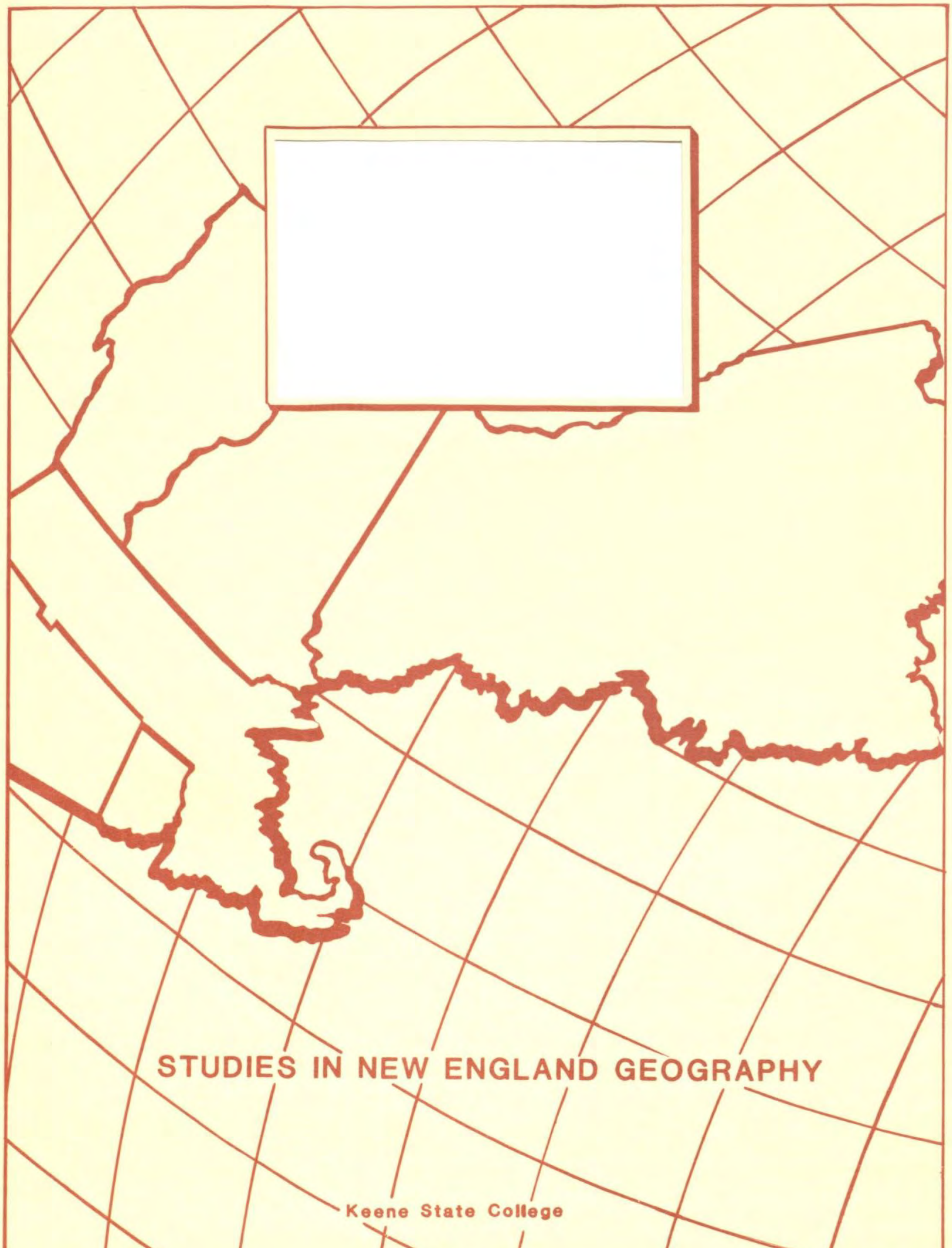

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PORT OF BOSTON CONTAINERIZATION

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ABSTRACT

To anticipate change in container flows and their effects on individual ports, it is important to identify quantitative indices which can accurately compare flow patterns on a periodic basis. It is the purpose of this study to apply three techniques: a percentage share evaluation; location quotients; and indices of concentration to measure Boston's performance relative to other United States North Atlantic ports from 1974 to 1977. Analysis results indicate that, although Boston is not the primary port of the range, it fares well regarding containerized imports and exports. The data reviewed reveal that Boston approached its maximum capacity for containerization of general cargo between 1974 and 1977.

PORT OF BOSTON CONTAINERIZATION

"Port geography is concerned essentially with what happens at the waterfront, across the frontier between land and maritime space, wherever trade is regularly carried out" (Hoyle and Hilling, 1984). This paper reviews briefly the current status of containerization at the Port of Boston and assesses Boston's comparative performance with other U.S. North Atlantic ports. It centers on containerization during its mid-years development, and examines empirical information which contributed to port expansion policy.

From a beginning in the late 1950s, containerization has grown from an innovative phenomenon to become an integral part of the modern transport system. The function of a container in maritime transport is primarily to facilitate the movement of heterogeneous goods (cargoes of different shapes, sizes, and values) with a minimum of handling. Reductions in port costs are achieved with the aid of expensive container handling equipment. An additional advantage of containerization is a potential reduction of theft and pilfering. Although the incidence of such occurrences has declined, substantial cost-savings have been negated, since when theft occurs entire units have been lost. Standardized dimensions of the maritime cargo container are 8 feet in height and width and lengths in multiples of 10 feet (Whittaker, 1972). Most containers in use are either 20 feet or 40 feet long. A major exception is the U.S.-flag operator Sea-Land's commitment to a 35-foot box (Nersesian, 1981). A 45-foot long container is gaining in popularity, and 48-foot containers are beginning to take hold in the United States (Mahoney, 1985).

Situation and various cultural factors influence the development and vitality of ports. In the case of Boston, changing modes of transportation contributed to the port's decline. Until shortly after the American Revolutionary

War, the Port of Boston was the dominant American port (Albion, 1961). With the development of a national rail system, Boston's relative importance was eclipsed and it was surpassed in importance by the Port of New York (National Research Council, 1976).

Prior to the acceptance of containerization, Boston remained the first port-of-call for westbound liner services originating in Europe. Liners are differentiated from other types of waterborne transport in that they provide service between fixed ports of call, with a regular frequency. Today many ocean carriers, in an attempt to become more efficient, no longer call at Boston. Shipping company modernization efforts generally encourage the selective elimination of unprofitable port calls to decrease total voyage turnaround time. Reductions are facilitated through a policy of absorption pricing. In such instances, irrespective of the port to which the cargo is shipped, the shipper is charged an inland transport fee equivalent to the cost of movement through the nearest traditional port (Pearson and Fossey, 1983). To further exacerbate Boston's competitive position, increased investments and implementation of modernization programs at Canadian maritime facilities to the north -- principally at Montreal, Halifax, St. John's and Saint John -- have diverted traffic which formerly flowed through Boston.

Boston's public involvement in containerization began in July of 1971 with the opening of the 25 million dollar, 45-acre Moran Terminal, in Charlestown (Cellineri, 1976). After almost a three year delay, due to management and labor disagreements, a second major intermodal facility became operational, at Castle Island, in April 1984 (see Figure 1). The opening of Conley Terminal created an aura of optimism exemplified in a statement made by the Maritime Director of Massport. Aylward (1984) stated that "the port now has modern, accessible container terminals, stable labor-management relations, extensive

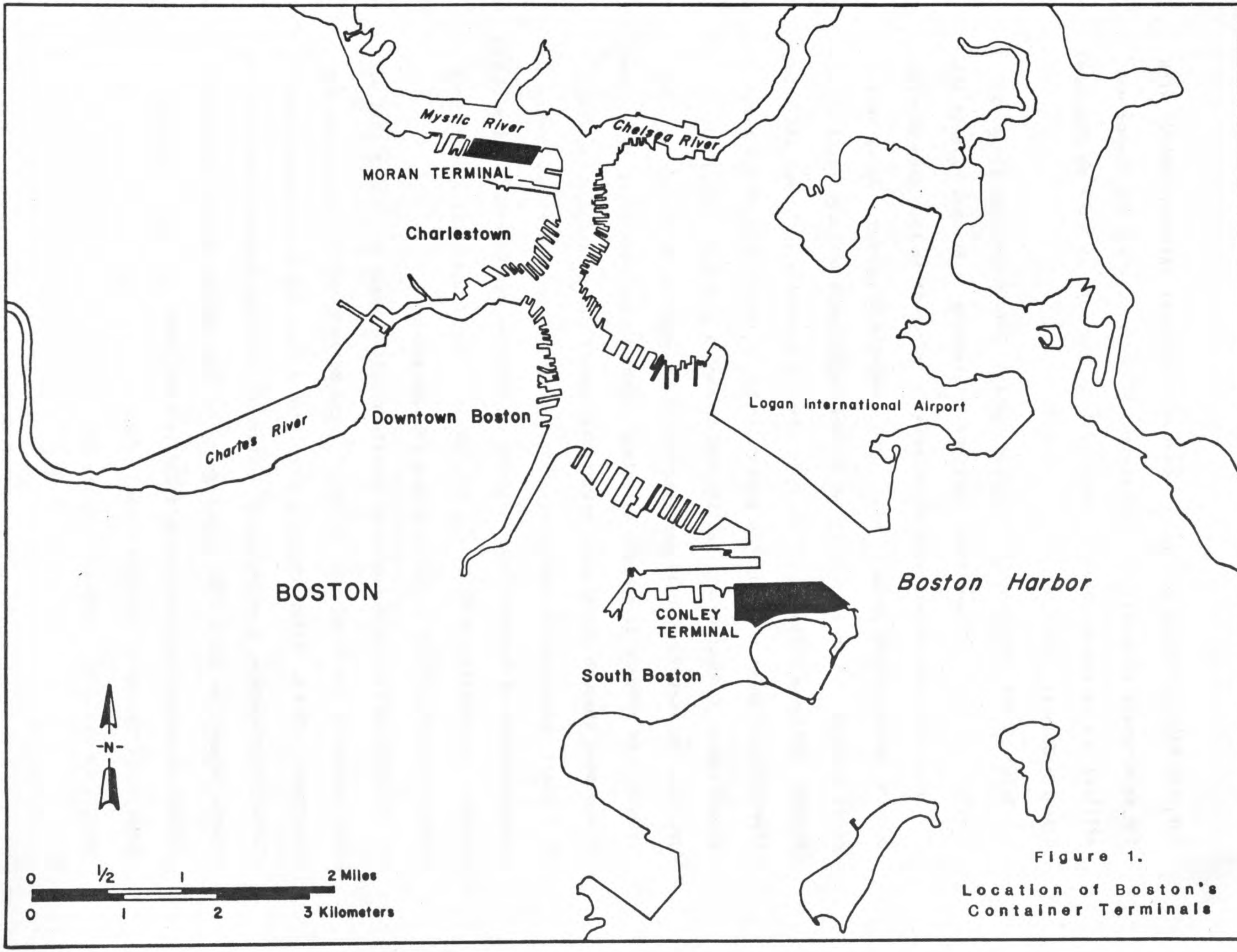

Figure 1.

Location of Boston's Container Terminals and frequent steamship service, and a regional market which ships the most valuable seaport cargo in the nation." "High tech" or advanced technology companies located in Boston's hinterland -- such as Wang, Data General, GenRad, and Teradyne -- provide the nucleus for high dollar value exports, while an immediate domestic market amounting to four million people, which is seventh highest in the United States, is highly favorable for imports (Cowan, 1985).

To anticipate change in container flows and their effects on individual ports, it is important to identify quantitative techniques which can accurately compare flow patterns on a periodic basis. Variability in maritime cargo flows may affect a port authority's planning decisions regarding expansion to enhance its port capacity. If investment capital is to be provided for expansion, then a port should expect to attract increasing amounts of cargo. An alternative to *a priori* expansion is to wait for cargo throughput to reach or exceed port capacity, thereby justifying investment. Unfortunately, if the latter option is chosen, it imposes a time-lag differential between the planning and operational stage (Bird, 1971), and a port may lose cargo to neighboring ports rather than gain at their expense.

Data, Assumptions, and Methodology

A compilation of data from two primary sources measures Boston's growth in containerization relative to other ports in the U.S. North Atlantic Range (see Figure 2). International containerized statistics are extracted from unpublished U.S. Maritime Administration (MARAD) reports for 1974 and 1977 (U.S. Department of Commerce, 1974 and 1977). Particulars concerning all commodity movements, whether containerized or not, are gained from *Waterborne Commerce of the United States* (U.S. Army, Corps of Engineers, 1975 and 1978).

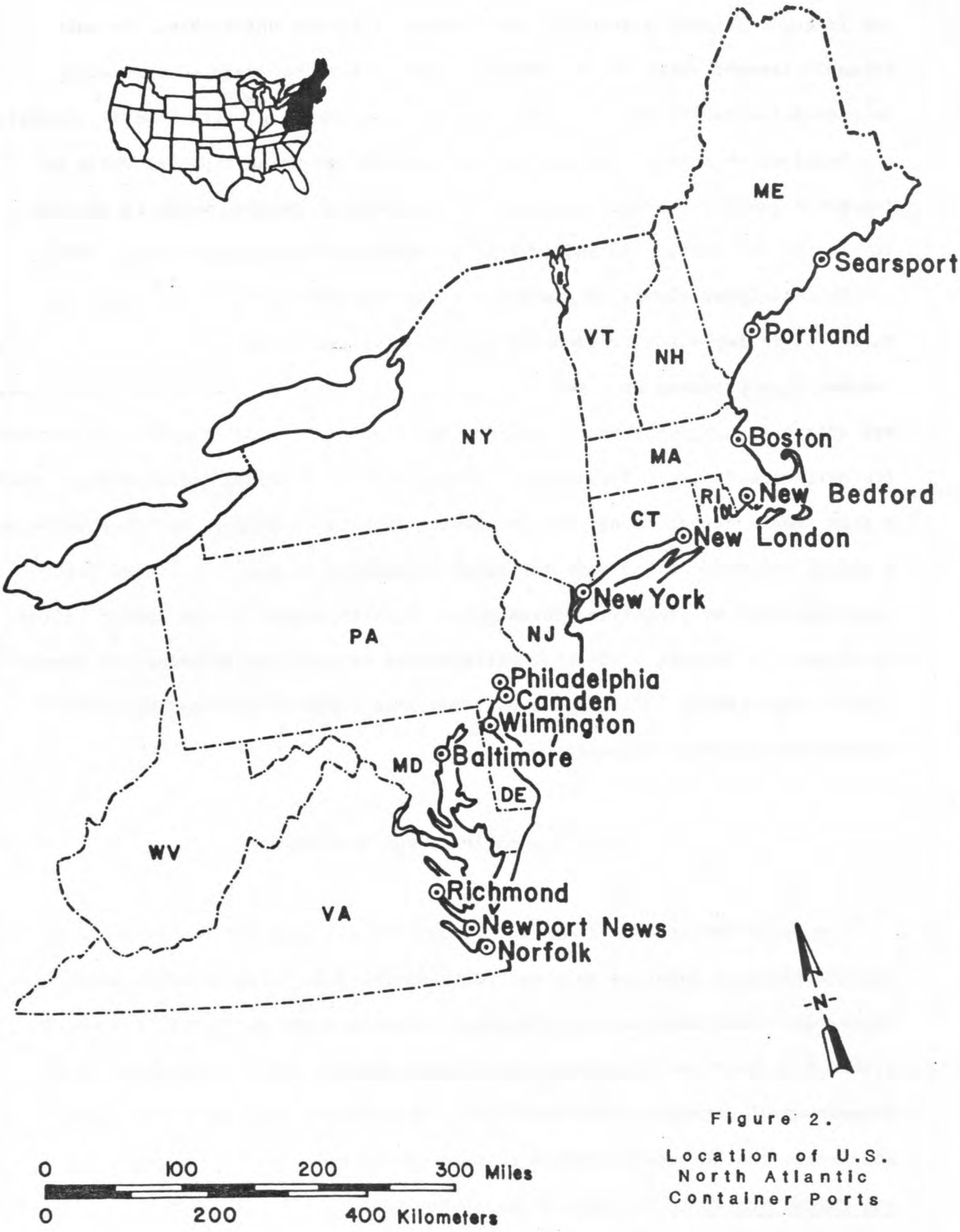

Figure 2.

Location of U.S. North Atlantic Container Ports

Tonnage units of each data set differs, with the Department of Commerce reports in short tons of 2,000 lbs., while the Department of the Army reports long tons of 2,240 lbs. To make the statistics comparable, a conversion factor of 1.12 is applied to short tonnage. Additionally, a determination of the total cargo volume moved through the range, during 1977, is complicated by the fact that commerce was interrupted from October 1 to November 29, due to a contractual dispute between stevedores and steamship lines (New York Times, Nov. 30, 1977, p. 1). Therefore, an adjustment upwards by twenty percent is employed to keep the data in a format permitting comparison with data for the prior study year.

One final data modification or assumption is required before describing this paper's methodology. The seven major bulk commodities, oil, iron ore, manganese ore, coal, grains, bauxite, and phosphates, as defined by Lawrence (1972, pp. 144-149), as well as the lesser bulk commodities, as defined by Frankel and Marcus (1973, p. 187), are eliminated from the category of possible containerizable cargo, since such cargoes normally move in bulk shipments. After this final adjustment, actual and potentially containerizable movements are compared.

The methodology utilized here for comparisons first express change in absolute terms of tonnage moved and the port's percentage share. Later, these values are needed to calculate location quotients (LQs) for containerized tonnage, and to determine the index of concentration of the same cargo over a four year period.

Location quotients are computed in the following manner suggested by Britton (1965):

$$LQ = \frac{\frac{V_{cp}}{V_{gp}}}{\frac{V_{cr}}{V_{gr}}}$$

where: V_{cp} - represents the volume of containerized cargo moved through the port during the study year;

V_{gp} - represents the volume of all general cargo moved through the port during the study year;

V_{cr} - represents the volume of containerized cargo moved through the range during the study year; and

V_{gr} - represents the volume of all general cargo moved through the range during the study year.

Location quotients are calculated using both tonnage of containerized imports and exports and tonnage of container-suited imports and exports that moved through the port and the range. An LQ equal to one indicates that the port handled containerized cargo in the same proportion to other general cargoes as did the rest of the port range. An LQ greater than or less than one indicates that containerized cargo is respectively more or less important to the port than it is to the range.

The index of concentration of containerized cargo is dependent upon the following hypothetical tonnage formula, suggested by Rimmer (1967):

$$PV_h = PV_i \frac{RV_t}{RV_i}$$

where: PV_h - represents the port volume to be expected in the terminal study year;

PV_i - represents the port volume in the initial year;

RV_t - represents the range volume in the terminal year; and

RV_i - represents the range volume in the initial year.

The hypothetical volume for the port is calculated using the tonnage of containerized imports and exports that moved through the port and the range during the two study years. A comparison of hypothetical and actual volume for the port indicates the absolute differences in the rates of growth of containerized cargo at Boston and for the entire range.

Analysis

An examination of the range containerized traffic (Table 1) yields a clear picture of the Port of New York/New Jersey's dominant position. New York handled almost 66 percent of the range containerized cargo in 1974, and over 62 percent in 1977. In contrast, Boston handled a mere 2.6 percent of the range total in 1974 and increased throughput by only 0.5 percent by 1977. Nevertheless, based on absolute tonnage values, Boston was the fifth most important U.S. North Atlantic container port in both years. Furthermore, Boston experienced an absolute gain of 126,733 tons -- 87,755 in imports and 39,108 in exports -- over the four year period.

Table 2 indicates the tonnages of general or non-bulk cargoes that could have been containerized at individual ports in the U.S. North Atlantic Port Range in 1974 and 1977. It reveals that total general cargo tonnage which could have been containerized increased; although, export tonnage actually decreased. By comparing containerized and containerizable tonnage, it can be seen that the percentage of unitized general cargo that moved through the range grew at a moderate rate, accounting for 52 percent in 1974 to over 84 percent in 1977. Most of the increase was attributable to over 95 percent of Boston's general cargo exports being containerized in 1977.

Table 1 U.S. North Atlantic Port Range Containerized Tonnage, 1974 and 1977

Port	1974 Imports	1974 Exports	1974 Total	1977 Imports	1977 Exports	1977 Total
Boston, MA	184,842	121,373	306,215	272,597	160,391	432,988
Searsport, ME		313	311	1,042		1,042
Portland, ME	692	2,731	3,423	3,031	1,230	4,261
New Bedford, MA	19		19			
New London, CT				480		480
New York*	4,326,545	3,279,030	7,605,575	5,816,270	3,035,786	8,852,056
Camden, NJ				289	199	488
Philadelphia, PA	317,649	276,249	593,898	490,336	299,440	789,776
Wilmington, DE	7,024	5,792	12,816	3,308		3,308
Baltimore, MD	716,556	738,765	1,455,321	1,008,958	1,184,273	2,193,231
Norfolk, VA	565,708	986,518	1,552,226	652,780	1,212,702	1,865,482
Newport News, VA	6,375	21,587	27,962	2,354	13,739	16,093
Richmond, VA	1,300	16,095	17,395	31,879	30,024	61,903
TOTAL	6,126,710	5,448,453	11,575,163	8,283,324	5,937,784	14,221,108

SOURCE: Department of Commerce, 1974 Marad Containerized Foreign Trade Data, (unpublished report) and 1977 Marad Containerized Foreign Trade Data, (unpublished report).

*Includes traffic at New Jersey facilities also.

Table 2 U.S. North Atlantic Port Range Containerizable Tonnage, 1974 and 1977

Port	1974 Imports	1974 Exports	1974 Total	1977 Imports	1977 Exports	1977 Total
Boston, MA	319,529	175,435	494,964	344,268	168,648	512,916
Searsport, ME		10,250	10,250	34,424		34,424
Portland, ME	7,645		7,645	10,854	8,959	
New London, CT			0	81,754		81,754
New York*	6,559,432	4,451,752	11,011,184	7,960,726	3,999,466	11,960,192
Camden, NJ			0	670,417	34,920	705,337
Philadelphia, PA	1,294,796	1,024,420	2,319,216	2,104,015	732,142	2,836,157
Wilmington, DE	341,151	9,574	350,725	383,945		383,945
Baltimore, MD	2,098,744	2,199,020	4,297,764	2,723,426	1,798,066	4,521,492
Norfolk, VA	1,448,970	1,758,262	3,297,232	2,089,960	1,539,125	3,629,085
Newport News, VA	69,179	208,202	277,381	67,840	181,034	248,874
Richmond, VA	56,289	306,592	362,881	74,622	303,366	377,988
TOTAL	12,195,735	10,143,507	22,339,242	16,546,251	8,765,726	25,311,977

SOURCE: U.S. Army, Corps of Engineers, Waterborne Commerce of the United States, 1974 and 1977.

*Includes traffic at New Jersey facilities also.

Further inquiry along the above lines, specific to Boston, progressed quite naturally to the application of geographic location quotients. Containerization location quotients can be described as comparisons of percentages of incidence of a given phenomena -- acceptance of containerization at Boston -- in relation to acceptance throughout the entire port range. Boston suffered an imbalanced flow of containers biased inbound. Yet the percentage of general cargo moving through the port in containers was relatively high in 1974, and increased markedly by 1977, when Boston led all ports in the range. All location quotients for Boston exceed 1.0 (Table 3). This indicates that containerized shipments are consistently more important to the port than to the range. Boston, in fact, is the only port in the range which containerization is uniformly more important to an individual port compared to all ports.

Table 3 Location Quotients for Boston, 1974 and 1977

1974		1977	
Imports	Exports	Imports	Exports
1.27	1.32	1.58	1.40

The statistics pertaining to Boston's index of concentration are shown in Table 4. Based upon an assumption that individual port flows vary as the range flow average, Boston, once again fared well. It handled 22,691 import tons (9.1%) more than expected, and 28,094 export tons (21.2%) more than expected. Thus, again it can be seen that, although containerized import movements exceeded exports, growth in total general cargo exports grew at a faster rate than did imports.

Table 4 Index of Concentration for Boston, 1977

Hypothetical(h)	Actual(a)	Difference(d)	Index(d/h)
Imports			
249,906	272,597	22,691	0.091
Exports			
132,297	160,391	28,094	0.212

CONCLUSIONS

With the opening of the Conley Terminal, the Port of Boston authorities believe that the port entered a new era in which it will be in a better position to attract containerized cargoes. However, a complex mix of endogenous and exogenous factors will ultimately influence whether success is achieved.

This study addresses the changing geographic concept of 'situation' and its impact on the developmental process at Boston. The study also illustrates that each port's circumstance must be studied in comparison to competing ports.

Three techniques: (1) a percentage share evaluation; (2) location quotients; and (3) indices of concentration, are applied to measure Boston's performance relative to other United States North Atlantic ports from 1974 to 1977. The results of the analysis indicate that, although it is not the primary port of the range, Boston fares well regarding containerized imports and exports. Indeed, the statistics reviewed reveal that Boston approached its maximum capacity for containerization of general cargo during the period 1974 to 1977.

Boston's present strengths include its gateway status to the New England Market (12.5 million in population), and a realization that the port cannot hope to become a major load center for mainline containerships. Current marketing efforts are directed toward attracting new European business, while developing a role as a feederport (Containerization International, 1984). If international containerized traffic continues to grow, the decision to construct and operate additional port facilities at Boston was prudent if the port can capture containerized cargoes which would otherwise flow through other range ports.

REFERENCES

Albion, R. (1961), The Rise of New York Port (Archon Books, Hamden, CN).

Aylward, A. (1984), 'Boston: A New View,' WWS/World Ports, 47:3, 43.

Bird, J. (1971), Seaports and Seaport Terminals (Hutchinson University Library, London).

Britton, J. (1965), 'The External Relations of Seaports,' Tijdschrift Voor Economische En Sociale Geographie, 56, 109-112.

Cellineri, L. (1976), Seaport Dynamics (D.C. Heath & Co., Lexington, MA).

Containerization International (1984), 'Boston Beats the Drum," 18:7, 27.

Cowan, W. (1985), 'Boston: Low Volume but High Dollar Value,' WWS World Wide Shipping, 48:3, 67-72.

Frankel, E. and Marcus, H. (1973), Ocean Transportation (MIT Press, Cambridge, MA).

Hoyle, B. and Hilling, D. (eds.) (1984), Seaport Systems and Spatial Change (John Wiley & Sons, Chichester).

Lawrence, S. (1972), International Sea Transport: The Years Ahead (D.C. Heath & Co., Lexington, MA).

Mahoney, J. (1985), Intermodal Freight Transportation (Eno Foundation for Transport, Westport).

National Research Council (1976), Port Development in the United States (National Academy of Sciences, Washington, D.C.).

Nersesian, R. (1981), Ships and Shipping (Penn Well Books, Tulsa).

New York Times (1977), 'Agreement in New York', November 30, 1:2.

Pearson, R. and Fossey, J. (1983), World Deep-Sea Container Shipping (Gower Publishing Co., Hants).

Rimmer, P. (1967), 'Recent Changes in the Status of Seaports in the New Zealand Coastal Trade,' Economic Geography, 43:3, 231-243.

U.S. Army Corps of Engineers (1975), Waterborne Commerce of the United States, Calendar Year 1977.

Wittaker, J. (1975), Containerization (Hemisphere Publishing Corp., Washington, D.C.).