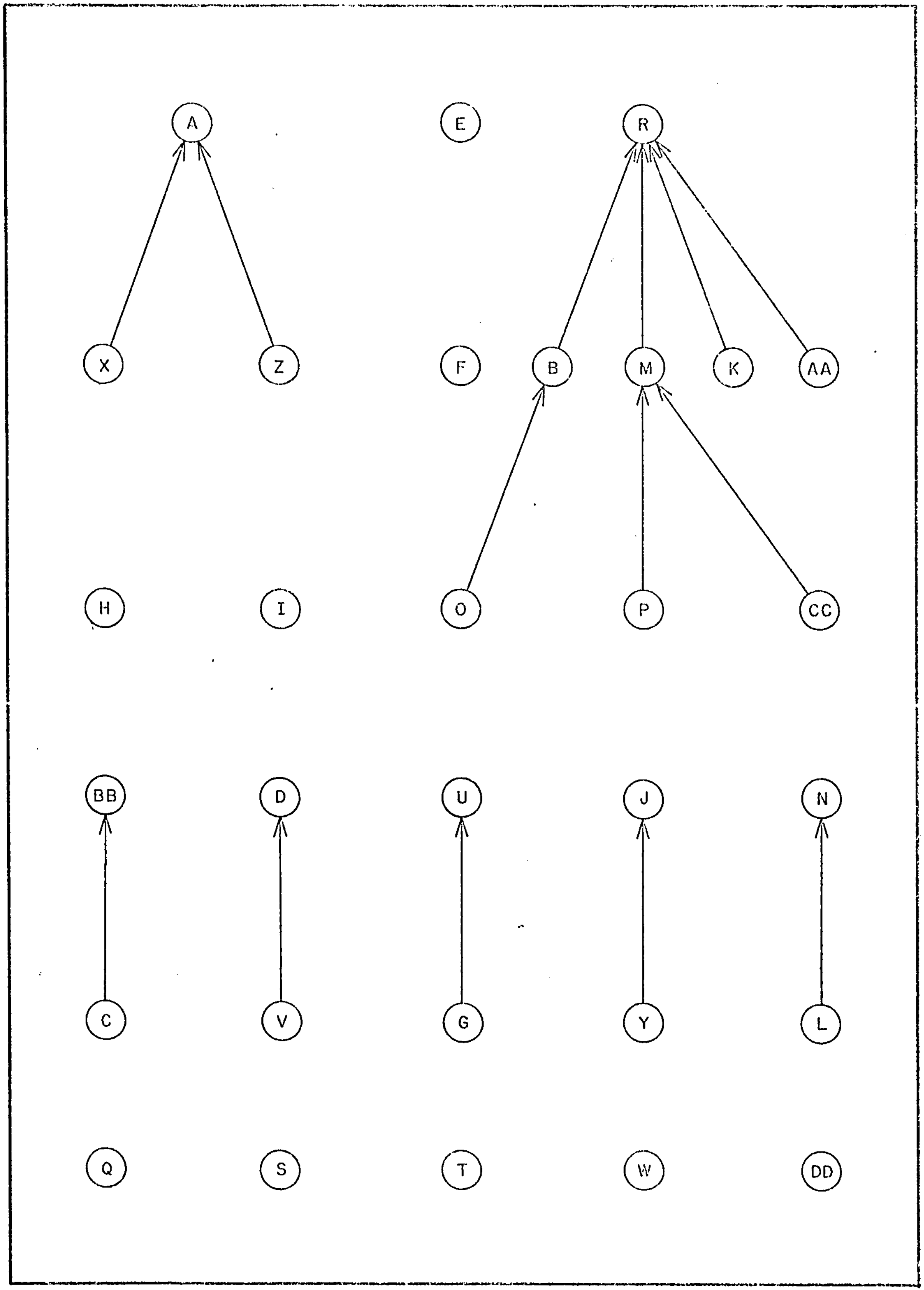
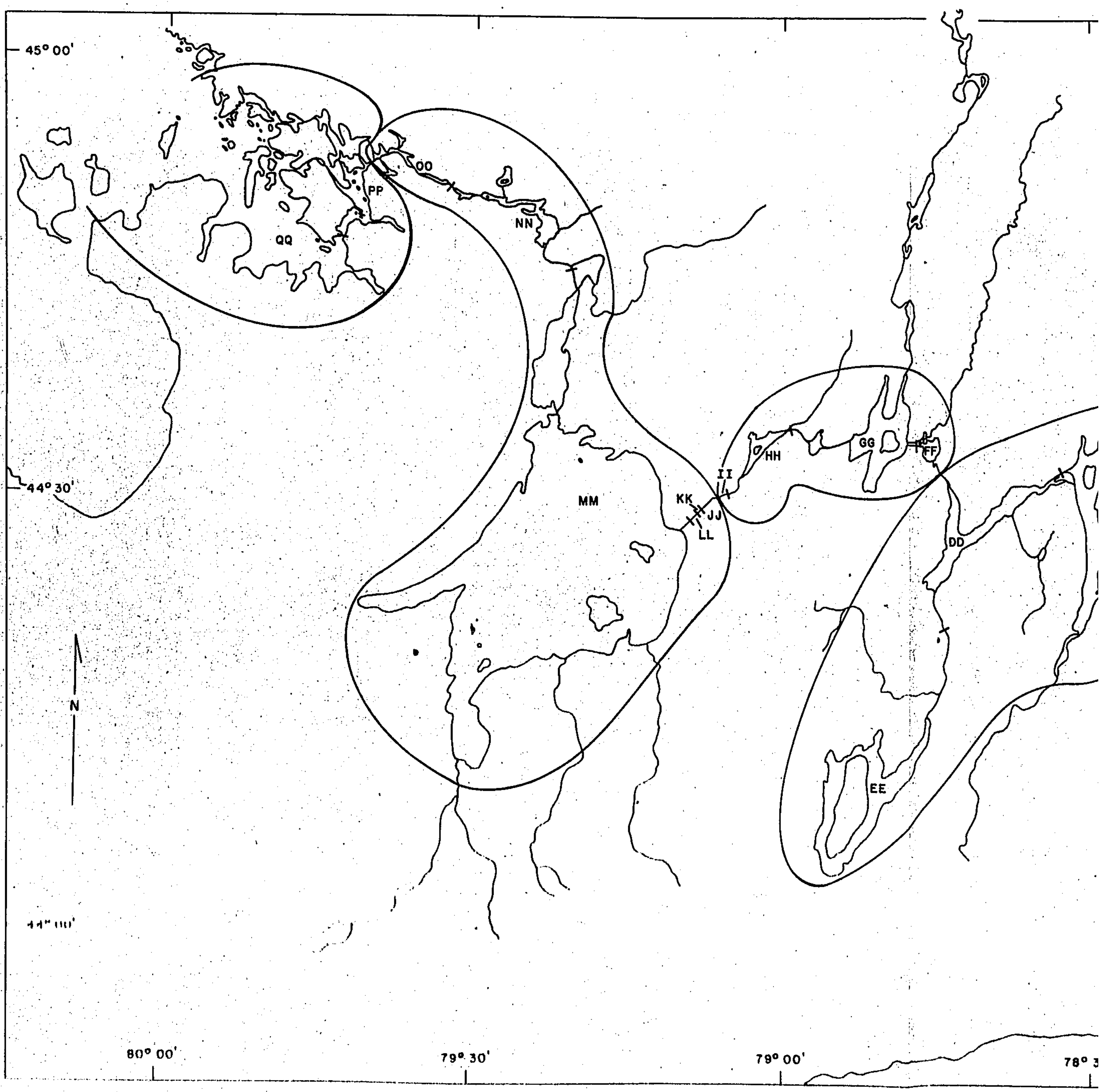


Figure 15. The Functional Structure of a Hypothetical Waterway, with Trip Data Randomly Selected



45° 00'
44° 30'
44° 00'
80° 00'
79° 30'
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78° 3
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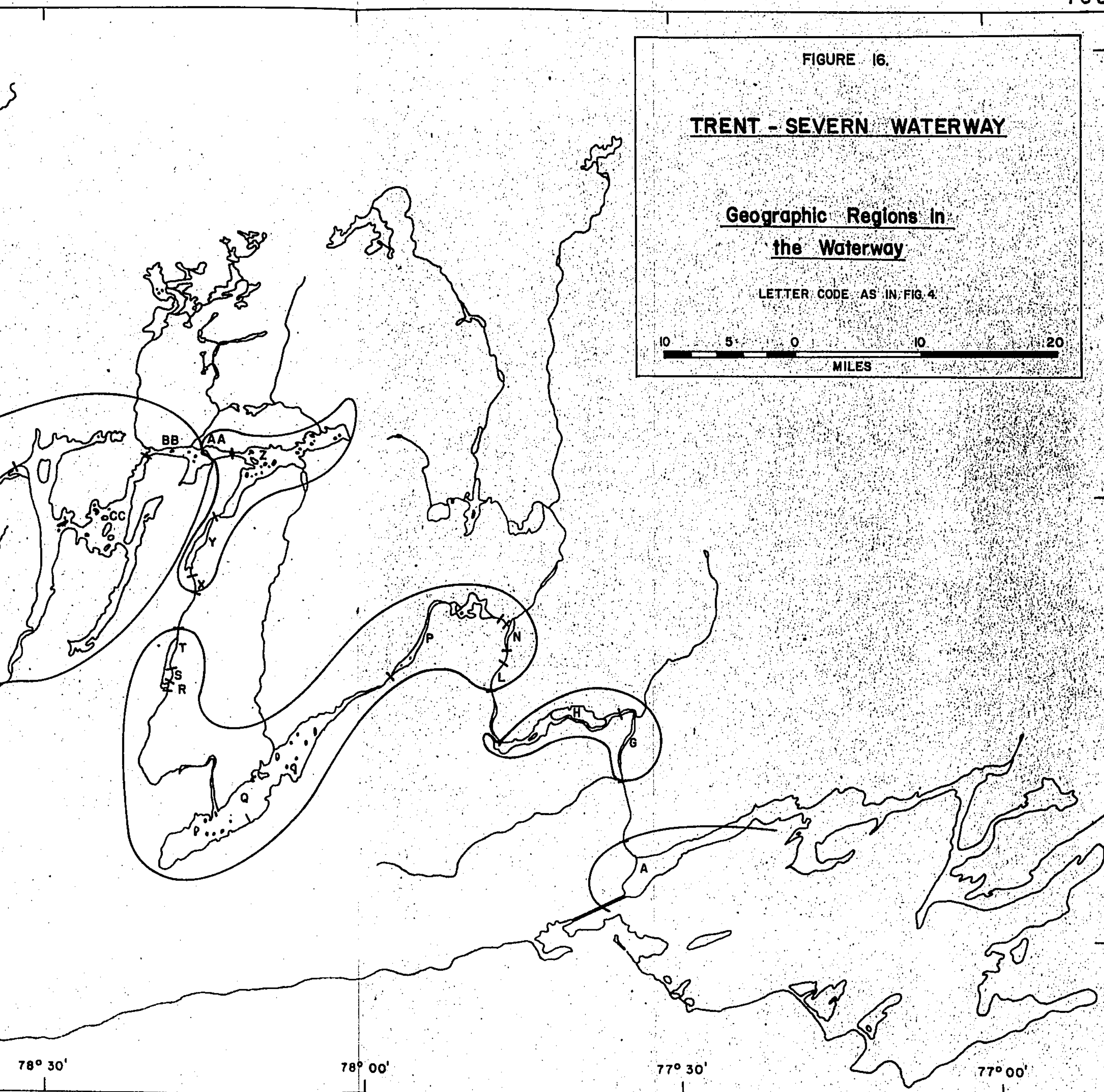
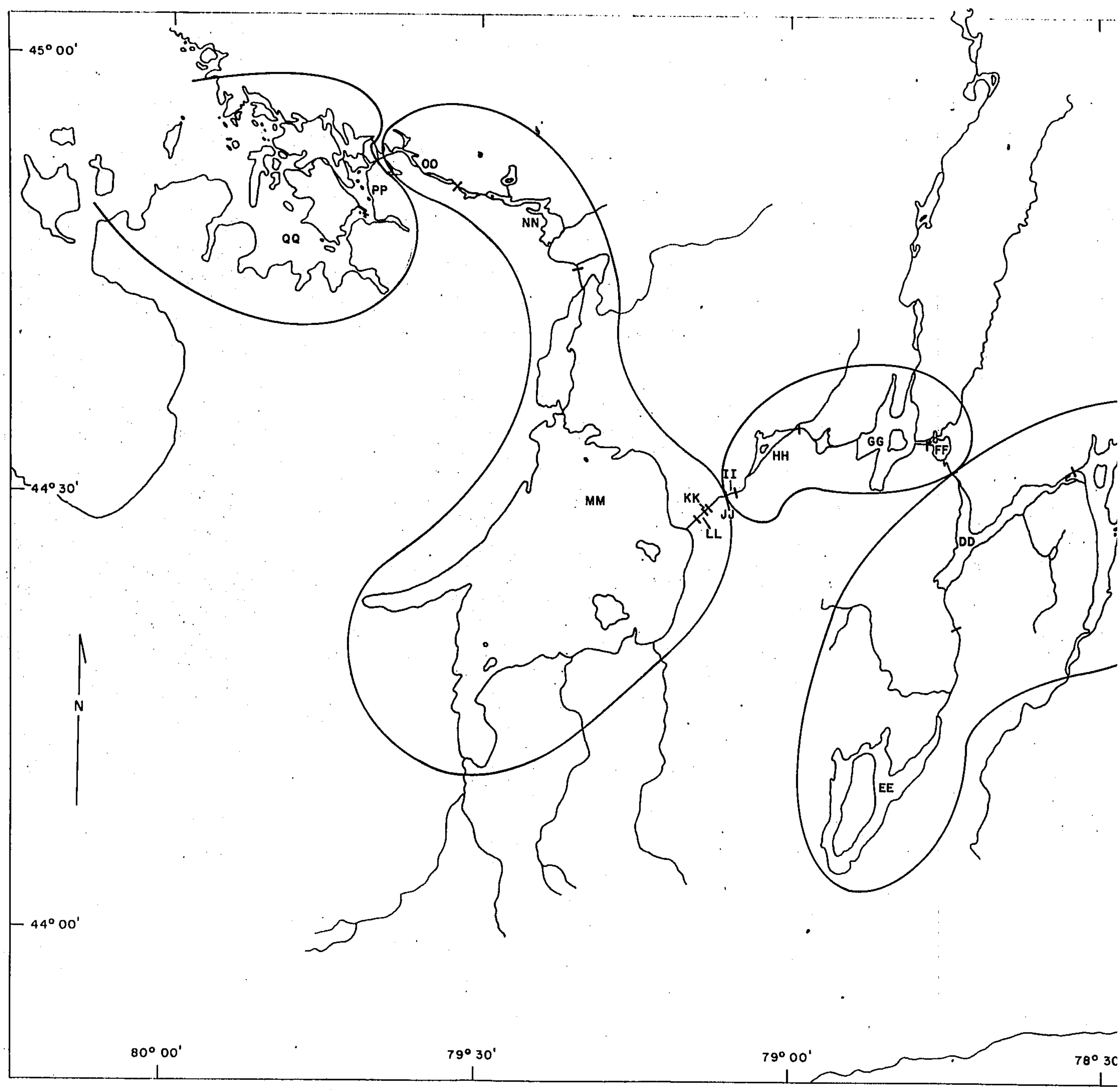


FIGURE 16.
TRENT - SEVERN WATERWAY
Geographic Regions in the Waterway
LETTER CODE AS IN FIG. 4
10 5 0 10 20
MILES
BB
AA
Z
CC
Y
X
T
S
R
P
N
L
H
G
Q
A
78° 30'
78° 00'
77° 30'
77° 00'

full 43 terminal points (including trivial terminal points) are to be included, the sets of points still remain largely discrete, though there are two areas of overlap, as shown in Figure 17. Spatial overlapping does not preclude the definition of functional regions, which the present ones are by their nature. If the trivial terminal points are omitted from consideration, all of the points in each set are spatially contiguous, with two exceptions: points L and N are separated from the rest of their set by trivial terminal points and may therefore be considered as contiguous, and point A is separated from the rest of its set by the entire Waterway. One may conceive of a disjointed set such as the latter as being a contiguous set if the two ends of the Waterway are considered to be connected via the Great Lakes, which in fact they are, both physically and, to a certain extent, functionally, as a number of boaters do circumnavigate the interlake peninsula of southern Ontario by way of the Great Lakes and the Trent-Severn Waterway. Seen in this light, the spatial discontiguity of points A, PP, and QQ needs to present no obstacles to their being considered as a single region. If, however, there are practical reasons for seeking regions with greater spatial integrity, one could subdivide that region into two, one being composed of points PP and QQ (Gloucester Pool and Georgian Bay) and the other consisting of point A (Lake Ontario) either alone or in company with the trivial terminal points on the Lower Trent River, A., B, C, D, and E (whose relationship to point A can be demonstrated using the same graph theoretic approach as above).


45° 00'
44° 30'
44° 00'
80° 00'
79° 30'
79° 00'
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N
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DD

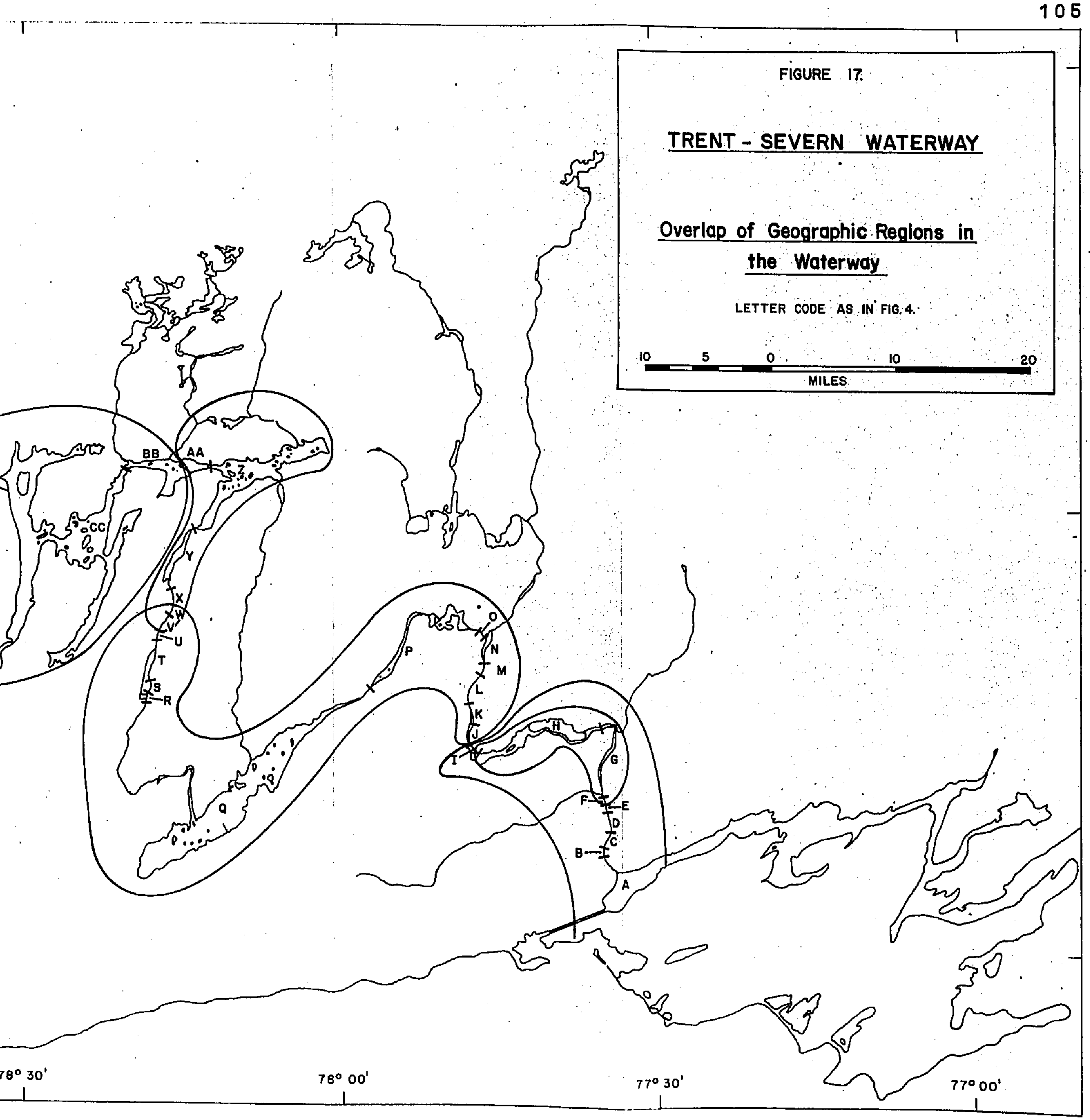

FIGURE 17.

TRENT - SEVERN WATERWAY

Overlap of Geographic Regions in the Waterway

By the same token, it is possible to recognize subregions among several others of the regions shown in Figure 16. To do so rationally, however, it is necessary to identify, within each region, a single point which serves as a node for its region. A reflexive relationship between two points may tend to obscure the dominant point (Nystuen, and Dacey, 107, p. 34), i.e., when two lakes receive their nodal flow from each other, but where this occurs the dominant point is the one with the greater nodality. A reflexive relationship does exist in each of the seven regions, but in terms of their nodality, the dominant lakes in the various regions are those shown in Table 13.

H	- Percy Reach
Q	- Rice Lake
Z	- Stony Lake
DD	- Sturgeon Lake
GG	- Balsam Lake
MM	- Lake Simcoe
QQ	- Georgian Bay

Table 13. Dominant Lakes in the Trent-Severn Waterway Regions

For convenience, the seven nodal regions may be designated by the names of their dominant lakes (Percy Reach Region, Rice Lake Region, etc.), but no other interpretation of the dominance of one lake in each region is necessary in this study. If subregions are to be identified, the division should be made within the dominant lake, so that the appropriate part of its total inflow of trips can be assigned to each subregion, and so that the dominant lake will continue to be represented in each of the subregions. As an example, if the Lake Simcoe region is to be divided, it would be done in the manner shown in Figure 18. The principle underlying this approach is that subregions can be identified only if they are permitted to overlap. It is possible to draw an analogy with

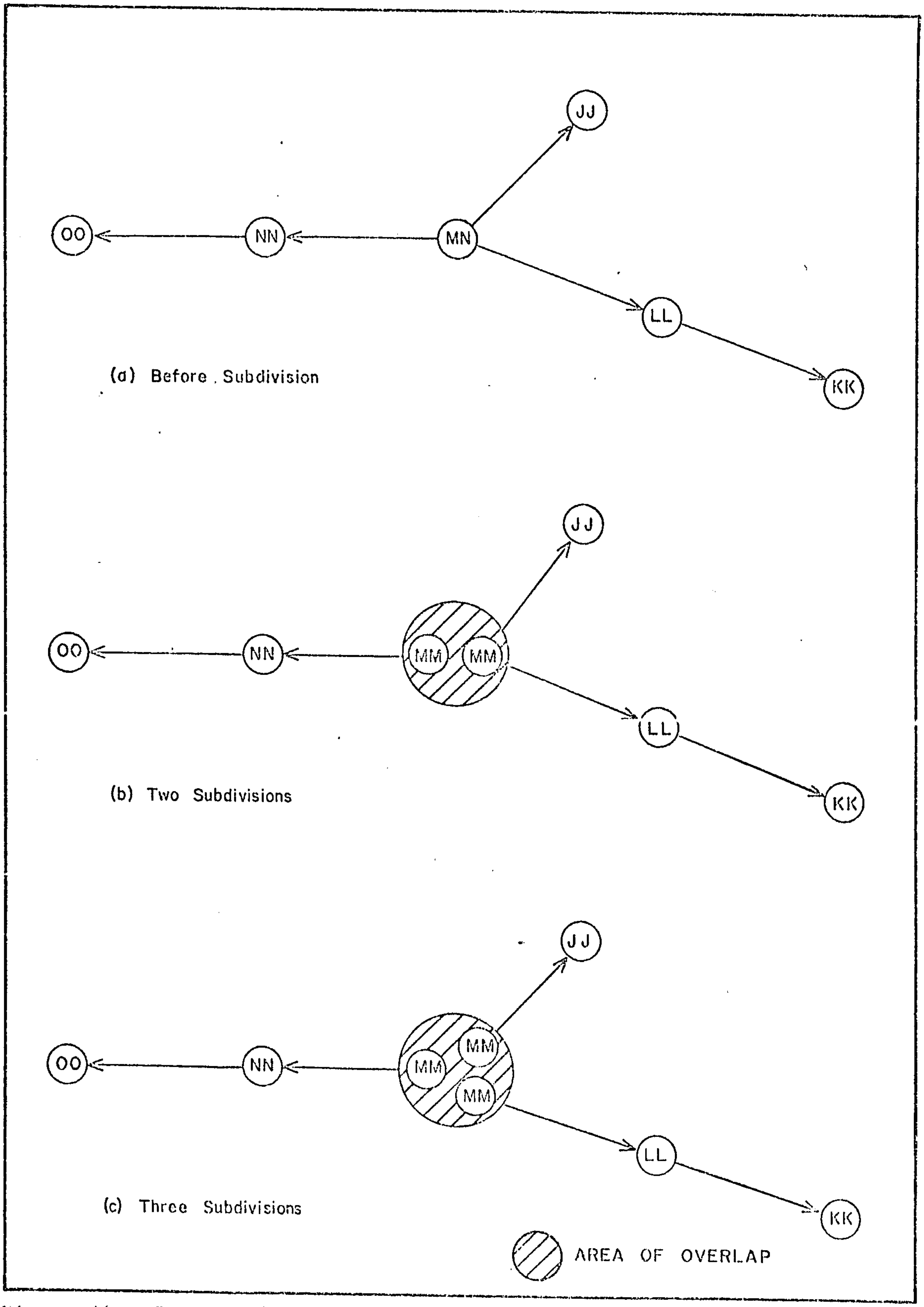

Figure 18. Suggested Procedure for Identifying Subregions within the Lake Simcoe Region

the subdivision of a city according to the "sector principle," whereby the city centre forms a part of each of the sectors into which the city is divided, because it is desired to preserve a functional relationship within each sector. In contrast, the division of a city into concentric zones is based on a uniformity of conditions within each zone and overlooks functional interdependence. The seven regions of the Trent-Severn Waterway are functional, not formal, regions; therefore it is appropriate that each subdivision of a region should include the dominant lake within it.

The only region with a subregion that extends off the main channel of the Waterway is the Sturgeon Lake Region. In an easterly direction, there is a subregion that includes all of the lakes as far away as Lower Buckhorn Lake. In a southerly direction, and having no other link with the rest of the Waterway, a subregion consisting of Lake Scugog and its connection to Sturgeon Lake can be recognized. The four sections of Table 14 have been compiled to illustrate the magnitude of the traffic to and from the uniquely situated Lake Scugog subregion. It is apparent that the basic orientation of the Sturgeon Lake boat traffic is parallel to the alignment of the entire Waterway. Nevertheless, the opportunity of using a truncated offshoot of the Waterway for boating has been far from neglected. A total of 2231 trips either originate or terminate in the Lake Scugog subregion, the rank of that subregion being 17th out of 43 in those terms. This is noteworthy for it demonstrated that the Waterway has breadth as well as length not only in physical terms, as shown in Chapter 4, but also in a dynamic sense, the flows to and from Lake Scugog being perpendicular to the general trend of the Waterway.

Boats Entering Sturgeon Lake (DD)

	1 lake away	2 lakes away	3 lakes away	4 lakes away	5 lakes away	Total
from W	1103	853	132	9	Ø	2332
from S (Scugog)	601	Ø	Ø	Ø	Ø	601
from E	2688	75	46	94	55	3062
						5995

Boats Leaving Sturgeon Lake (DD)

	1 lake away	2 lakes away	3 lakes away	4 lakes away	5 lakes away	Total
to W	1138	785	126	7	Ø	2265
to S (Scugog)	564	Ø	Ø	Ø	Ø	564
to E	2648	80	23	133	62	3040
						5869

Lake Scugog (EE) as an Origin

	1 lake away	2 lakes away	3 lakes away	4 lakes away	5 lakes away	Lake Simcoe	Total
to W	Ø	77	153	15	4	26	322
to N	601	Ø	Ø	Ø	Ø		601
to E	Ø	116	5	1	22		219
							1142

Lake Scugog (EE) as a Destination

	1 lake away	2 lakes away	3 lakes away	4 lakes away	5 lakes away	Lake Simcoe	Total
from W	Ø	85	139	16	Ø	38	324
from N	564	Ø	Ø	Ø	Ø		564
from E	Ø	99	5	Ø	34		201
							1089

Table 14. Boat Traffic to and from the Lake Scugog Subregion of the Sturgeon Lake Region

This tendency for recreational boaters to leave the marked channels and explore other parts of a waterway was noted also on the Rideau Waterway, where 37.9% of the boaters, particularly those with previous experience of the Waterway, took such side trips (Johnston, 86, pp. 56-58).

If the seven regions are retained intact and not subdivided, the degree to which they represent distinct entities can be expressed by a ratio which is proposed to be called their isolation ratio (I.R.), calculated as follows:

$I.R._j = \frac{i_j}{e_j}$, where i_j is the number of trips originating and terminating in region j (internal trips), and e_j is the number of trips originating outside region j and terminating in region j (external trips).

The isolation ratios for the seven regions in the Trent-Severn Waterway are given in Table 15.

Percy Reach Region	-	1.6
Rice Lake Region	-	3.0
Stony Lake Region	-	1.3
Sturgeon Lake Region	-	1.5
Balsam Lake Region	-	1.5
Lake Simcoe Region	-	2.5
Georgian Bay Region	-	1.5

Table 15. Isolation Ratios of the Trent-Severn Waterway Regions

There is no definitive method for interpreting isolation ratios, because their value is influenced by the size and activity level of the whole universe in which regions are being defined as well as by the size and activity levels of the regions themselves. However, given that the isolation ratios are inversely proportional to the number of regions into which a universe is divided and that a disproportionately large region in a universe lowers the isolation ratios of the other regions in the universe (ceteris paribus in both of these premises), the fact that all seven of the isolation ratios exceed unity suggests that the procedure has correctly identified an internally cohesive and externally balanced set of regions. Within the entire Waterway, 62.7% of the trips originated in the same region as that in which they terminated.

5.6 THE BOUNDARIES OF THE FUNCTIONAL WATERWAY REGIONS

The external trips (e_j) in the above calculation may be interpreted as interregional trips, which cross the boundaries of one or more regions. Wallace, in a passage that is remarkably apt for the present discussion though from a different context, refers to such trips as "bridge traffic":

> One of the basic features of complex rail systems is a division of the network of lines into a number of regional railnets. These regional railnets focus on major trade centers, and the pattern of traffic on the individual lines forming the networks is characterized by a general increase in density toward the regional centers...Regional railnets are separated by cols of low traffic density which approximate the hinterland boundaries of the focal cities. The traffic moving through these low density cols is composed largely of bridge traffic that flows from one regional railnet to another (Wallace, 149, p. 360).

It will be noted that the set of Waterway regions illustrated in Figure 16 does not include all parts of the Trent-Severn Waterway. Between each region and its neighbour is a portion of the Waterway consisting of one or more lock stations and, in some cases, a considerable stretch of river. These areas of no-man's-land are the Waterway equivalent of the "low density cols" described by Wallace, and may just as appropriately be termed "cols" in this context. It is not necessary that the entire Waterway be included within the regions that occupy it. It is therefore debatable whether the area between one functional region and its neighbour should be designated as a col or as an area of overlap, or as both. These areas do "approximate the hinterland boundaries" of the Waterway regions, and it is significant to note that, as terminal points for trips, the stretches of river involved are trivial. In cases where more than one lock occurs within a single col, therefore, the extra ones are redundant for the purpose of regionalizing the Waterway. The cols are the functional equivalents of articulation points in that they are points where the continuity of waterway travel is interrupted for the majority of vessels. Since the focus of a nodal region is at its core rather than at its boundaries, it would be no less meaningful, as a way of identifying regions, to extend each member of a spatially adjacent pair of regions so that it includes the cols, in which case the cols would be viewed as areas of overlap rather than as gaps. In fact, as an aid to the interpretation of the Waterway regions, the use of overlapping areas may be more appropriate than the use of vacant spaces, but for convenience of reference these zones are here referred to as cols. The locations of the cols in the Trent-Severn Waterway are as follows:

Lock 1 to Lock 6, and the entire stretch of Trent River between Trenton and Frankford

- When the trivial terminal points are included in the analysis, it is possible to pinpoint the col more closely at Lock 5, since the portion of river below that point then falls into the Georgian Bay Region along with Lake Ontario.

Lock 8 to Lock 12, and the entire stretch of Trent River between Percy Reach and Ranney Falls

- When the trivial terminal points are taken into account, the col is localized at Lock 9, the portion of river above that point falling into the Rice Lake Region, and that below Lock 9, through a statistical quirk, falling into the Georgian Bay Region because of six trips between that stretch of river and Lake Ontario. An alternative interpretation of this spatial irregularity (but one which is scarcely justified by the number of boats involved) is that the Georgian Bay Region overlaps all of the Percy Reach Region and extends upstream to Lock 9 and the Trent River.

Lock 22 to Lock 25, and the entire stretch of Otonabee River between (approximately) Nassau Mills and Lakefield

- The col actually occurs at about the middle of that stretch of river, Lock 24, as shown by the orientation of the trivial terminal point U. The orientation of the trivial terminal points immediately above and below Lock 24 is ambivalent but tends slightly to be the reverse of what their relative positions would suggest, point V being oriented to the Stony Lake Region and point W to the Rice Lake Region. There is a good case for treating this entire col, and particularly the area surrounding Lock 24, as an area of overlap between the Rice Lake Region and the Stony Lake Region.

Lock 30, between Lovesick Lake and Lower Buckhorn Lake

- There is a fairly clear-cut distinction between traffic in Lovesick Lake, which is oriented to Stony Lake, and traffic in Lower Buckhorn Lake, which is oriented to other lakes in the Sturgeon Lake Region.

Fenelon Falls

- This col, while clearly defined as to location, is the least significant of all of the cols, since there is a great deal of traffic between the Sturgeon Lake Region and the Balsam Lake Region.

Lock 38

- The location of this col lies somewhere between Canal Lake and Gamebridge. If the analysis is done using origin points instead of terminal points, the col moves to the western part of this zone (Lock 39), with point JJ being a part of the Balsam Lake Region instead of the Lake Simcoe Region. The two regions clearly overlap for a considerable stretch of canal here.

Big Chute

- The marine railway at this point is perceived as a col by boaters using craft of all sizes. It is not simply the 4' limiting draught at this point that separates the Georgian Bay Region from the Lake Simcoe Region, for very few of the boats that enter the Waterway are too large for the railway: an analysis of the 17,396 trips that take place completely on the Severn portion of the Waterway (see Figure 19) shows, surprisingly, that 31% of the yacht trips (over 40 feet in length) used the railway while only 26% of the trips taken by smaller craft used it. In fact, the nodal structure of the Severn portion of the Waterway is such that it forms a single region for yachts, but two regions for smaller vessels. One can observe many boaters who come only as far as the marine railway and tie up their boats above

small boats

	MM	NN	OO	PP	QQ	
MM	0	1484	407	197	265	
NN	1507	0	854	228	125	
OO	411	850	0	460	160	
PP	224	242	414	0	1220	
QQ	263	133	151	1212	0	
	2405	2709	1826	2097	1770	10807

medium boats

	MM	NN	OO	PP	QQ	
MM	0	1043	328	161	475	
NN	914	0	91	25	74	
OO	299	100	0	37	65	
PP	160	24	50	0	991	
QQ	501	73	61	1016	0	
	1874	1240	530	1239	1605	6488

large boats

	MM	NN	OO	PP	QQ	
MM	0	20	10	2	13	
NN	14	0	0	0	1	
OO	10	5	0	0	0	
PP	2	0	0	0	4	
QQ	13	0	0	7	0	
	39	25	10	9	18	101

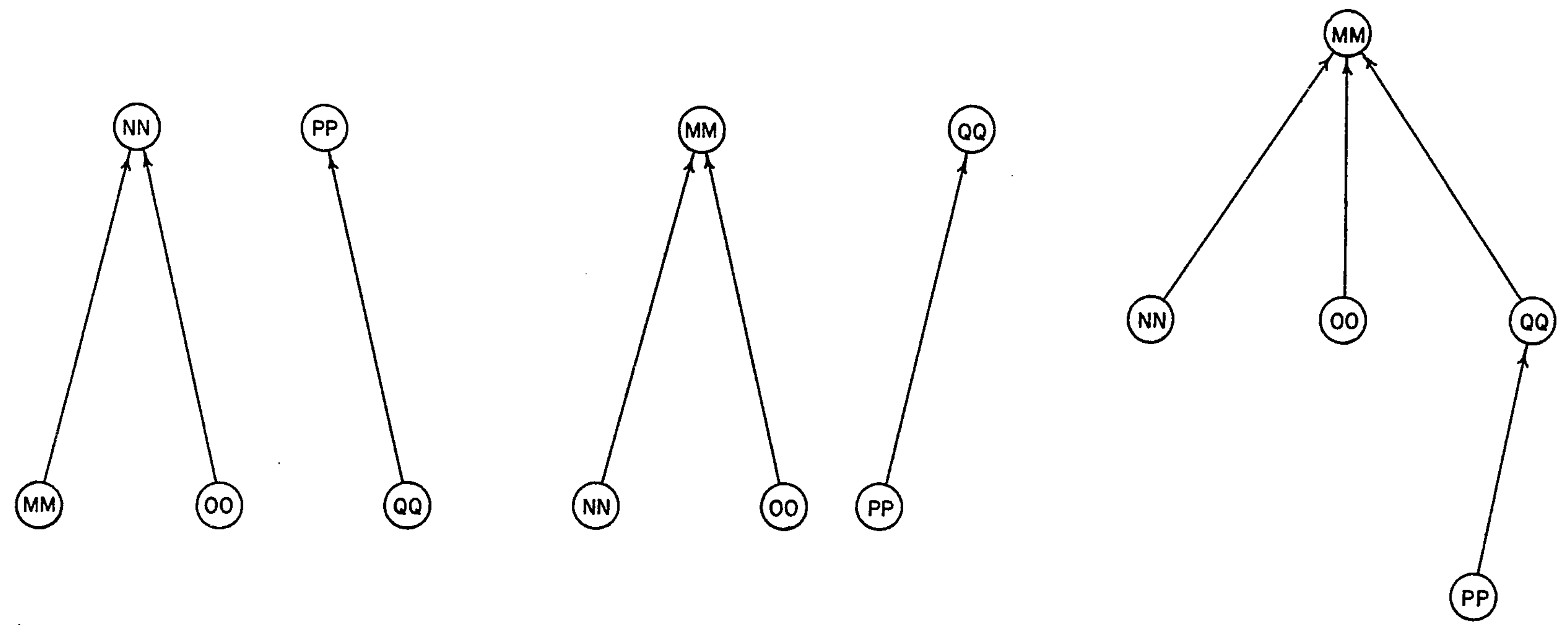

Figure 19. Size Analysis of Trips on the Severn Portion of the Waterway (Axes are the same as in Figure 9).

or below it without crossing it except on foot. They use the location as a picnic site, and spend their time watching the railway in operation, and swimming or fishing. This col, then, exists only for boat trips. For the boaters themselves, who continue their trip on foot for a few hundred feet, the marine railway represents, to an unknown degree, a recreational node, and serves as the terminal point of many trips. If it were possible to know the number of trips which originate or terminate there, and their destinations or origins, the marine railway could be inserted into the matrix as an additional point, and conceivably the entire nodal structure could be altered. Lacking that information, one is forced to regard the area of 100 yards as a clear case of overlap between the Lake Simcoe Region and the Georgian Bay Region.

5.7 THE WATERWAY AS A CORRIDOR

What has this graph theoretic analysis revealed? The Trent-Severn Waterway is not a single recreational unit, but rather seven fairly distinct regions. The designation of it as a recreational waterway can be valid only if it is recognized that the term connotes only physical unity and that, in a dynamic sense, a large measure of disunity can be subsumed under the rubric of that term. The Trent-Severn Waterway is a "recreation entity" as defined by Chubb: "an area of land (read 'water') with or without structures which is used for recreation and which is considered as one entity even though it may consist of a number of functional divisions" (Chubb, 48, p. 148).

The concept of a corridor, as discussed in Chapter 1, seems, up to this point in the analysis, to be the most appropriate form of regional type for characterizing the Trent-Severn Waterway. In static spatial terms, it has been demonstrated that the Trent-Severn Waterway, because the principle of least effort has discouraged the creation of more than one link between any two lakes, assumes a dendritic form that is similar to the essentially linear form of a corridor. At the same time, the spurs off the main channel impart to it a certain lateral extent that is also typical of corridors. Within the areal band thus described, there are functional links which tend to unify the whole system at a broad level of generalization. More locally, however, there is a series of semi-independent nodes defined by the dynamics of traffic flows around them and separated from each other by areas of lower traffic density. Therefore, the Waterway appears to have a hierarchical structure with the local functional regions nested within the entire Waterway unit in a manner typical of regions in general (Philbrick, 119) and corridors in particular. The fundamental characteristics of corridors are all to be found in the Trent-Severn Waterway. It remains to be shown whether the detailed characteristics of the several nodes (apart from being lakes instead of cities, in which respect they differ from the corridor model) give further justification to the characterization of the Trent-Severn Waterway as a corridor.

CHAPTER SIX

A PROFILE OF THE WATERWAY REGIONS OF THE TRENT-SEVERN

6.1 RECREATIONAL UNITY OF THE CORRIDOR

As stated in Chapter 1, ideally the various nodal regions that constitute a corridor should have certain common functions and characteristics, while retaining unique properties reflecting their different environments. As to the common characteristics which set the Trent-Severn Waterway apart from Lake Ontario and Georgian Bay at its extremities, it will be shown in the next paragraph that the former is almost exclusively recreational in function, which is not true of the Great Lakes. If it is accepted that "la délimitation des frontières des régions touristiques doit se faire au travers d'une analyse profonde de leurs caractéristiques" (Černý and Přikryl, 44, p. 70), then such analysis provides ample justification for terminating the Waterway at its entrances to the Great Lakes. If, on the other hand, one wishes to seek out the "unique properties" of regions <u>within</u> the Waterway, then a comparison of the Waterway regions identified in the preceding chapter is necessary, and this is the thrust of the present chapter. For the purpose of this comparison, the two disjunct portions of the Georgian Bay Region are treated as separate regions, making a total of eight regions. Each of the two sub-regions has distinct boating characteristics which warrant this treatment and which would be obscured if the region were retained intact. The portion adjacent to Lake Ontario will be referred to as the Lower Trent Region.

The basic point of similarity among all the regions of the Waterway, as far as boat traffic is concerned, is the overwhelming dominance of privately owned boats, as opposed to commercial or government vessels.[68] in all eight regions, the trips taken by such boats constitute 90% or more of the total, the percentage for the overall system being 98.66%. The significance of these figures is that this category of boats is synonymous with recreational boats, and the recreational nature of each of the seven regions can thus be clearly established.

The other two categories of boats are commercial and government vessels, the latter constituting less than one-third of one per cent in every region but highest in the vicinity of the Trent Canal Authority headquarters in Peterborough. The incidence of trips by commercial craft varies considerably from region to region. For the Waterway as a whole, the proportion is 1.23%, with five of the seven regions recording less than 1% in this category, but in the Rice Lake Region the corresponding figure is 9.75%. This is because fully 366 of the

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[68] In this analysis and the other comparisons to be made, as in the foregoing descriptions, the calculations are made from data on trips that terminate in the respective regions, which are taken to include the trivial terminal points. Discrepancies between the full 43-point matrix that includes these points and the partial 30-point matrix that ignores them amount to less than one per cent in almost every calculation, and in no case exceed 3%. Therefore the full matrix is used here to avoid unnecessary duplication of calculations. An alternative statistical basis for making the inter-regional comparisons would be to make direct use of the traffic data from the locks within the respective regions (ignoring locks at cols), instead of first converting the information to "trip" statistics. Such a technique would fail to cull out that traffic which, because it is just passing through a region, does not properly represent it. Moreover, use of the trip information is consistent with the method used for establishing the regions in the first place.

697 trips taken by "commercial" boats in the whole system are accounted for by a single vessel, the "Miss Peterborough," which takes several trips daily in the summer months, plying to and fro between Little Lake and the Nassau Mills section of the Otonabee River, carrying up to 30 or 40 tourists at a time on guided cruises over the Lift Lock. These tours are clearly recreational in nature, and thus the "commercial" designation serves to reinforce the recreational function of that region and probably of the other regions where the term may also be applied in similar circumstances. In recreational terms, therefore, the entire Waterway can be thought of as a uniform region as well as being a functional region because of its strong internal connecting links.

6.2 THE REGIONS AS UNIQUE RECREATIONAL UNITS

Beyond this basic similarity of function, the data on boat trips reveal considerable variety in the nature of the recreation carried on in the respective regions. The intensity of traffic within the regions, already used as a partial basis for identifying them in the first place, is one aspect which varies over a great range, as shown in Table 16.

Region	Number of Trips	Percentage of Total
Lower Trent Region	837	1.48
Percy Reach Region	359	.63
Rice Lake Region	4327	7.63
Stony Lake Region	5956	10.51
Sturgeon Lake Region	14821	26.15
Balsam Lake Region	10576	18.66
Lake Simcoe Region	12458	21.98
Georgian Bay Region	7341	12.95
	56675	99.99

Table 16. Traffic Intensity in the Regions of the Trent-Severn Waterway

In part, this variation reflects the disparities among the sizes of the regions. However, as pointed out in Chapter 5.4, the fact remains that some of the regions are used more intensively than others. Casual observation of boat traffic at various points on the Waterway makes this fact just as obvious to boaters as the fluctuation of motor vehicles from place to place on a highway is obvious to motorists.

The propensity of boaters to take short trips, which was mentioned in Chapter 5.2, is also not a constant. While the overall proportion of boats passing through only one lock is approximately 63%, the proportions vary from region to region as shown in Table 17.

Region	Number of Trips through one Lock	Percentage of All Trips Ending in the Region Using Only One Lock
Lower Trent Region	124	14.8
Percy Reach Region	243	67.7
Rice Lake Region	1844	42.6
Stony Lake Region	3558	59.7
Sturgeon Lake Region	10011	67.5
Balsam Lake Region	7253	68.6
Lake Simcoe Region	7742	62.1
Georgian Bay Region	4947	67.4

Table 17. Regional Variation in Trips Through only one Lock

The significance of the low values in the Lower Trent and Rice Lake Regions (indicating a relatively long trip length average) is that their intensity of traffic, as shown in Table 15, is noticeable at more than one place in those regions, and may in fact be noticeable in adjoining regions or even more distant ones if that is where the trips originate.

The length and frequency of trips taken are only two aspects of a complex of conditions by which recreational boaters may be differentiated, and whose variation from place to place in the Waterway can serve to characterize the recreational "personality"[69] of the Waterway regions. Trip length is a dimension of this personality which is not at all independent of its other manifestations, notably the factor of boat size. As mentioned in Chapter 3.4, the boats are classed into three size categories, and the larger ones typically take longer trips than the smaller ones. The mean trip lengths for the three size categories of boats are as shown in Table 18.

small	-	2.03 lockages
medium	-	4.58 lockages
large	-	5.47 lockages

Table 18. Mean Trip Lengths, by Size of Boat[70]

The relationship between trip length and boat size is shown graphically in Figure 20. The most extreme contrast among the three size categories of boat exists in the case of the shortest recorded trips (one lockage), of which 76.62% are taken by small boats and only .37% by large boats. The slight upward "blip" near the left end of the curve representing large boats is caused by the frequent tours through two locks (and back) taken by the "Miss Peterborough," mentioned above.

In the light of the close correlation between trip lengths and boat sizes, it is not surprising to find as much variation among the eight regions in boat size as there is in trip length. This pattern is shown in Table 19, which gives a breakdown of each Waterway region by percentage of small, medium, and large boats.

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[69] This is an adaptation of "LANDSCAPE PERSONALITY: the sum or result of those distinguishing characteristics which result in a unique regional quality" (Lewis, 97, p. 27).

[70] For definitions of these size categories, see Chapter 3.4.

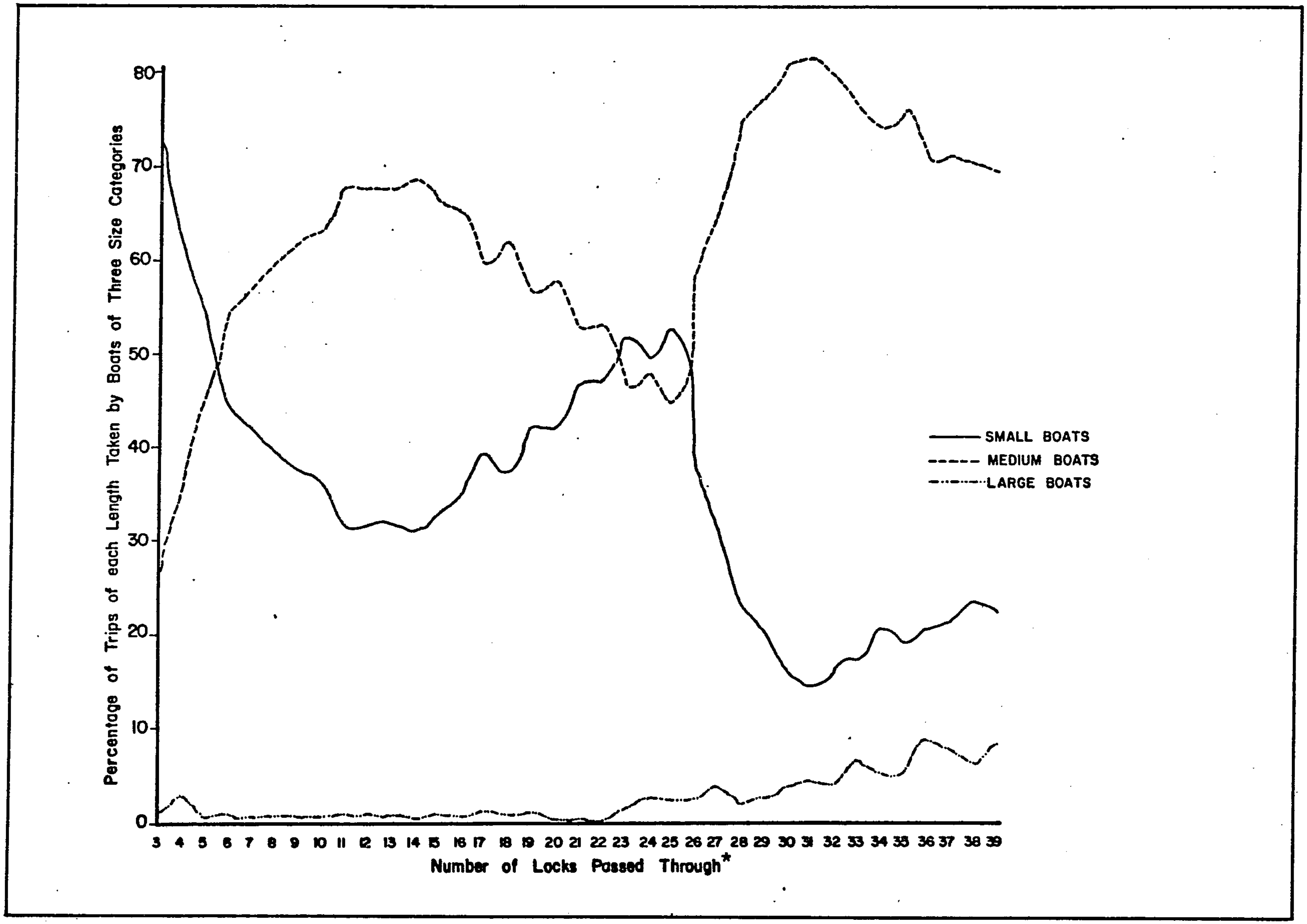

Figure 20. Trip Lengths by Size

*These have been aggregated on the basis of a five-lock moving mean so as to overcome chance fluctuations.

Region	Small Boats (% of trips)	Medium Boats (% of trips)	Large Boats (% of trips)	Total
Lower Trent Region	38.35	57.23	4.42	100.0
Percy Reach Region	66.29	30.92	2.79	100.0
Rice Lake Region	65.35	25.31	9.34	100.0
Stony Lake Region	80.36	19.29	.35	100.0
Sturgeon Lake Region	72.33	27.52	.15	100.0
Balsam Lake Region	78.54	21.10	.36	100.0
Lake Simcoe Region	62.41	36.84	.75	100.0
Georgian Bay Region	55.12	44.24	.64	100.0

Table 19. Proportions of Trips in each Region by Boats of Various Sizes.[71]

Two of the regions in particular (the Stony Lake and Balsam Lake Regions) have a very high proportion of small boats, while at the extremities of the Waterway, and particularly in the Lower Trent Region, the proportion of small boats is much less. In the Georgian Bay Region, the relative scarcity of small boats is compensated for almost entirely by medium-sized boats, but in the Lower Trent Region, large boats also occur in considerable numbers. The anomalously high proportion of trips by large boats in the Rice Lake Region is almost exclusively a reflection of the 366 trips taken by the "Miss Peterborough," mentioned earlier. If those trips are excluded from the calculations, there is a progressive increase of trips by medium and large boats eastward from the Stony Lake Region, and a corresponding decrease in trips by small boats, to the point where the latter represent a minority of the trips in the Lower Trent Region.[72]

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[71] For definitions of these size categories, see Chapter 3.4.

[72] In general, these findings are corroborated by the boater survey described in Chapter 3.5

6.3 GEOGRAPHIC ORIENTATION OF THE REGIONS

A further element in the "personality" of the Waterway regions is the nationality of the boats that use them.[73] Only two nations are represented in the boat trip data on the Trent-Severn Waterway, Canada and the United States, and the former is by far the dominant one (95.19%). The population of American boats, while small numerically, exhibits some interesting interregional contrasts, as shown in Figure 21. Their proportion is at a minimum in the Balsam Lake Region (2.69%) but rises progressively both westward to the Georgian Bay Region, where it reaches 5.52%, and eastward to the Lower Trent Region, where it reaches its maximum of 12.78%, over four times as many, proportionately, as in the Balsam Lake Region. The contrast between the ends of the Waterway and its interior, in terms of American boats, is not, however, as striking as these figures suggest, for the calculations are based on trip destinations, and the American boaters exhibit a greater propensity to take long trips and a lesser propensity to take short trips than do their Canadian counterparts, as shown in Figure 22. This being the case, a higher proportion of the American boats than of the Canadian boats must necessarily pass through other regions than those to which the technique used here assigns them. The conclusion follows that there are fewer trips by American boats on the Trent-Severn Waterway than is commonly supposed. Information compiled for the Department of Transport for the year 1969, and based on the number of vessels locked through, shows a percentage of American boats (7.83%) that is about 63% higher

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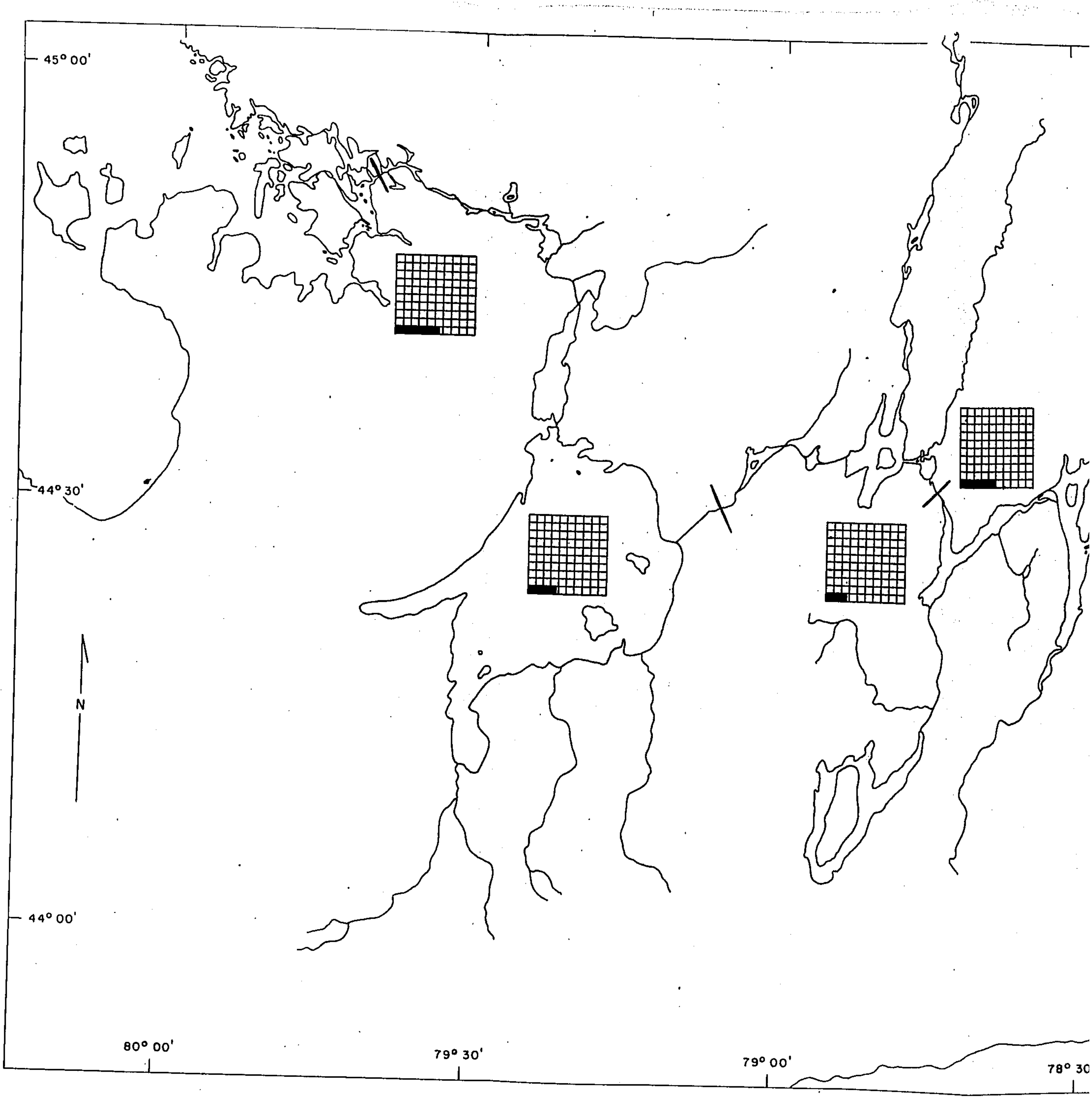
[73] For another study which differentiates recreational regions according to the size of the foreign component in their visitor population, see Christaller (47).



45° 00'
44° 30'
44° 00'
N
80° 00'
79° 30'
79° 00'
78° 30

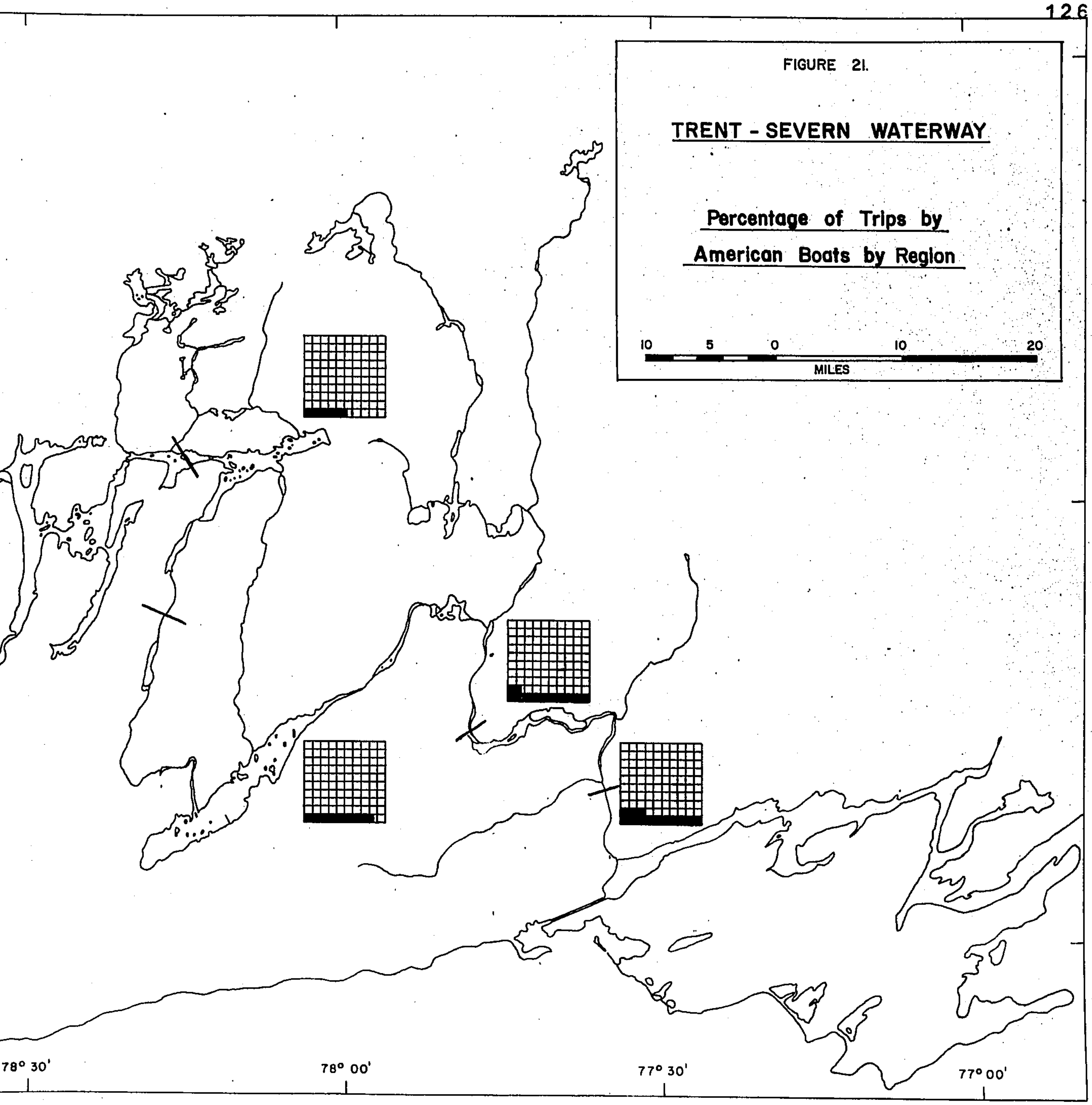


FIGURE 21.
TRENT - SEVERN WATERWAY
Percentage of Trips by American Boats by Region
10
5
0
10
20
MILES
78° 30'
78° 00'
77° 30'
77° 00'

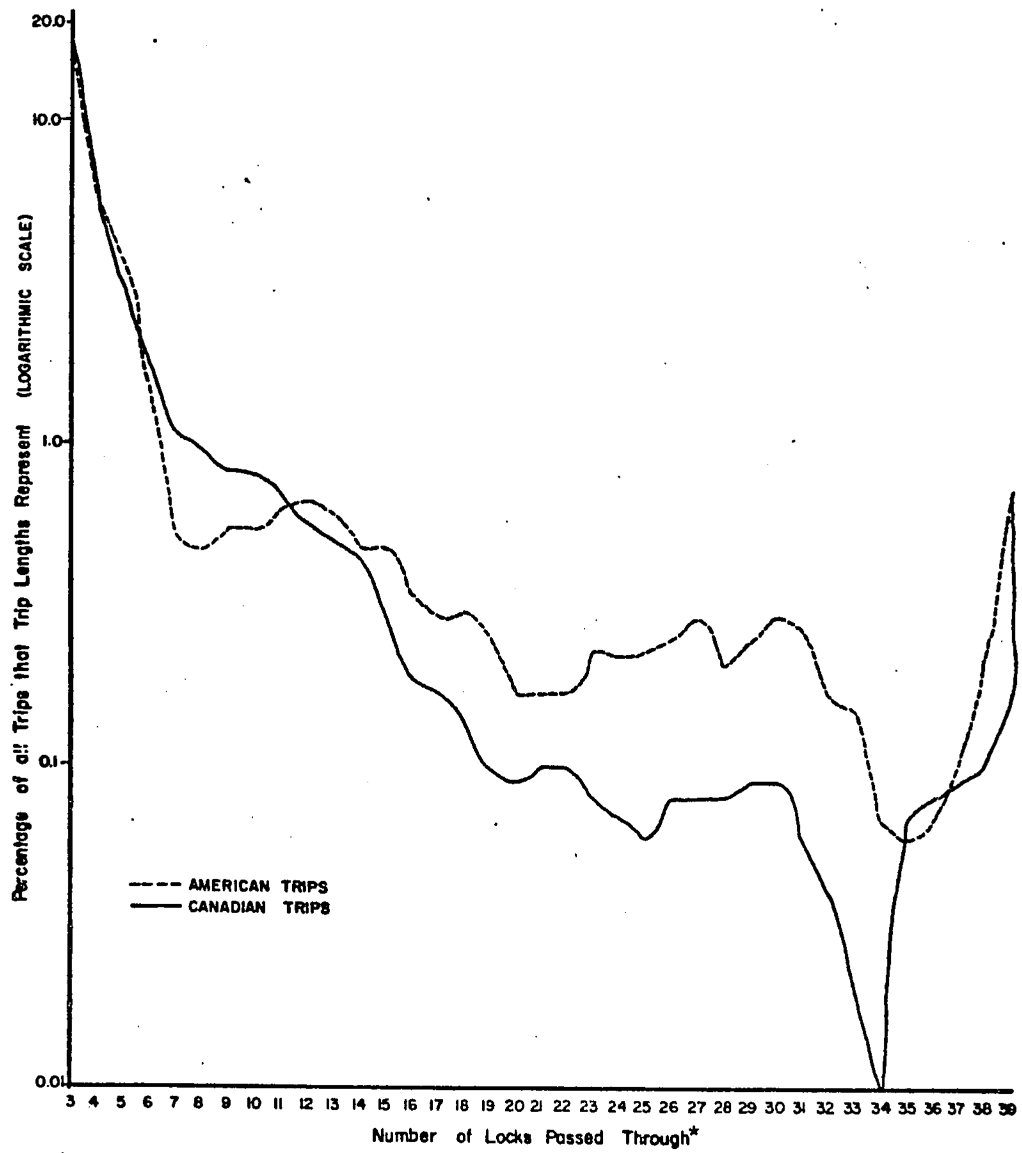


Figure 22. Comparison of Canadian and American Trip Lengths

*These have been aggregated on the basis of a five-lock moving mean so as to overcome chance fluctuations.

than the figure calculated on the basis of trips. The actual numbers of American boats passing through each of the locks on the Waterway are published by the Ministry of Transport, and it is not thought necessary to present the data here. The fact remains that the number of long trips by American boats in the Trent-Severn Waterway is not sufficient to account entirely for the progressive increase in their numbers towards the eastern end of the Waterway, a phenomenon which finds a rough parallel in Whebell's concept of "culture gradient" in a corridor (Whebell, 156, p. 4). In short, the most "American" of the Waterway regions are still the Lower Trent and the Rice Lake Regions. The reasons for the use of that part of the Waterway by many American boaters have not been investigated, but it is probable that a statement about Americans who drive cars to Canada for a holiday is applicable in this context as well: "The proximity of the Canadian border is a tempting invitation for Americans to drive across it and explore the Canadian countryside" (Gilman, 67, p. 177). Unlike the rest of the Waterway, the eastern end lies within an easy day's return trip of the United States. In other words, while it may be "site" factors that lead to interregional differentiation in terms of such things as boat size or boating intensity, it is probably a "situational" factor that explains the variation from region to region of their American boating component.

An attempt was made in this study to create Waterway regions using the data on American boat trips alone (see Figure 23), and employing the

TO

FROM	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	
A	0	2	0	0	1	1	0	3	0	0	1	6	0	0	0	1	3	6	0	2	1	0	0	0	0	2	1	1	2	6	1	0	4	4	0	0	0	0	2	2	1	6	34	93
B	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5
C	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6
D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
F	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
G	0	0	0	0	0	0	0	8	0	0	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	16
H	1	0	0	0	0	0	10	0	1	0	1	3	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
I	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	0	0	0	0	0	0	0	1	0	1	0	7	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
L	7	0	0	0	0	0	3	3	0	0	5	0	0	3	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	28
M	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
N	0	0	0	0	0	0	0	2	0	0	0	2	1	0	2	9	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
O	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
P	0	0	0	0	0	0	0	1	0	0	0	6	0	6	6	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64
Q	1	0	0	0	0	0	0	1	0	0	1	0	0	3	0	40	0	21	5	28	1	2	0	0	1	0	1	0	0	2	0	0	1	0	0	0	0	0	2	1	0	0	8	119
R	4	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	23	0	1	2	1	7	0	0	1	3	1	0	0	3	3	2	3	0	1	0	0	0	3	0	0	0	5	65
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	4	0	0	0	0	0	0	0	0	1	0	1	0	3	0	0	0	0	0	0	0	0	0	0	14
T	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	27	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
U	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0	34	6	7	8	0	0	0	2	0	1	0	0	0	1	0	0	0	1	64
Z	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	38	0	26	43	27	3	0	0	4	0	0	0	0	0	0	0	0	1	1	149
AA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	3	33	0	25	11	1	0	0	0	0	0	0	0	1	1	0	0	0	0	78
BB	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	8	35	24	0	72	3	1	0	1	0	0	0	0	0	0	0	0	0	2	151
CC	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	9	30	13	77	0	180	1	5	14	1	1	0	0	0	0	0	0	3	2	341
DD	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	2	2	4	179	0	5	14	18	5	0	0	0	0	0	0	0	0	0	238
EE	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	11
FF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	4	13	0	0	71	2	0	1	0	0	0	0	0	0	4	98
GG	5	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	3	1	0	0	0	1	1	3	0	0	1	11	17	0	68	0	16	1	1	0	0	5	0	2	0	6	144
HH	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	6	0	2	17	0	0	0	0	0	1	0	0	0	0	32
II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	1	0	0	0	0	5
JJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	3	0	0	0	0	8
KK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	3
LL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	2	0	1	0	1	0	1	9
MM	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	1	0	0	1	0	0	2	0	0	2	2	0	3	0	1	0	69	22	26	40	176
NN	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	67	0	57	20	22	170
OO	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	21	56	0	9	8	99
PP	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	3	2	0	0	2	0	0	0	0	0	25	14	10	0	97	163
QQ	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	4	2	2	2	0	0	2	3	1	0	0	0	0	45	24	7	105	0	238
	96	2	4	2	2	3	15	23	1	2	10	27	2	16	8	68	117	53	15	40	6	14	1	9	69	145	77	163	325	244	12	95	150	35	4	8	5	4	179	166	102	171	234	2724

Figure 23. Matrix of Origins and Destinations of American Boat Trips on the Trent-Severn Waterway

same technique as was described in the preceding chapter. The results show a pattern that differs in several respects from the set of regions already described (see Figure 24). A new region has become split off from the Rice Lake Region, and is centred on the town of Campbellford. Undoubtedly, the urban amenities at that site, rather than the recreational potential of that particular stretch of river, are the motive for the relatively large number of American boats which make it their destination. The Stony Lake, Sturgeon Lake, and Balsam Lake Regions all merge into a single super-region that accounts for almost 50% of the trip destinations of American boats.

Following the discovery that the users of the Trent-Severn Waterway are somewhat differentiated spatially according to their country of origin, it would be useful to analyse the spatial origins of the Canadian users of each of the Waterway regions, a type of analysis which others have found fruitful in the past.[73] Such a study has not been attempted here because the necessary data are not as readily available. However, some insights into this question, and others, were obtained in the boater survey mentioned in Chapter 3.5.

With the benefit of hindsight, and drawing on the analysis in the preceding chapter which has identified regions, it is possible to comment that the five sampling sites in that study were not well chosen. Ideally, for a study of the geographic origins of boaters in the eight regions, there would have been eight sampling sites instead of five. As it is, two of the five (Campbellford and Peterborough) were located directly on a col rather than in the heart of a region, and a third (Gamebridge)

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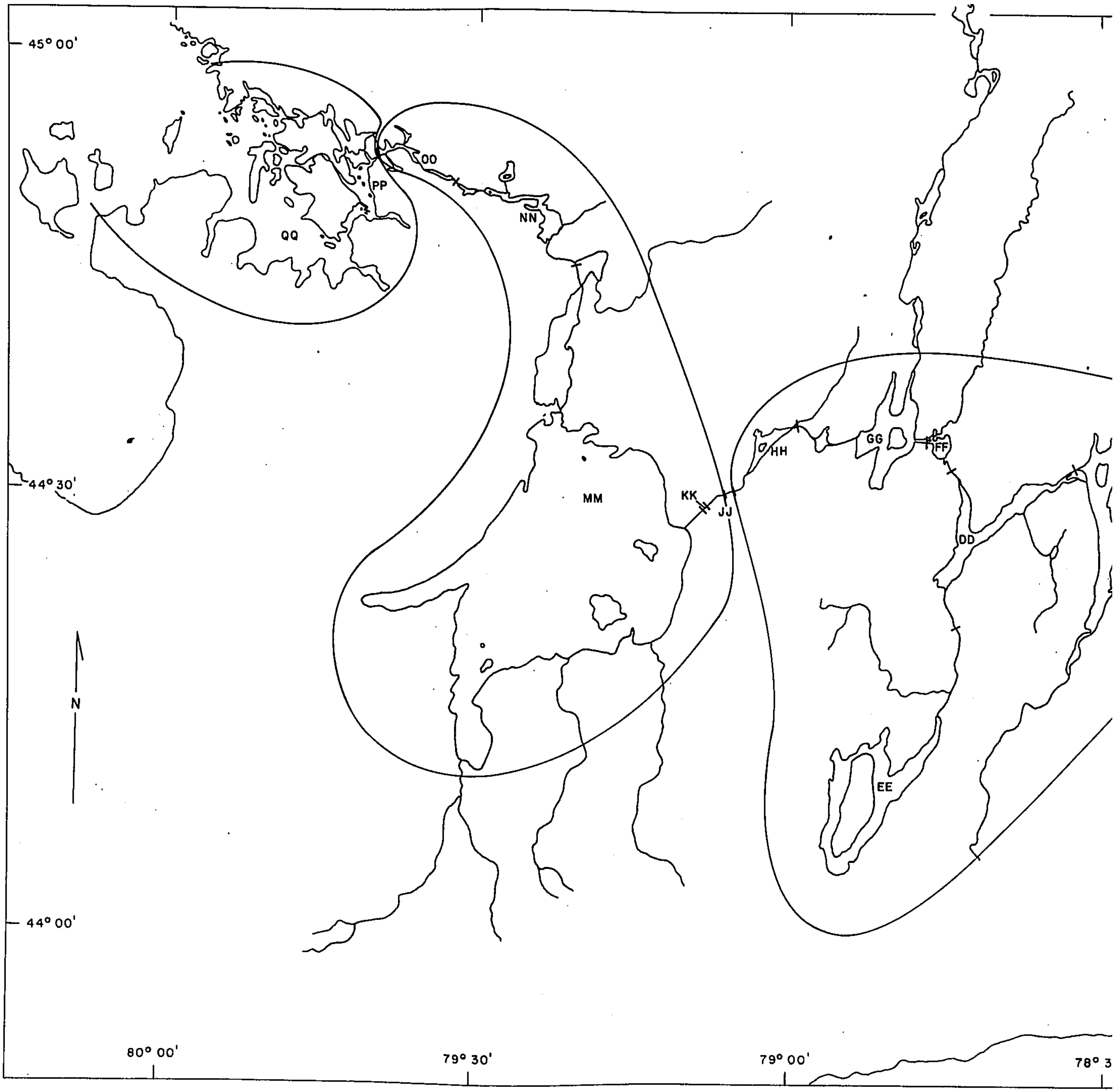
[73]See, for example, Klopchic (90, pp. 4-6 and 89, pp. 3-4); Boggs and McDaniel (10, pp. 39-43); Wolfe (159, passim); Ellis (56, p. 48); and Ellis and Van Doren (57, p. 48). A similar approach employed by A. Koch and U. Hubrich is described by Rungaldier in his bibliographic survey (Rungaldier, 124, p. 89).



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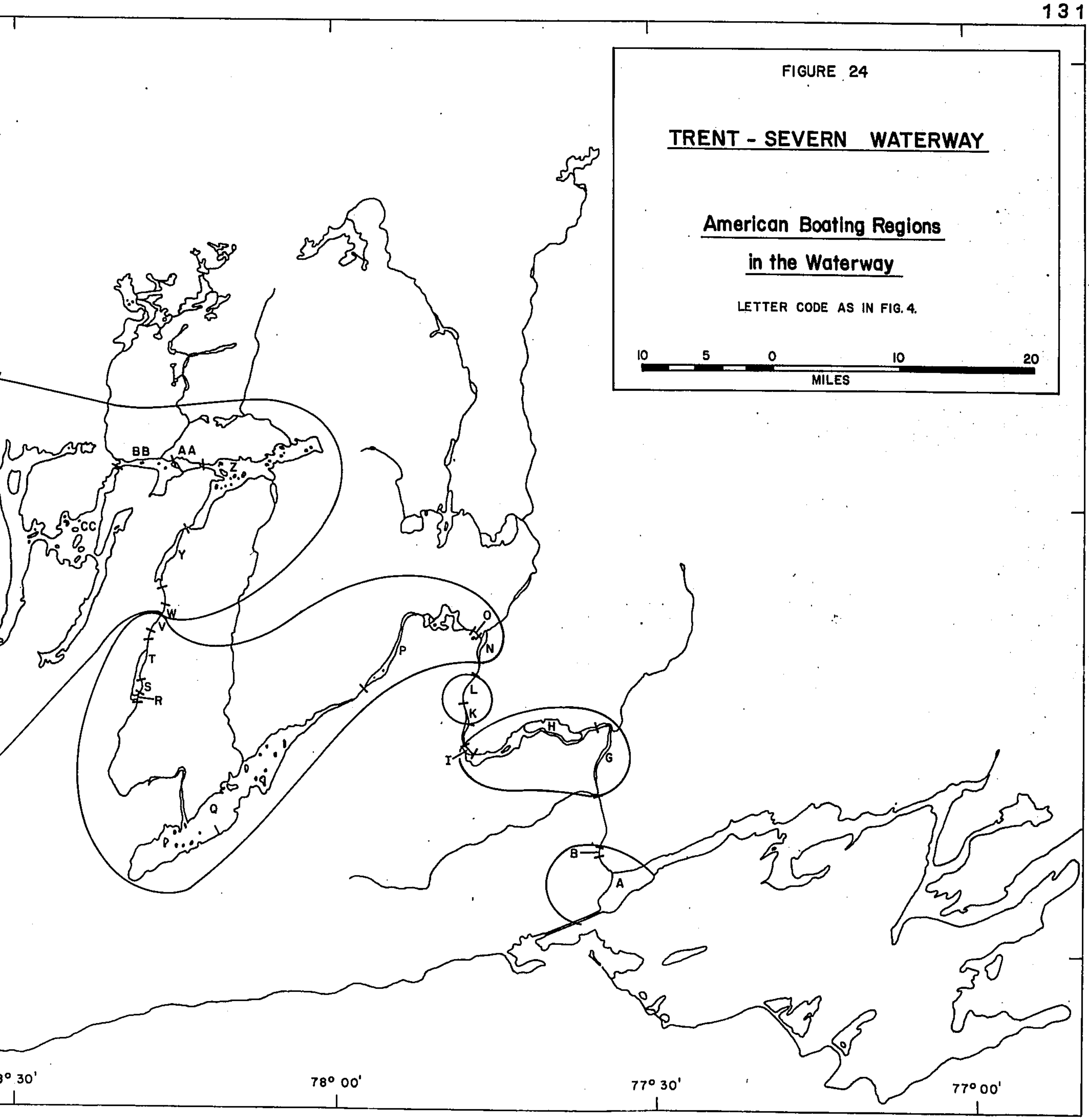

FIGURE 24

TRENT - SEVERN WATERWAY

American Boating Regions in the Waterway

LETTER CODE AS IN FIG. 4.

was nearer to the edge of its region than to its core. Fortuitously or otherwise, the Campbellford site, while poorly located from the point of view of the overall trip pattern, does coincide well with one of the regions identified in Figure 24 as reflecting American boat traffic patterns. In terms of the eight regions reflecting total boat traffic, the Campbellford site may be said to represent the Percy Reach and Rice Lake Regions equally well. Fortunately, the two major regions in terms of intensity of use (see Table 16), the Sturgeon Lake Region and the Lake Simcoe Region, are well represented in the boater survey by samples taken at Bobcaygeon and Washago, respectively. The Peterborough sampling site typifies some elements of both the Rice Lake and the Stony Lake Regions, while the Gamebridge site may be equated with the Lake Simcoe Region, or at least with one subdivision of it. The Balsam Lake, Lower Trent, and Georgian Bay Regions remain totally unrepresented in the boater survey.

In the boater survey, the ports of registration can be equated with the spatial origins of the population. The study recognized four categories of Canadian origins, as listed in Appendix 1. The ports of registry of the total sample were as shown in Table 20.

Port of Registration	Number of Boats	Percentage
Ontario on the Trent-Severn Waterway	646	30.3
Metropolitan Toronto	561	26.3
Other points in Ontario	802	37.6
Other points in Canada	20	0.9
Foreign points	105	4.9
Total	2134	100.0

Table 20. Ports of Registration of Boats in the Trent-Severn Waterway, 1969

It is clear that the vast majority of the boats sampled were registered in Ontario (over 94%), and that as a single point of origin, Metropolitan Toronto was dominant. The dominance of Toronto boats was not constant, however, either over time or from point to point on the Waterway. It declined from 29.0% in the period June 20 to July 26 to 17.0% in the period September 2 to October 15, while there was a concomitant increase from 26.7% to 37.5% in the proportion from points on the Trent-Severn Waterway.

Table 21 illustrates the considerable degree of interregional diversity in points of origin.

Port of Registration	Washago	Gamebridge	Bobcaygeon	Peterborough	Campbellford
Ontario on the Trent-Severn Waterway	26.0%	23.3%	32.7%	48.9%	30.9%
Metropolitan Toronto	31.7%	29.3%	27.2%	14.9%	17.3%
Other points in Ontario	39.8%	43.0%	34.8%	28.6%	37.7%
Other points in Canada	0.3%	0.8%	0.8%	1.4%	2.7%
Foreign points	3.1%	4.4%	4.3%	6.5%	10.9%
	100.0%	100.0%	100.0%	100.0%	100.0%

Table 21. Ports of Registration of Boats in the Trent-Severn Waterway, 1969, by Sampling Site.

Boats registered on the Waterway formed a high proportion (almost one-half) of the boats sampled at Peterborough. Boats from Metropolitan Toronto were overrepresented at the more westerly sampling points and underrepresented at the more easterly ones. To a lesser extent this was also true of boats registered at "other points in Ontario."

The question of eastward or westward orientation of traffic in the Waterway regions has already been discussed (see Chapter 5.3). Interregional contrasts in this aspect of traffic are minor, but, as previously pointed out, in the Lower Trent Region and the Percy Reach Region westbound traffic exceeds eastbound by a considerable degree.

6.4 SUMMARY OF THE REGIONAL DESCRIPTIONS

Using the information already presented here and additional information extracted from the boater survey (Trent University, 139 and 140) and other sources mentioned in Chapter 3, it is possible to arrive at a composite picture, in general terms, of the nature of recreational boating in each of the Waterway regions. It can be seen that the differentiation of the Waterway corridor into distinct nodes is not only a statistical device for interpreting traffic data but that it also represents true differences in "personality" which make each region unique in terms of its recreational components, at least at this point in time. Whether, as in Whebell's model (Whebell, 156, p. 4), diffusion over time will obscure these differences remains to be seen. Christaller has shown that recreational regions do change over time, both in their intensity and in their total "personality" (Christaller, 47, p. 221).

Despite Rungaldier's plea that geographers should bridge the gap between their technical data on tourism and their knowledge of the landscape (Rungaldier, 124, p. 92), these summaries are necessarily more descriptive than interpretive since it has not been possible in most cases to relate the observed patterns to any local or regional resource endowments. The occurrence of traffic from region to region is an indication of complementarity among them (See Chapter 1.4), and it is probable that some elements of this complementarity consist of variations in the local resources. In the absence of firm evidence of this variation, the applicability of the "environmental corridor" concept remains to be established. The basic corridor model, however, fits the case of the Trent-Severn Waterway remarkably well.

a. The Lower Trent Region

The Lower Trent Region is a lightly used portion of the Waterway in which many of the boat trips are of extended length and destined for the western part of the Waterway. Large and medium-sized boats are typical, and many of them are of American registry. In contrast to this group is a smaller number of local residents (especially Trenton) who use this portion of the Waterway for frequent short fishing trips, in many cases using small boats.

b. The Percy Reach Region

In the Percy Reach Region, as in the preceding one, there are two distinct classes of boaters, which, even when combined, do not make this portion of the Waterway a busy portion. On the one hand there are many boaters, using small craft, that travel to and fro through the very scenic lock (number 7) at Glen Ross but seldom extend their trips beyond that stretch of the Trent River. On the other hand, there are the boats which are merely passing through the Region on a more extended trip to or from Campbellford, Rice Lake, or the western end of the Waterway. On the whole, these latter are larger, use inboard motors, and are in many cases American. Very few boats of this group are kept on the

Waterway all summer. The boaters in this transient group are not, as a rule, regular users of the Waterway, many of them having used it for the first time in 1969, and then only for a few days.

c. The Rice Lake Region

The Rice Lake Region is physically one of the larger three regions, though its extent is rather open to question. It includes at least two subregions, one extending eastward to Hastings and/or Healey Falls and another extending northward to beyond Peterborough, and including Little Lake. For such a large region, the number of boat trips in it is not great, but it is significant that most of the Region is free of locks and is therefore used for a more protracted season than would be possible if it were necessary to use locks, which are open for a period of time that is somewhat shorter than the ice-free period. Within the Rice Lake Region are several attractions to boaters, such as the hydraulic lift locks at Peterborough, the Serpent Mounds Provincial Park, and the opportunity to leave the main channel and sail to Bewdley, at the west end of Rice Lake. A regular tour boat, the "Miss Peterborough," is a feature of this region that is not found elsewhere on the Waterway. As well as having a fairly large American component in its boating population, the Rice Lake Region is also heavily overrepresented by local boaters, probably fishermen and other day-trippers. Excluding the fairly small number of trips that pass through the Region, there are three times as many trips which take place entirely within the Region as there are trips that originate outside it but terminate within it, an unusually high ratio.

d. <u>The Stony Lake Region</u>

Many boaters from outside the Stony Lake Region make it their destination. These are also probably day-trippers for the most part, whose boats are launched at Peterborough, which is in the Rice Lake Region. As a reflection of that pattern, the proportion of small boats within the sample is the highest of any of the regions. In other respects, the "personality" of the Stony Lake Region differs only slightly from that of the rest of the regions in the Waterway. It is probably the most representative of the Waterway as a whole. Within it, the only major departure from the main channel that is possible is toward the east end of Stony Lake itself.

e. <u>The Sturgeon Lake Region</u>

Over one-quarter of the trips on the Trent-Severn Waterway terminate in the Sturgeon Lake Region, making it the most intensively used of all. It is also the only region in which the canal statistics permit the documentation of lateral flows which give this Region a measurable second dimension, a dimension which is observable in most parts of the Waterway but nowhere to the extent that it is in the Sturgeon Lake Region, with major branches extending to Chemung Lake and Lake Scugog. The proportion of trips taken by large boats reaches its nadir in the Sturgeon Lake Region, and the proportion of trips by American boats is also low. Conversely, the proportions of small boats and of boats that are brought to the Waterway by trailer are exceptionally high. The boating population at Bobcaygeon seems to consist largely of cottage-based day-trippers with homes elsewhere in Ontario (Helleiner, 78, p. 5).

Within the Sturgeon Lake Region, there may be more diversity than the data reveal because of the presence of three large interconnected lakes (Pigeon, Buckhorn, and Chemung) within which none of the internal traffic has been recorded.

f. The Balsam Lake Region

The Balsam Lake Region is a small, highly concentrated, and intensively used region. It shares with the Sturgeon Lake Region, from which it is separated by the Fenelon River, many of the same characteristics and a good deal of interregional traffic. The proportion of small boats is unusually high, and the proportion of American boats is at its lowest in the Balsam Lake Region, though there are inevitably a number of larger and American boats which use the Region only in passing through. A much travelled side route is to Coboconk, on the Gull River.

g. The Lake Simcoe Region

Lake Simcoe itself is the largest water body on the Trent-Severn Waterway, and it provides the opportunity for boaters to find a considerable diversity of destinations without passing through any lock. Hence it is impossible to know whether the Lake Simcoe Region has the same lateral extent in a dynamic sense that it has in a physical sense, and that the Sturgeon Lake Region further east has. A high proportion of the recorded trips that terminated in the Region also originated from within it, which is to be expected in such a large region. A high proportion of the boats using the Lake Simcoe Region are registered in Metropolitan Toronto and other Ontario points not on the Waterway. They are above average in size, and are in many cases more suited as floating cottages[74] than as floating adjuncts to littoral cottages. Many of the boaters use Lake Simcoe as their year-round base of operations for boating trips (Bourke, 11, p. 51).

h. The Georgian Bay Region

The Georgian Bay Region has affinities with both the Lake Simcoe Region, because of the considerable degree of interaction with it, and the Lower Trent Region, because of that small but distinct group of large boats, many of them American, that travel the entire length of the Waterway. The use of small boats is limited, and yet the proportion of trips through only one lock is high, a somewhat unusual combination of characteristics (see Chapter 6.2) which can be attributed to the limited number of locks in the Region and the prevalence of interesting side channels that may be reached with a minimum of canal travel.

This chapter has analyzed the Trent-Severn Waterway, region-by-region, in an attempt to convert the mathematical abstractions of the preceding chapter into a more conventionally geographic form, i.e., to re-introduce some of the elements of reality that were temporarily discarded during the analysis. The next problem is to consider some of the broader aspects of recreational waterways than those which have been treated in the bulk of this thesis.

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[74] Maier notes that leisure-time homes can be mobile (Maier, 100, p. 2).

CHAPTER SEVEN

DEFINING THE EXTENT OF A RECREATIONAL WATERWAY

7.1 INTERACTION BETWEEN LAND AND WATER

From the preceding chapters, it has become clear that the Trent-Severn Waterway is not a linear feature, but rather a dendritic one, whether viewed in a physical sense or in terms of its boat traffic patterns. The activity of recreation, however, is not carried on by boats, but by boaters and other recreationists. Hence, a proper appreciation of the extent of a recreational waterway can not be attained simply through an analysis of boat traffic. Boat movements and boater movements are not necessarily co-extensive. The former are constrained by the latter, but the converse is not true, for boaters can and do participate in recreational activities in places inaccessible to boats. For other recreationists this is even more true. This chapter is an attempt to assess the degree of interaction between recreation on the water and recreation on the adjacent lands, on the part of both boaters and other recreationists. The empirical basis for this assessment is less satisfactory than that which has been used in the foregoing chapters.

7.2 USE OF LAND BY BOATERS

For a variety of reasons, the activity space of the recreational boater includes the land. His contact with the land inevitably occurs at the point of entering the boat to begin a trip and when he steps ashore at the conclusion of the trip. What he does on the land before or after undertaking the boat trip may be just as much a part of his total recreational experience as the trip itself. This is especially true of those whose base for boating is a cottage or a provincial park, 21.4%[75] and 3.9% respectively, according to the 1969 boater survey, described in Chapter 3.5. No attempt has been made to locate precisely where trips begin and end. Casual observation suggests that actual launching points occur at thousands of points, along the whole length of the shores of the Waterway.

While actually on a trip, boaters go ashore for a variety of reasons, some practical (e.g., to shower, to obtain supplies, to empty their sewage holding tanks) and some that are more properly classed as recreational. In the latter category, picnicking and camping are engaged in by 70.8% and 25.3%, respectively, of the boaters, according to the 1969 survey. Others reported going ashore for the sake of browsing through towns, visiting points of interest, hiking, swimming off the shore, and watching the locking operation, all of which can be classed as recreational activities.[76]

Inasmuch as such recreational activities form a part of a total recreational experience centred on the Trent-Severn Waterway, it is reasonable to regard the "recreation space" of that Waterway as extending beyond the confines of the shorelines and up on to the land. The extent of these forays is difficult to determine. A limited inquiry among 47 boating parties showed that 36 wander no farther than 100 yards from the water for recreational purposes, and only one went more than one-half mile.[77] The littoral lands used for recreation by boaters clearly

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[75] This figure represents those who gave "private property" as their type of origin into the Waterway; experience suggests that most of those in that category were based at cottages.

[76] Johnston made the same observation along the Rideau Waterway (Johnston, 86, pp. 86-87).

[77] In a similar vein, Wells wrote, with reference to boaters on the Severn portion of the Waterway, "Some never think of stopping until they have to" (Wells, 153, pp. 14-15).

do form a part of the Waterway and indeed they may more properly represent the core of the Waterway than the channel does, for it is there that much of the recreational activity takes place.

In addition, the recreational experience of all boaters, whether or not they go ashore, may be said to include all of those adjacent lands the perception of which adds to the boaters' recreational experience.[78] The various descriptive accounts of boating on the Trent-Severn Waterway emphasize the nature of the surrounding land as much as, or more than, the water itself. They note a variety of sensory images such as scenic beauty or the smell of pines, which clearly form a part of the Waterway in the minds of both the writers and their readers. When boaters are asked whether they like the Waterway, their responses as often as not include their opinion of the surrounding lands. Since the boaters seem to regard the Waterway in such broad terms, the breadth of the Waterway may be thought to extend as far as the line of sight, which is the principle of the "visual corridor" described in Chapter 1.4. There is little doubt that land-based recreationists, when visiting a body of water, have their recreational experience affected by all of the water within their line of sight. It would therefore seem reasonable to assume the converse for water-based recreationists.

In actual fact, the land which is visible from the water varies greatly in its inherent attractiveness. It may be, therefore, that a "line of sight" definition of a waterway is too broad in some unattractive places, where the recreational potential is perceived as being limited

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[78] Fodchuk has suggested that a mutual enhancement of land-based and water-based recreational experiences by each other occurs on the Rideau Waterway, and it is reasonable to assume this to be the case on the Trent-Severn as well (Fodchuk, 58, p. 10).

to the water.[79] On the other hand, where boaters have a perception of the nature of the hinterland beyond the line of sight, the extent of a waterway may be broadened in concept so as to include elements of the historic environment or points of interest not visible from the water, both of which are incapable of affecting the direct sensory perception of a recreationist in a boat, but which may influence his perception of his "recreation space" in an indirect way.[80] If one wishes to define the breadth of a waterway so as to include perceived features beyond a line of sight, then the problem becomes a very subjective one. In the case of the Trent-Severn Waterway, for example, Canadian boaters are undoubtedly more aware of those historical and cultural aspects of the Waterway hinterland which enhance its recreational attractiveness than are their American counterparts using the same Waterway. As a rough indication of the areal extent of a recreational waterway as seen by all boaters, therefore, a line of sight criterion seems applicable. This is manifestly not true of commercial waterways, on which traffic is largely independent of the littoral. In such waterways, there is movement across the land-water interface at a relatively small number of points, and the water's edge forms a convenient and easily definable boundary along most of their length.

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[79]At such points, a waterway may begin to assume the characteristics of a commercial canal, or of a "pass" through unfavourable terrain (see Chapter 1.4). A promising avenue of research would be to determine the effect on boat speeds that such a narrowing of the "visual corridor" may have.

[80]Good mentions several "outstanding features along the Trent Severn Waterway which constitute substantial recreational assets" (Good, 68, p. iii). Timme defines the "recreational boating hinterland" as "the land which lies contiguous to and extends out from the river and supplies the bulk of the boaters using this outdoor recreational resource" (Timme, 138, p. 6). This definition seems inappropriate to the Trent-Severn Waterway in that it encompasses too broad an area. It is therefore rejected here.

7.3 USE OF WATER BY NON-BOATERS

To this point, the discussion of recreational waterways has been confined almost exclusively to their use by boats and boaters. It has been shown that boaters are actually in a minority, at least among visitors to "day use" sites along the Trent-Severn Waterway (Good, 68, pp. 11 and 46-47). It is therefore necessary to consider the extent of the space used by other recreationists whose activity is centred on the Waterway, this group including swimmers and anglers most obviously, but also sightseers, picnickers, naturalists, and others whose choice of recreational location is motivated by the presence of the Waterway. It would be an exceedingly difficult task to compile data on the extent of interaction between recreation on the land and recreation on the water by this group, as there are over 800 areas or structures within ½ mile of the water's edge, and an estimated 300,000 persons made use of them during the summer of 1970 (Good, 68, p. 11). Moreover, both the sites and the users are far from uniform, and the sampling method in any meaningful survey would have to take this variation into account.

In an attempt to gain an impression of the interaction between land and water, on the part of non-boaters, 58 parties of swimmers and fishermen were asked how far from the water's edge their wanderings took them during the time that they were engaged in their particular recreational pursuit at the places where they were interviewed. Both groups typically brought their vehicles to the closest feasible place to the water's edge, and seldom moved farther from the water than the location of the vehicle. During the time which these people devoted to their recreational activity, the anglers seldom moved more than three feet away from the water, and the swimmers normally remained within forty feet of the water. Both groups moved freely across the land-water interface and seemed to have a highly localized "recreation space," whose core was the water's edge itself. Indeed many anglers and swimmers spent most of their time within a foot of the interface. The "recreation space" of a sample of 20 sightseeing parties was similar to that of the swimmers and fishermen in that it was localized between the water's edge and the nearest point accessible by vehicle. There was, of course, no movement by sightseers from land to water, and the core of their "recreation space" was some little distance removed from the water's edge.

In terms of actual use, therefore, the "boundary" of the Waterway must be thought to lie a short distance inland from the shoreline, the actual distance perhaps being greater for some types of recreationists than others. As in the case of boaters, the extent of inland movement by other recreationists exhibits "distance decay," which makes the establishment of a boundary a very arbitrary business. In that respect, there is a further similarity between the Trent-Severn Waterway and the model of a corridor proposed by Whebell, who postulated "secondary diffusion" transverse to the alignment of the corridor, whereby the most intense manifestation of a corridor's properties is to be found along its spine and its identity becomes progressively weaker with lateral distance (Whebell, 156, p. 4).

If it were necessary to define the lateral boundaries of the Trent-Severn Waterway in terms of its non-boating recreational users, one would have to launch a full-scale perception study, and the conclusions of such a study could well be ambiguous in any case. The experience of this writer is that within several miles of the water people do identify their location with the Waterway, and, if questioned about the region within which they live, would use terms such as Kawartha Lakes, Lake Simcoe, etc. On the other hand, their functional reason for living where they do is only remotely attributable to the presence of the Waterway in the vast majority of cases, and in their day-to-day activities they seem to be unaware of its presence from one week to the next, even if they have to cross it in commuting to and from work. Therefore a functional or land use approach to the problem would probably result in a much narrower corridor than a "regional identity" approach. It would also involve considerable overlap between Waterway-oriented recreational functions and functions which are largely independent of the recreational potential of the Waterway. (It is because of a similar problem of overlapping that this thesis makes no attempt to differentiate between a recreational and a commercial waterway in terms of the relative dominance of the two types of boating.) A third approach to defining the breadth of the Waterway would be to determine the drawing-power of the Trent-Severn Waterway for water-oriented recreational activities as compared with the drawing-power of other bodies of water for the same purpose. A preliminary investigation of this question, based on the survey described at the end of Chapter 3, suggests that even as far away as thirty miles from the core of the Waterway it is still a more popular destination than other bodies of water.

7.4 THE AREAL NATURE OF WATERWAYS

The discussion in this brief chapter has not elucidated the problem, identified in the C.O.R.T.S. Report, of establishing criteria for defining the lateral limits of the corridor (C.O.R.T.S. Report, 42, p. 7). The problem of boundaries is one which regional geographers have never yet been able to overcome. Šprinçová has rejected altogether the use of boundary-lines for delimiting recreational regions (Šprinçová, 129, p. 192). What this discussion has attempted to demonstrate is that a study of the movement of boats to and fro upon the waters of a waterway does not suffice to conceptualize a recreational waterway, without which it would not have any unity.[81] To belabour the metaphor, the true essence of a recreational waterway, that which gives it a healthy recreational life, is to be found in the flows of people and images around the skeleton. The movement of people around the skeleton is comparable to the flow of blood, which is concentrated in a few arteries close to the skeleton but which diffuses outward from these arteries at many points. The flows of sensory images from the environment to the recreationists are more akin to a network of neurons, relying as a network does on receptors, stimuli, and a central adjustory mechanism. Finally, the range of these flows encompasses an area which adds flesh to the skeleton. In spatial terms, waterways do have area and may justifiable be considered as regions.

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81 The metaphor of a "spine" or "backbone" (already used twice before in this thesis) has been applied to waterways by several writers, e.g., Fodchuk (58, p. 11) and C.O.R.T.S. (42, p. 7).

CHAPTER EIGHT

A RECREATIONAL WATERWAY MODEL, ITS VALIDITY, AND ITS APPLICABILITY

8.1 RECREATIONAL WATERWAYS AS REGIONS

This chapter is an attempt to abstract from the particular case of the Trent-Severn Waterway a set of properties which, when taken together, may serve as a reasonably adequate description of recreational waterways in general, *i.e.*, a descriptive model. It presents no new reflections on the nature of the Trent-Severn Waterway, but by isolating the prime characteristics from their methodological and statistical backgrounds, it may serve as a useful summary, against which other waterways may be compared and from which approaches to practical situations may be extrapolated. The wording in the summary portion of this chapter makes little or no direct reference to the Trent-Severn Waterway. It implies that the process of abstraction has been going on continuously throughout the foregoing chapters and that the generalizations derived therefrom can now be stated *as* generalizations, without further reference to specifics.

A recreational waterway is a spatial phenomenon defined by physical and functional criteria. The spatial condition required of a region is that it be two-dimensional. A recreational waterway may tend towards one-dimensional linearity, as does a commercial canal, but it does have a second spatial dimension, that of breadth, in varying degrees. This breadth extends not only to the limits of the dendritic topological structure consisting of the lakes, rivers, and other water bodies which are its spatial core, but further on to the adjoining lands as well.

The spatial contiguity of a recreational waterway is assured through a combination of natural and man-made connections among the water bodies and by the facility with which recreationists and recreation-enhancing images may move within the waterway, that term being taken to include both land and water.

The functional identity of a recreational waterway is determined by its third dimension, the independently selected non-spatial criteria by which it may be differentiated from other parts of the earth's surface. This functional identity can be most firmly established by considering the boat traffic on the core of the waterway: its nature, its purpose, and its movements. A recreational waterway is typically comprised of small or otherwise sheltered bodies of water and much of the boat traffic uses several or even all of the water bodies. The boats involved are small in contrast to those on commercial waterways, and consequently navigational possibilities need not exist beyond an overall minimum depth of between four and six feet. The vessels are designed for recreational purposes, and the boaters themselves are primarily engaged in such pursuits. There is a good deal of flexibility in where the recreational activities may take place and in where the boats are able to go. The variety of boat trip patterns is consequently much greater than the repetitive comings and goings of boats on a commercial waterway, and the paths which the boats follow form an interconnected network of a dendritic or quasi-dendritic form. The internal diversity of trip patterns is perhaps the most distinctive feature of recreational waterways.

The physical and societal environment throughout a recreational waterway, on both land and water, is closely tied to recreational activity, including swimming, angling, and sightseeing as well as boating. The greatest concentration of recreational activity of all forms is on the land immediately adjacent to the shoreline. It is broadly dispersed along that littoral, however, rather than being confined to a handful of points, as commercial activity typically is. The progressive decline in the intensity of recreational activity with greater distance inland from the shore of a waterway may provide a basis for establishing, albeit somewhat arbitrarily, a boundary for a waterway region.

8.2 RECREATIONAL WATERWAYS AS CORRIDORS

The conceptualization of a recreational waterway is fundamentally similar to the corridor concept described in Chapter 1. Water-oriented recreation, instead of being uniformly dispersed throughout a recreational waterway, is concentrated at a few lakes or clusters of lakes. These nodes of activity are comparable in many ways to the cities which form the nodes of activity in corridors, which have been described previously. The most striking point of similarity between individual lakes on a recreational waterway and the nodal cities in a corridor is the large volumes of inbound and of outbound traffic, approximately equal in both directions, which they generate. Along a recreational waterway, as along an urban corridor, much the major part of the traffic is localized and consists of short trips of a reciprocal nature.[82] The trips go to and from a relatively small number of points, if "points" are abstractions of entire lakes or cities, but actually a very large number of points if the waterway or the urban corridor is considered on a large scale.

Between these few activity peaks are areas of somewhat lower traffic density, but the individual nodes are still strongly linked to each other, in a quasi-linear arrangement, both by through traffic representing interaction,[83] and, more significantly, by an affinity of interests and economic function. Though each lake on a recreational waterway is set in its own unique environment and enjoys a resource endowment not necessarily the same as that of its neighbours, and each lake has its own situational peculiarities as well, there is nevertheless a common orientation throughout the waterway to recreation, and, more specifically to small-craft boating, swimming, fishing, and sight-seeing, an orientation which is expressed in elements of the natural environment and in various structures, facilities, and even modes of thought which are geared toward these activities. There is in this concept both a functional unity and an internal diversity which make it a recreational system. Within the functionally unified system, the various lakes or clusters of lakes in a recreational waterway form recognizable nodal regions at a lower level in the hierarchy. At a still lower level, overlapping subregions may also be identifiable on the basis of the orientation of traffic patterns.

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[82]For a clarification of this point, see Chapter 5.3

[83]Much of the through traffic on a waterway consists of boaters whose homes are far removed from the corridor and who must therefore travel along much of the corridor before they reach a particular destination on it.

Whether recreational waterways are considered in their entirety or in terms of their separate components, they are a spatial phenomenon with particular aspatial characteristics. The recognition of recreational waterways, which can, of course, be accomplished only if there is understanding of the spatial and aspatial properties that the term connotes, is therefore an exercise in "dividing the earth into meaningful parts" (see page 1). The latter, as pointed out in Chapter 1, is one of the aims of Geography, and the concept of a "recreational waterway," which this thesis has sought to clarify, is a means towards that goal.

8.3 A SCHEMATIC SUMMARY

The objective of this study has been to conceptualize and express the nature of recreational waterways by specifying their component elements and observing how they interact. An attempt is made, in Figure 25, to illustrate in a schematic way, the more significant interrelationships that have been identified.

The symbols employed in the diagram are connecting lines and connecting arrows. Where two elements are connected simply by a line, it is implied that the lower of the two (on the diagram) is a component of the higher. There is no action or interaction implied by such a line. An arrow, on the other hand, is intended to suggest that the element at the source of the arrow in some way affects, impinges on, or helps to create the element at the distal end of the arrow. Where two such arrows converge from different sources to a common destination, the implication is that the two source elements together affect, impinge on, or help to create the other element. By way of heavy outlines, the diagram draws attention to the three distinctive facets of the model as it has been presented: the overall form, the overall function, and the internal form.

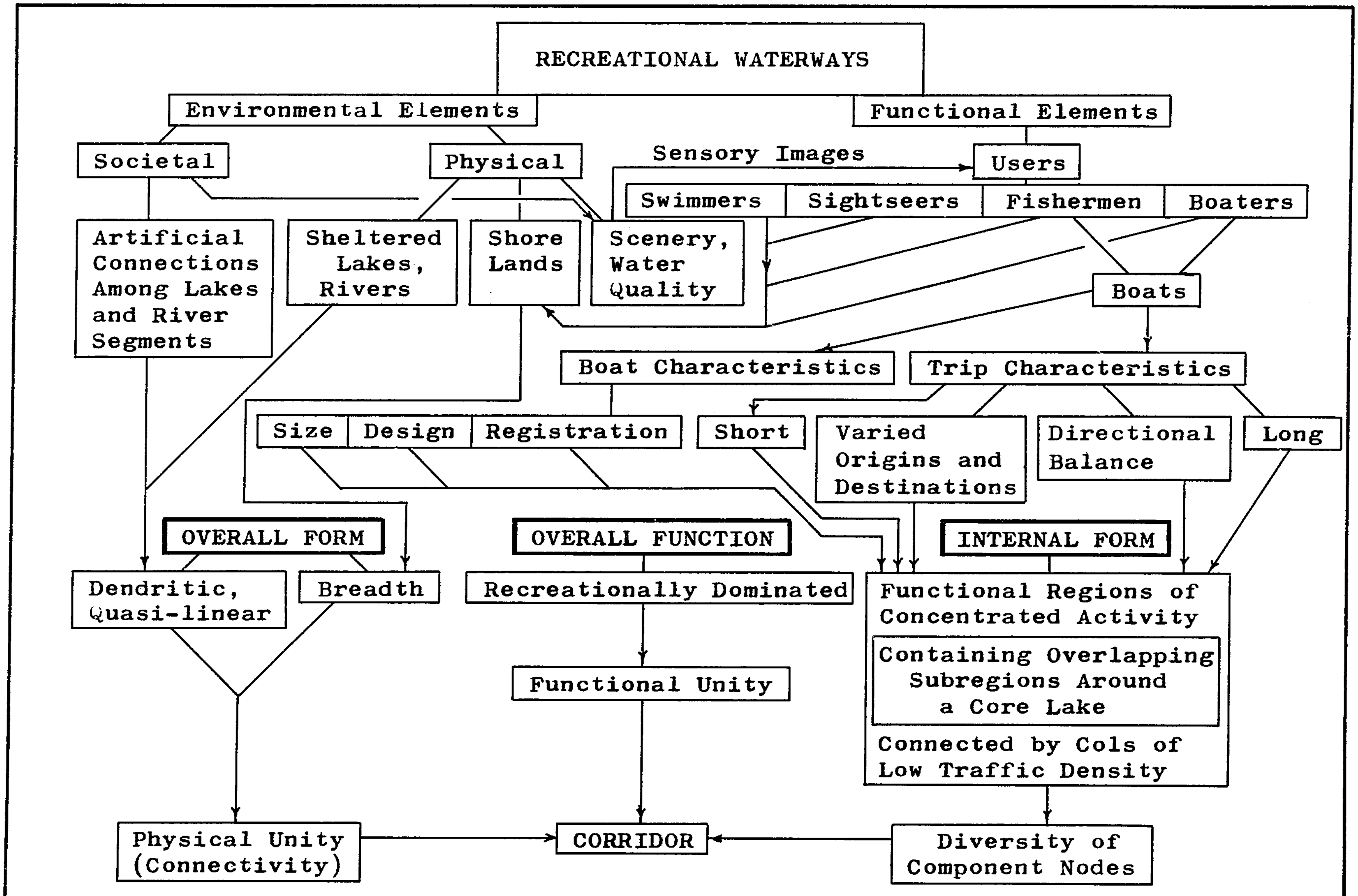

Figure 25. Interrelationships of the Elements of the Recreational Waterway System (for explanation see text).

This thesis has taken, as a starting point, the premise of an overall recreational function. Thus, only the other two aspects, overall form and internal form, have been elaborated in this study. It is significant that the model of a recreational waterway developed here should stress a degree of internal disunity, since it is customary to think of such waterways as single units. In this respect, the analogy with a corridor, as suggested in Chapter 1, seems to be a particularly apt one, and this similarity is noted in the diagram, by the ultimate convergence of the three facets into the one corridor concept.

8.4 THE THEORETICAL VALIDITY OF THE MODEL

The model that has been put forward in this thesis has been flaunted as having general value to Geography beyond the particular case from which it was derived. As pointed out in Chapter 1, the testing of that proposition is beyond the scope of this study. It is obligatory upon the writer, however, to offer some insight into his thoughts and investigations which moved him to lay claim to a degree of universality. These thought processes have been both deductive and inductive in nature. Deductive reasoning has been applied to the support of only the most distinctive feature of recreational waterways, namely the fact that they are internally compartmentalized into functional regions. The detailed facets of the model cannot be rationalized; support for them must rest upon empiricism.

The deductive reasoning behind the argument is simple, if certain basic propositions are accepted:

1. the boaters on any recreational waterways that exist are primarily recreational boaters;

2. recreational boaters universally have similar preferences in terms of trip lengths;

3. there are no universal situational factors by which base populations are distributed at a constant distance from attractive areas;

4. recreational boaters everywhere seek out the most attractive areas on a waterway in which to pursue their recreation;

5. attractive areas are randomly distributed within a waterway;

6. recreational boaters within any given part of the world where they exist have a common idea, in general terms, of what is an attractive area.

About the first of these propositions there can be no debate because the definition of recreational waterways has beenpredicated on their use for recreation (see Chapter 1.2). The others are submitted, with a <u>ceteris paribus</u> proviso, as uncorroborated axioms in the belief that they are essentially more valid than invalid. By way of comment on the sixth, the diversity of tastes on the part of recreationists is indeed a major complicating factor in many studies of recreation. However, broadly speaking, the problem may be overrated. Casual inquiry, admittedly limited and unsystematic, suggests that in southern Ontario the boaters are a fairly homogeneous group in this respect, and there is no obvious reason for hypothesizing greater heterogeneity in other parts of the world. The logic which follows from these six propositions is that if the majority of the recreational boaters on a recreational waterway (who themselves are in a majority among the boaters) are attracted by areas which they each perceive in a similar way, then they would all become concentrated in a single area if there were no limitation on trip lengths. Also, since a standard trip length for all parts of the world has been postulated, and since a preference for short trips in one part of the world has been demonstrated (see Chapter 5), then the preference for short trip lengths is universal. Given the unequal distribution of attractive areas, the preference for attractive areas and the preference for short trips will come into conflict in a certain proportion of cases. In the process of conflict resolution, the boaters may be thought to reject the most extreme of the unfavourable conditions, namely the longest of trip lengths and the most unattractive areas. The rejection of long trip lengths may involve the sacrifice of attractive destinations, and the rejection of unattractive areas may involve the sacrifice of short trip lengths. The result will be a pattern of trips of moderate length to areas of moderate attractiveness, wherever conflict resolution was required. In all other cases, the goals of short trips and attractive areas remain compatible. Therefore, the moderate trip length is likely, in a statistical sense, to be the upper limit rather than the median. Consequently, trip patterns on any recreational waterway would necessarily approximate those of the model: a number of separate nodes to which the bulk of the boat traffic gravitates.

8.5 THE EMPIRICAL VALIDITY OF THE MODEL

The inductive process employs the technique of sifting through the available literature on recreational waterways in various parts of the world (see Chapter 1.5) to determine the extent to which they, collectively, approximate the model. The literature is neither sufficiently voluminous to constitute a reliable statistical sample nor adequate in detail to provide the basis for individual comparisons with the model in the majority of cases. A few isolated points of comparison, selected eclectically from the two continents where recreational waterways are known to exist, are offered here, both in the conviction that they are representative and do justify a more widespread application of the model, and in the hope that that claim will be challenged and the model proven for its worth, or lack thereof. The waterways from which these details are selected represent canalized river systems, a network of lakes, and tidal waters.

The Rideau Waterway in eastern Ontario bears many points of similarity to the model. It is a canalized river and lake system (Johnston, 86, pp. 11-12; Wyatt, 164, pp. 69 and 98), on which the majority of boaters do not make a through trip (Johnston, 86, p. 52). The local boaters (those who own property along the waterway) typically take very short trips (Johnston, 86, pp. 55-56). A significant proportion of the boaters (41.5%) depart from the main marked channel of the waterway at some point or other (Johnston, 86, p. 56).[84] The use of the water is not confined to boating, and even the boaters themselves make considerable use of the surrounding land for picnicking, hiking, camping, etc. (Johnston, 86, pp. 86-88), uses to which the natural environment is well suited.

In the Muskoka area of Ontario, there are four lakes of over 25 square miles, seven of over 5 square miles, and 121 of over 40 acres

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[84]Wyatt (164, p. 135) mentions several places where this is feasible.

(Brown, 32, p. 89). Most of these are interconnected by rivers and short canals and form a recreational waterway ideally suited for and used by small boats. The recreational system contains many terrestrial features of both the natural and societal environment. The lakes can be classified according to their navigability and the recreational function to which they are best suited (Brown, 32, p. 109).

The Puget Sound area of the State of Washington, U.S.A. is widely used for recreational boating (U.S. Army, 145). The surrounding shores are well suited to enhancing the recreational potential of the waters, both by their natural beauty and because of the intensive development of facilities for the small boat population which dominates the waterway (U.S. Army, 145, pp. 18-61). Different parts of the waterway exhibit different boating characteristics, which would justify the identification of regions within it (U.S. Army, 145, passim). On this waterway, too, the boaters show a propensity to participate in shore-based recreation (U.S. Army, 145, pp. 79-80).

The upper Illinois River in the United States, at least from Dresden Island Lock and Dam downstream to Henry, and perhaps to its mouth, has no side channels that are used for recreational boating, but in other respects it closely resembles the model. It is, of course, only a portion of a much more extensive waterway consisting of the Mississippi River and its tributaries. There are along it several "areas of concentration" (Timme, 138, p. 6) of recreational boating, which differ significantly from each other in several respects related to boating. The overall waterway is a canalized river with recreational facilities and a favourable natural environment along much of its length (Timme, 138, pp. 1, 9, 11, and 34). It is navigable only for small boats (Timme, 138, pp. 8-9). The interface between land and water is the focus of much recreational activity on the part of both boaters and land-based recreationists (Timme, 138, pp. 1 and 32).

The Intracoastal Waterway on the Atlantic and Gulf Coasts of the United States is widely used for recreational boating. Along its length are many inlets and alternate channels that give it a topological structure similar to that of the model (Mortimer, 105, pp. 18-26, 35). Recreational boats in the case of this waterway are not in a majority (46% - Mortimer, 105, p. 40) but are sufficiently prominent that the waterway can be classed as a recreational one.

In Great Britain, the network of recreational waterways is so complex in its interconnectedness that no one portion can be singled out as an individual recreational waterway. The entire system lends itself to particular internal traffic patterns much more readily than to an end-to-end passage. Indeed the linearity of the entire system is so obscured by branches off it that the "ends" of the waterway, as well as its "spine" can be identified only arbitrarily. Possibly the nearest approximation of a spine would be the channel that follows the Grand Union, Oxford, Coventry, Trent and Mersey, and Shropshire Union Canals from London to Ellesmere Port. The regionalization of this network is recognized to exist in terms of its historical development and its functions. Whether the accepted entities coincide with those that traffic patterns might reveal remains to be determined. The pressure on land for a variety of uses is so great along many parts of this waterway network, that its extent landward is severely constricted in many places. Despite this, the use of the shores for angling, hiking, and other land-based activities is widespread.

In continental Europe, recreational waterways commonly follow rivers and canals rather than lakes. France has about 5200 miles of largely interconnected inland waterways in use, on which there is, as one function, a variety of recreational uses, strongly regionalized around large towns (O.R.R.R.C., 117, p. 19). In West Germany, the mileage is much more limited (about 400 miles of river, including the Danube, Rhine, Weser, and Elbe, and about 100 miles of canals), but their use for recreational purposes is sufficient to justify an investment in extending the network (O.R.R.R.C., 117, p. 21). The most extensive network on the continent, and perhaps the most widely used for recreation, is that of the Netherlands, which includes rivers, lakes, canals, and arms of the sea (O.R.R.R.C., 117, p. 21).

There are many other waterways, both on the two continents mentioned, and elsewhere in the world, to which the model may well be applicable. Among the better known ones in North America, apart from those already mentioned, are the Erie Canal system from Buffalo and Rochester to Albany and thence via the Hudson River to New York; the Richelieu River route, using the St. Ours, Chambly, and Champlain Canals to navigate from the St. Lawrence River to the Hudson River; and the north shores of Lakes Huron and Superior.

The model seems, prima facie, to be applicable to many, if not all, of those waterways mentioned here. In order to establish its validity, it will require testing in many situations, in many of which the data have as yet not been collected. The techniques employed in this study of the Trent-Severn Waterway are theoretically applicable, if the necessary data are available, to a large majority of, and a great variety of, recreational waterways. A significant exception, however, as noted in Chapter 4.3, is the case of rivers whose current is swift and on which the use of powered pleasure boats is precluded by problems of inadequate depth and an absence of navigational aids to overcome rapids or other obstructions. Such waterways, referred to as "wild rivers," while being true recreational waterways by definition, are sufficiently discrete in all topological aspects and in their ability to be regionalized by graph theoretic measures, as well as in many other less abstract ways, that they need to be studied as a totally different class of phenomenon. They are therefore excluded from this study. Some descriptions of wild rivers are in existence (O.R.R.R.C., 115, pp. 317-321; Ontario Department of Lands and Forests, 113 and 114; Leopold, 96).

8.6 THE APPLICABILITY OF THE MODEL: PRACTICAL IMPLICATIONS FOR PLANNING

A scientific evaluation of a descriptive model relies on its truth or its falsity. There is however, a body of opinion which, not satisfied with truth, subjects scholarly research to a second evaluation, and passes judgment on a model according to its fecundity or sterility. In order to survive this double jeopardy, the concept of a recreational waterway presented here must be not only valid, but also useful, in the practical world of mankind. The concluding pages of this thesis are therefore aimed at demonstrating how an awareness of the nature of recreational waterways is essential to their management.

The spatial structure of administration in most parts of Europe and North America is exceedingly complex. Not only is there a nested hierarchy of governmental units from the federal state downwards (which is not particularly complex in a spatial sense), but there are, at each level in the hierarchy, several agencies dealing with related matters but operating in different spatial jurisdictions. The topological unity of recreational waterways and their interconnectedness may provide a rational basis for delimiting the water area over which a recreational waterway management agency should have jurisdiction. Recreational boating is an activity that has only recently acquired significant dimensions. For this reason, the present patterns of traffic on what are now recreational waterways have only recently taken shape. Accordingly, any restructuring of prior administrative units impinging on a recreational waterway ought to take into account both the topological unity of the entire waterway and its internal structure of regions as established through a study of its traffic patterns.[85] A recognition of appropriate internal subdivisions of a recreational waterway is also essential to a

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[85]As an example, the segments of the Trent-Severn Waterway delimited "for the planning process" in the C.O.R.T.S. Report (42, Map 1) can be compared with the regions and sub-regions identified in Chapter 5 of this thesis, and modified where necessary. Similarly, the regions currently employed by the agencies responsible for policing the Waterway could be adjusted to conform to the geographic realities of the Waterway, instead of arbitrarily being set in accordance with police work on the land beyond the Waterway.

sound selection of criteria for the collection of data for administrative purposes.[86]

An unresolved question which bears on the matter of appropriate jurisdictional boundaries is that of the lateral extent of a recreational waterway. The model does imply that an agency whose zone of jurisdiction is confined to the water is not able to deal with an entire recreational waterway, since the latter includes a littoral strip of unspecified and varying width. A line-of-sight criterion was proposed in Chapter 7, not as a definitive standard, but as a general indication of the area encompassed by recreational waterways. For planning purposes, even that criterion may be too narrow. Just as wilderness parks require control over a surrounding buffer zone in order to maintain their functional integrity, so recreational waterways, dependent as they are on perceived images of the environment, also need protection in the form of environmental controls over an area beyond the line-of-sight. The critical importance of water quantity and water quality to the integrity of recreational waterways suggests a watershed boundary as an appropriate one for planning purposes. Within the watershed zone will be found all of those features of the natural and societal environment which, when perceived directly or indirectly, contribute to the recreational function of recreational waterways.

In the operation of a recreational waterway, a management agency may seek, as one of its objectives, to maximize the recreational opportunities

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[86] It has been suggested, in retrospect, that the sampling points for interview programmes on the Trent-Severn Waterway were inappropriately chosen in the light of traffic patterns.

that the waterway provides at a minimum cost. The significant element of the traffic patterns represented in the model is the variety of points that serve as origins and destinations. To foster greater recreational use, the strategy of providing an even greater variety of opportunities for recreational boating trips would seem an obvious one. To the extent that private ownership of shorelands is a constraint to the number of potential origins and destinations, a public management agency can remove this constraint and increase the range of options by acquiring land for potential launching sites at frequent intervals along the shores. The indicated policy becomes not one of acquiring large acreages <u>per se</u>, but one of acquiring numerous parcels of property at frequent spatial intervals. Boaters, according to the model, do however make extensive use of shorelands as well as water bodies, and for this purpose public ownership of land area does seem important.

The marginal value[87] to the range of trip options that an increment of one parcel of shoreland provides is rather small. Given a finite financial resource, a much greater increment to the range of options can be provided by other forms of expenditure, which, though initially great, yield a significantly higher benefit-cost ratio, if benefits are measured in terms of the range of trip options available to boaters. The topological analysis described in Chapter 4 provides insight into the form that such investment might take. In the early days of the Trent-Severn Waterway's existence, before it was completed from end

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[87] using the term "marginal" in its economic sense.

to end, the variety of possible destinations from any point of origin was confined to limited stretches of the Waterway, the other reaches being inaccessible because of unnavigable connections among lakes. Each additional lock constructed on the Waterway represented a very much greater increase in the variety of possible trips than could have been achieved within the confines of a single stretch of the Waterway. Any new navigational aid that constitutes an articulation point on a network has great potential value, particularly those where the stress is highest. On the Trent-Severn Waterway, the creation of a link with the Muskoka Lakes network, through Morrison Lake, is a possibility. Although it would undoubtedly be expensive, the benefits, in terms of increasing the range of trip options, would appear to be several orders of magnitude greater than an equivalent expenditure on shoreland acquisition. The extension of the period during which the locks are operative would be another, much less costly, project with a high benefit-cost ratio. To link up artificially the various branches of the network would be an expensive undertaking, but the range of trip options that a series of ring routes provides is considerably greater than that in a dendritic network.

The extension of these principles to other recreational waterways, existing or yet to be created, is a simple step. Where a lock or other navigational aid can be provided, the benefits are considerable. As an example, the hand-operated marine railway between Kingsmere Lake and Waskesiu Lake in Prince Albert National Park in Saskatchewan has greatly extended the effective waterway network in that park. Other links in that park could have just as great an impact. On a more local scale, the network of lagoons around the Toronto Islands has certain cul-de-sacs, which, if linked, would greatly increase the range of trip options open to boaters. To create a totally new recreational waterway on the scale of the Trent-Severn Waterway, where interconnections do not at present exist, is prohibitively expensive in most cases. On a smaller scale, however, recreational waterways have been, and are being, planned. They are a feature of recreational complexes like Disney World in Florida, Ontario Place in Toronto, and Man and his World in Montreal. The plans that existed for Harbour City in Toronto also envisaged a recreational waterway network. The principles of the present model can be applied in the planning of any such waterways.

The study of recreational waterways is a new direction in a relatively new field, that of recreational geography. If the trends of the last quarter century persist, and recreational activity continues to increase at phenomenal rates, the scope for developing and applying the study of recreational waterways, which this thesis has merely introduced, will remain broad, and the practical value of such studies will be realized.

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APPENDIX 1

Trent University 1969 Boater Survey (Trent University, 143 and 144)

The recording sheet used by the interviewers is shown on the following pages. Items of particular relevance to this thesis are the following:

Type of Craft (launch; cruiser; runabout; car top; sailboat; houseboat; canoe; water-taxi, other)
Type of Power (inboard; inboard-outboard;[88] outboard)
Draft of Boats (under 1'; 1' - 3'; 4' - 6'; over 6')
Type of Fuel (oil-gas mix; gasoline; diesel; other)
Length of Craft (10' or less; 11' - 14'; 15' - 18'; 19' - 25'; 26' or more)
Ports of Registration (Ontario on the Trent-Severn Waterway; Metropolitan Toronto; other points in Ontario; other points in Canada; states in the U.S.A. bordering on the Great Lakes; other)
Ownership (registered in respondent's name; borrowed; rented)
Type of Origin into the Canal (public access; private property; provincial park; outside of ends; marina; other)
Method of Access (already in the system; trailered in; came in through the ends of the system)
Location of Launching Points (Lake Ontario entrance to Waterway or beyond; between Lake Ontario and the Highway 7 bridge at Peterborough; between the Highway 7 bridge at Peterborough and Lake Simcoe; Lake Simcoe or Lake Couchiching; Severn Waterway; Georgian Bay entrance to the Waterway or beyond)
Boat Storage Location (on the Waterway; not on the Waterway)
Respondent's Year-round Home (Ontario on the Trent-Severn Waterway; Metropolitan Toronto; other points in Ontario; other points in Canada; states in the U.S.A. bordering on the Great Lakes; other)
Total Seasonal Use of the Waterway (5 days or less; 6 - 25 days; 26 days or over)
Number of Years Boating on the Waterway (0 - 1; 2; 3; 4; 5 - 10; 11 and over)
Party Size (1 person; 2 -3 persons; 4 - 5 persons; 6 - 7 persons; 8 - 9 persons; 10 or more persons)
Party Composition (one person alone; one family with children; two families with children; organized group; one couple only; two or more couples; group of friends; other)
Education Levels of Respondents (grade school; part high school; high school; part university; university degree)
Occupations of Respondents (professional, technical, teacher, or student; clerical; sales, or service; transport; primary or labourer; craftsman)

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[88] "Although the motor is within the hull or 'inboard', its propeller and shaft connections are designed to swivel up and out of the way, much like an outboard, to facilitate launching from a trailer" (Michigan Waterways Division, 102, p. 9).

Income Levels of Respondents (up to \$3,999; \$4,000 - \$7,999; \$8,000 - \$11,999; \$12,000 - \$15,999; \$16,000 - \$19,999; \$20,000 or over).

TRENT -SEVERN WATERWAY QUESTIONNAIRE Sticker ________

Interview location ________ Direction ________ Weather ________
Time of interview ____ Port of Reg ________
Date ________

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1. Type of Craft
   Launch ____ Car top ____ Canoe ____
   Cruiser ____ Sailboat ____ Water Taxi ____
   Runabout ____ Houseboat ____ Other ____

2. Inboard ____ Outboard ____
   Inboard-Outboard ____ Non-powered ____

3. Length of craft in feet ________

4. Draft
   Less than a foot ____ 4 to 6 feet ____
   1-3 feet ____ Over 6 feet ____

5. Type of fuel for motor operation
   Oil-gas mix ____ Diesel ____
   Gasoline ____ Other ____

6. Is this craft registered in your name ____
   Borrowed ____
   Rented ____

8. a) Location of launching point to the system on this trip ________

7. Type of Origin into the Canal
   Public Access ____ Provincial Park ____ Marina ____
   Private property ____ Outside of ends ____ Other ____

   Method of access
   Already in the system's waters ____ Trailered in ____
   Portaged in ____ Other ____
   In through ends ____

8. b) On what date did you commence this trip ____ (if origin within system)
   c) On what date did you enter the system ____ (if origin outside system)
   d) Calculation of travel days to date ____
   e) Where is your boat normally moored or kept during the canal season (May 15-Oct. 15) ________
   f) Your year-round home is located in ________
   (city, town etc.)

9. a) Total seasonal use of the Trent-Severn System per year in approximate days. 1969 ____ 1968 ____ 1967 ____
   b) For approximately how many years have been boating on the system. ____
   c) Have you ever boated on the Rideau System ____
   d) During the 1969 season you will use of have used the Rideau ____

10. a) Where will you terminate this trip in the system (Furthest point from the starting location) ________
   b) On what date will you hope to reach this farthest objective ____
   c) Total travel days estimated on this trip ____.

11. What major stops have you made or will you make on this trip?

Where ________________: ________________: ________________: ______________:

TYPE	METRO				SYSTEM	
	USE	COST	TIME	COMMENTS	USE	COMMENTS
Boat Service						
Accommodations:						
Food (restaurants)						
Food (groceries)						
Souvenirs						
Supplies (gen.)						
Tourist Services						
Hotels, motels						
Shower facilities						
General Services:						
Laundry						
Sewage pump outs						
Public telephones						
Garbage disposal						
Flush toilets						
Recreation facilities:						
Boat launching						
Public docking						
Picnic areas						
Scenic trails						
Lookouts						
Historic sites						
Pub. Swimming areas						
Campsites						
Off-route nav. aids						
Other:						

12. Average running time per day in hours __________ (except lay overs)

13. What are the major influences which affect the daily running time period. Please indicate whether this would cause you to extend or decrease your running time.
Comments ____

____

____

____

14. Average expenditure per day to operate boat while in the System $_____

15. Average expenditure per day excluding boat operating costs while in the System $______.

16. a) Have you or do you intend to picnic on this trip? __________
b) Do you picnic when land and/or dockage is available? Check one.
(a) always __________
(b) often __________
(c) sometime __________
(d) seldom __________
(e) never __________

17. a) Do you carry camping gear? __________
b) Have you or do you intend to camp on this trip? _____ Where __________
c) Do you camp when land and/or dockage is available? Check one.
(a) always __________
(b) often __________
(c) sometime __________
(d) seldom __________
(e) never __________
d) Would you camp more on the Trent-System if more or better public stop-overs were available? __________
e) Comments relative to picnicking and camping: ______________________________

____

18. Preference for overnight accommodation:
(a) on board ______ (b) land oriented ______ (c) not app. ______

19. Ranked preference for overnight accommodation location. Top three only
(a) marina __________ (f) private lodge __________
(b) public dock __________ (g) public park __________ name
(c) boat motel __________ (h) private cottage __________
(d) outside end walls at locks __________ (i) city motel __________
(e) other __________ (j) other __________

20. Number in the party ________

21. What best describes the composition of this party?

______ One person along	______ One couple only
______ One family with children	______ Two or more couples
______ Two families with children	______ Group of friends
______ Organized group (troop team)	______ Other ____________

22. Age and sex: (Indicate respondent with an asterik)

Male	Age	Female
______	0 - 4	______
______	5 -14	______
______	15-19	______
______	20-24	______
______	25-34	______
______	35-54	______
______	55-64	______
______	65+	______

23. Education level of respondent or head of party.____________

24. Occupation ____________

25. Family Income ____________

TRENT QUESTIONS:

SINCE TRENT UNIVERSITY IS CONDUCTING THIS SURVEY, THERE ARE A FEW QUESTIONS ON WHICH WE SHOULD LIKE YOUR OPINION.

Do you know that Trent University is on this waterway? ________
If yes, did you know this before beginning this trip? ________
Would you stop at Trent University, if dockage were available? ______
Would you join a conducted trip of the campus? ________
What is your impression of the university? ____________

____

____

____

____

APPENDIX 2

Limitations and Scope for Further Study

At the time when this thesis was defended before the examining board, the fact was stressed by several of the examiners that this study must be regarded as a case study of a single recreational waterway. Any claims made herein to universality, which the repeated use of the plural "waterways" may imply, are therefore clearly on very weak grounds. The study is directed towards the construction of a descriptive model, one whose components are derived entirely from the case of the Trent-Severn Waterway. To the extent that the use of the term "model" implies universality, the procedures by which this model was constructed are invalid: to generalize from a sample of one does not produce statistically reliable results.

It should be recognized by anyone who wishes to make use of this model that the case study can do no more than to generate a hypothesis. The customary and accepted progression of thought does indeed permit and even require the transition, at an early stage, from specific cases to general statements, which is what this thesis has done. The general statements, however, must be regarded as tentative ones (working hypotheses) until they are submitted to the rigours of scientific testing in <u>other</u> specific cases and thereby corroborated or invalidated. It is this very stage of thought which the study has deliberately omitted. The research is not definitive and subsequent workers should bear this in mind. The confidence that this writer has felt in proposing the descriptions herein as a model worth applying in other situations remains to be justified.

It is to be hoped that the area of study which this thesis has attempted to open up will be pursued by others with access to information on other waterways. If this does not happen, the present study will be of no value at all beyond the case of the Trent-Severn Waterway, for its conclusions will remain untested hypotheses. The proposed model needs to be taken to specific situations in a wider context and appraised in the light of factual evidence. Only then will the requirements of scientific methodology have been satisfied and the sequence completed, in going from the specific to the general and then back to the specific.