



# PHOTOGRAMMETRIC ANALYSIS OF COASTAL EROSION AND BARRIER MIGRATION NEAR CHEZZETCOOK INLET, EASTERN SHORE, NOVA SCOTIA

Geological Survey of Canada Open File 3027

Bob Covill<sup>1</sup>, Donald L. Forbes<sup>2</sup>, Robert B. Taylor<sup>2</sup> and John Shaw<sup>2</sup>

<sup>1</sup> Tekmap Consulting Company, P.O. Box 2016, Fall River, N.S. B2T 1K6

<sup>2</sup> Atlantic Geoscience Centre, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, N.S. B2Y 4A2

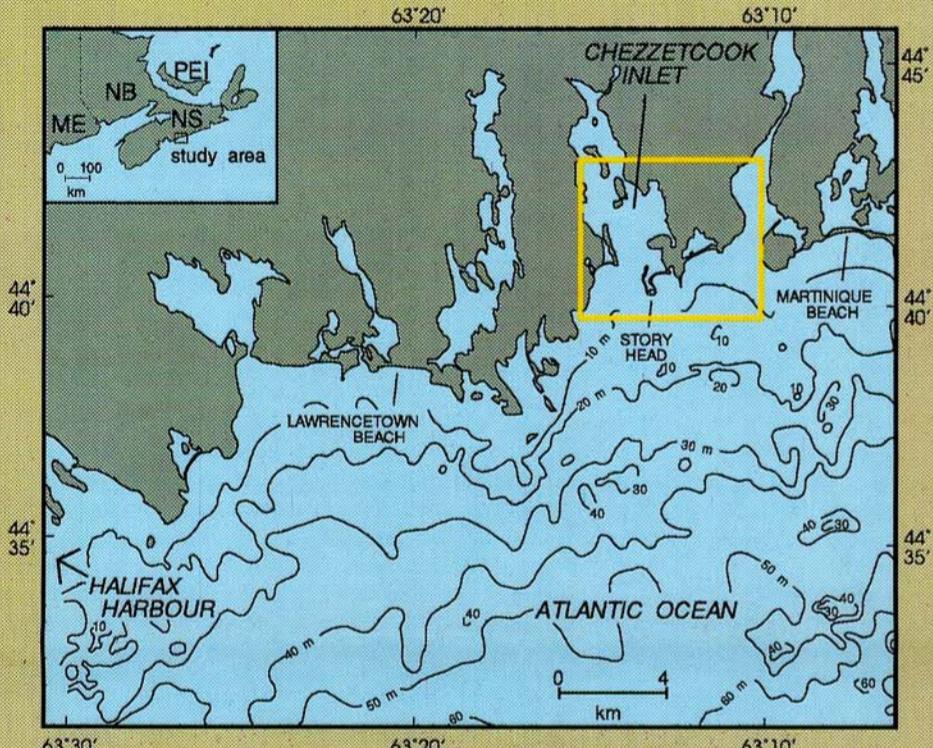


FIGURE 1:  
Study area (yellow box) on the Eastern Shore of Nova Scotia.

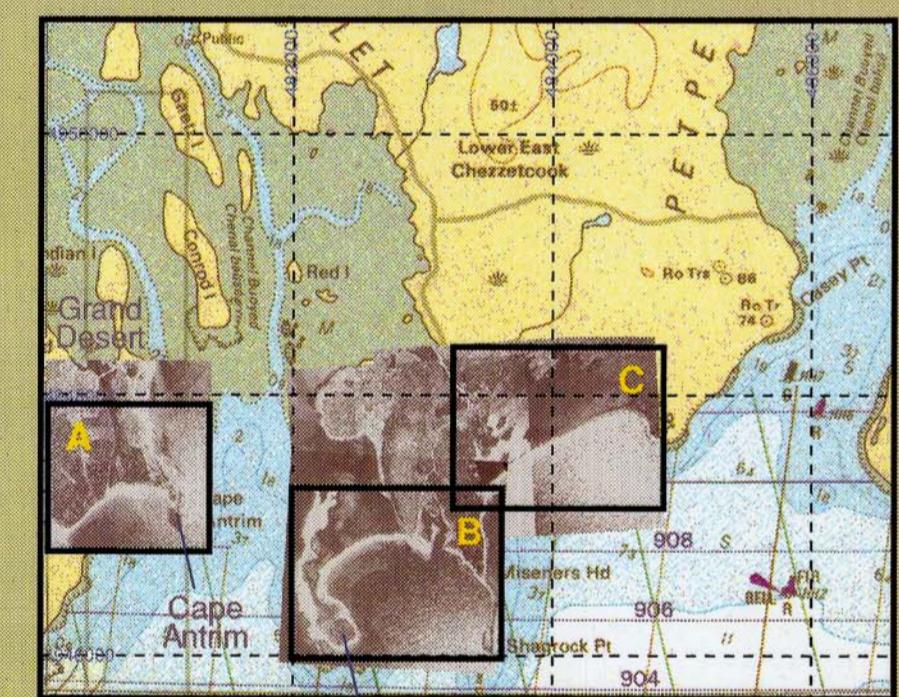


FIGURE 2:  
Location of detailed study sites (letters in yellow refer to panels above right). UTM coordinates (NAD27) on a 2000 m grid. 1992 aerial photography superimposed on the 1987 hydrographic chart (CHS 4236). Apparent misalignment of the shoreline at Grand Desert is the result of erosion between 1987 and 1992.

The Atlantic coast of Nova Scotia east of Halifax (known locally as the Eastern Shore) is dominated by glacial drumlin headlands, sand and gravel beaches and barriers, and shallow backbarrier estuaries and marshes. Bathymetric charts dating from the late 1700s and air photographs from 1933 to 1992 show that the coast in this area has undergone many changes, with some of the most rapid adjustments during the past few decades (Taylor et al., 1985; Boyd et al., 1987; Carter et al., 1990; Orford et al., 1992; Forbes et al., 1991, 1995). This poster presents a photogrammetric analysis of coastal changes at headlands and barriers flanking the entrance to Chezzetcook Inlet.

Air photographs for each of the years indicated in the legend were digitized and rectified to a common UTM grid using the public-domain image-analysis and GIS package GRASS (Covill, 1994). The top and base of cliffs and the seaward and landward shores of the barriers were digitized to produce vector files, which are superimposed on the 1992 photographs in Figures 1 to 3 above. Measurements of the distance between cliff-top and beachface shoreline vectors on shore-normal transects for each year of available photography provided data on the rate of barrier migration (Table 1) and cliff recession (Table 2).

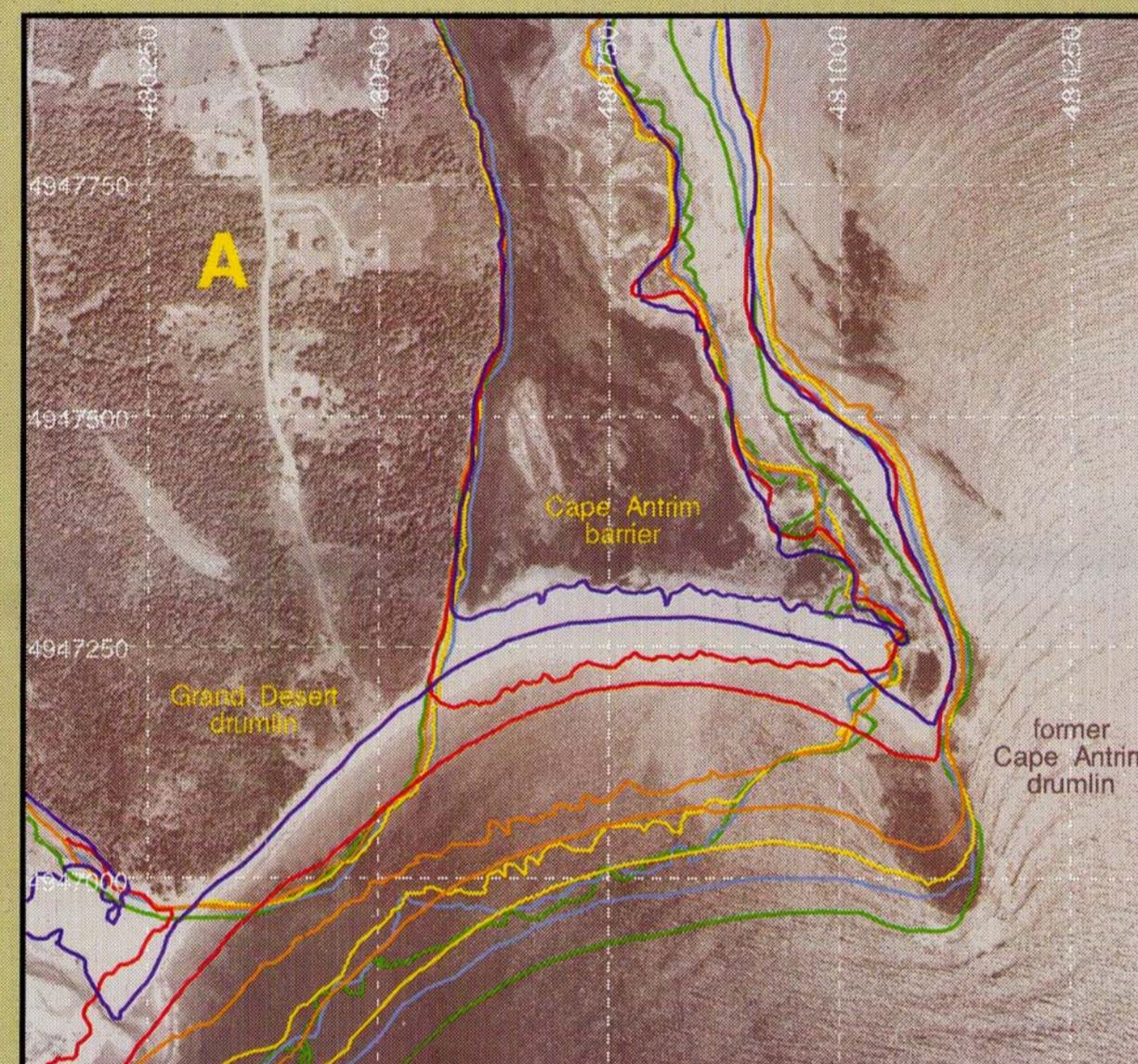


FIGURE 3:  
Grand Desert drumlin and Cape Antrim barrier. Shoreline positions from rectified air photos (1933 to 1992).

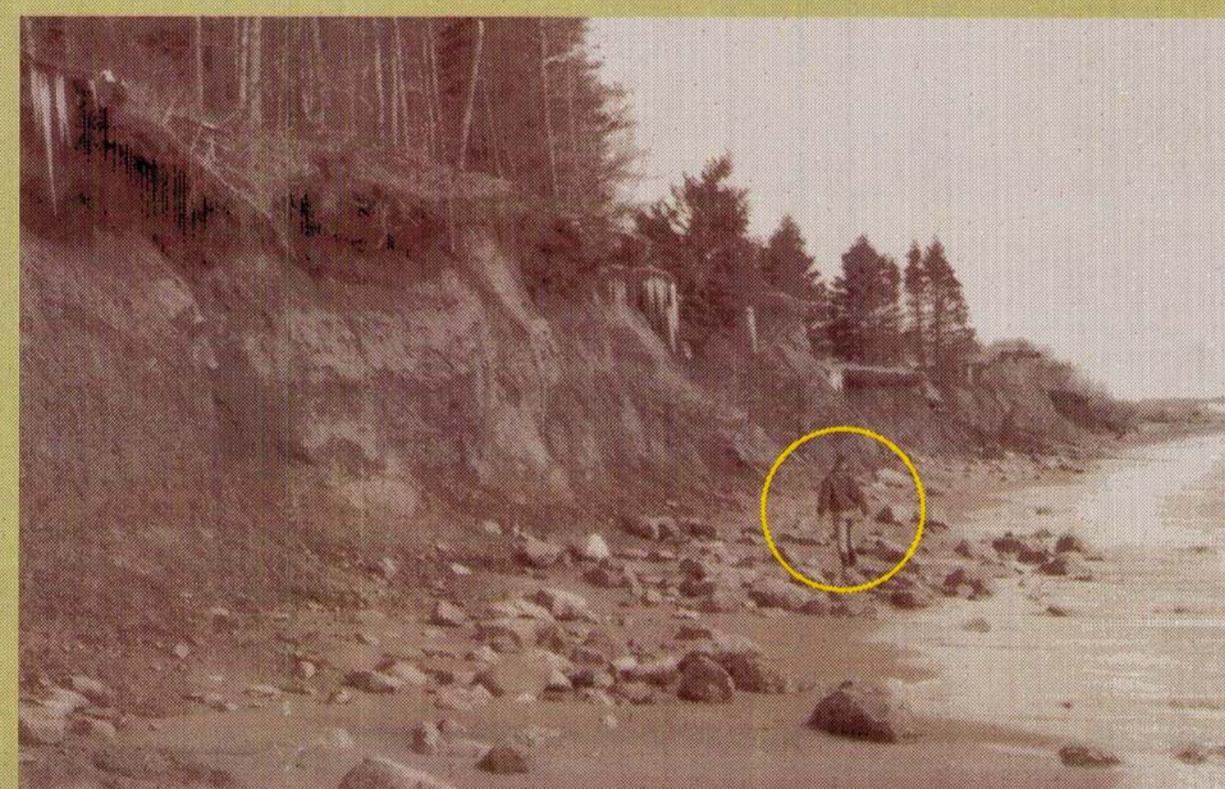


FIGURE 4:  
Looking east along central part of Grand Desert drumlin (19 March 1992). Cliff face is about 8 m high (person circled for scale).

CAPE ANTRIM BARRIER. <i>n</i> = 7		STORY HEAD BARRIER. <i>n</i> = 6	
Interval	Retreat Rate (m/a)	Interval	Retreat Rate (m/a)
1933 to 1954	1.81 ± 0.06	1954 to 1966	2.18 ± 0.26
1954 to 1966	6.41 ± 0.44	1966 to 1974	10.72 ± 0.53
1966 to 1973	14.08 ± 0.71	1974 to 1982	7.22 ± 0.37
1973 to 1982	6.11 ± 0.46	1982 to 1992	3.82 ± 0.22

TABLE 1:  
Rate of retreat of beachface high water line on barriers at Cape Antrim and Story Head (mean and standard error in m/year, *n* is number of transects). 1933 photography available only at Cape Antrim.

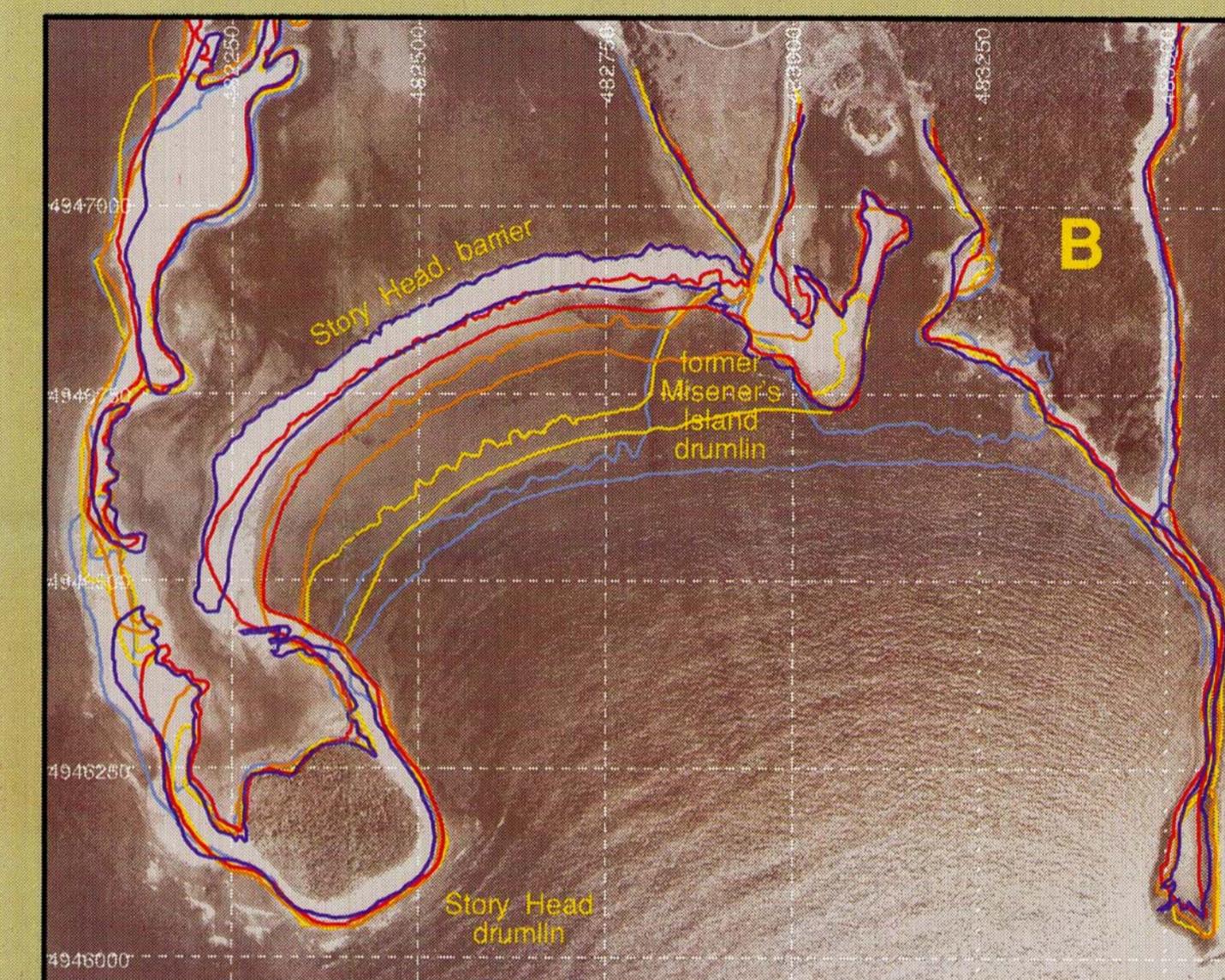


FIGURE 5:  
Story Head drumlin headland and barrier and now-vanished Misener's Island drumlin. Shoreline positions from rectified air photos (1954 to 1992).



FIGURE 6:  
Washover on Story Head barrier during passage of tropical storm Gloria (September 1985). Looking east along the barrier backslope, showing landward flow moving sediment over the crest and down a washover channel toward the back of the barrier. Circle marks 3 m wave staff at line 10.

GRAND DESERT DRUMLIN. <i>n</i> = 4		CAPE ANTRIM DRUMLIN. <i>n</i> = 3	
Interval	Retreat Rate (m/a)	Interval	Retreat Rate (m/a)
1933 to 1954	0.00 (protected)	1933 to 1954	0.75 ± 0.19
1954 to 1966	0.00 (protected)	1954 to 1966	2.01 ± 0.31
1966 to 1973	0.00 (protected)	1966 to 1973	6.20 ± 0.56
1973 to 1982	2.74 ± 0.77	1973 to 1982 (n=1)	12.70
1982 to 1992	3.04 ± 0.83	1982 to 1992	N.A.

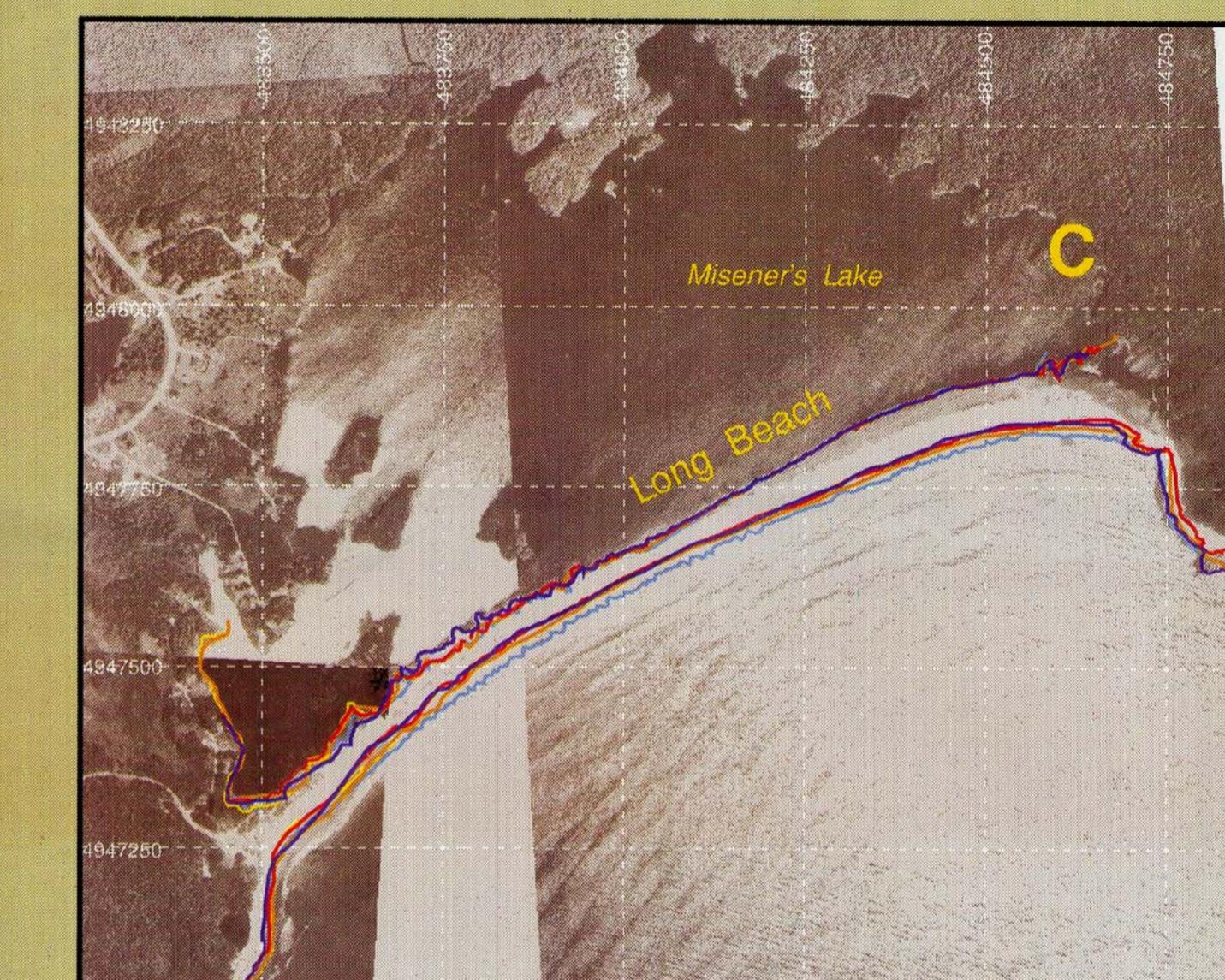


FIGURE 7:  
Long Beach barrier showing seaward and landward shoreline positions from rectified air photographs (1954 to 1992).

LEGEND	
UTM coordinates	
1992 air photos	
1933.	
1954.	
1964. <sup>1</sup>	
1974. <sup>2</sup>	
1982.	
1992.	
1966 at Cape Antrim	
1973 at Cape Antrim	

Cases illustrated here include the start of cliff erosion at Grand Desert as the barrier migrated back against a previously protected drumlin slope (Figures 3 and 4) and the complete disappearance of a drumlin headland at Misener's Island (Figure 5), in contrast to the relatively stable cliff fronted by a broad boulder shoal at the Story Head drumlin remnant (Figure 5). The associated gravel barriers at Cape Antrim and Story Head have migrated rapidly landward (Table 1) by overwashing (Figure 6) in response to changes in barrier morphodynamics, sediment supply, sea level and wave climate. However, the nearby high gravel barrier at Long Beach has remained relatively stable (Figure 7), growing slowly higher and narrower with minor wave overwashing and overtopping (Forbes et al., 1995).

## REFERENCES

- Boyd, R., Bowen, A.J. and Hall, R.K. 1987. An evolutionary model for transgressive sedimentation on the Eastern Shore of Nova Scotia. In: Glaciated coasts (FitzGerald, D.M. and Rosen, P.S., editors). San Diego, Academic Press, 87-114.
- Carter, R.W.G., Orford, J.D., Forbes, D.L. and Taylor, R.B. 1990. Morphodynamic development of drumlin-flank barriers in a zone of rapidly rising sea level, Story Head, Nova Scotia. *Sedimentary Geology*, 69, 117-138.
- Covill, B. 1994. Analysis of coastal changes using GRASS: Grand Desert and Story Head. Unpublished contract report to Atlantic Geoscience Centre, Dartmouth, 28 p.
- Forbes, D.L. and Syvitski, J.P.M. 1995. Paraglacial coasts. In: Coastal evolution: Late Quaternary shoreline morphodynamics (Carter, R.W.G. and Woodroffe, C.D., editors). Cambridge, Cambridge University Press, 373-424.
- Forbes, D.L., Taylor, R.B., Orford, J.D., Carter, R.W.G. and Shaw, J. 1991. Gravel barrier migration and overstepping. *Marine Geology*, 97, 305-313.
- Forbes, D.L., Orford, J.D., Carter, R.W.G., Shaw, J. and Jennings, S.C. 1995. Morphodynamic evolution, self-organisation, and instability of coarse-clastic barriers on paraglacial coasts. *Marine Geology* (in press).
- Orford, J.D., Hinton, A.C., Carter, R.W.G. and Jennings, S.C. 1992. A tidal link between sea-level rise and coastal response of a gravel-dominated barrier in Nova Scotia. In: Sea level changes: determination and effects. American Geophysical Union, Geophysical Monograph 69, 71-79.
- Shaw, J., Taylor, R.B. and Forbes, D.L. 1993. Impact of the Holocene transgression on the Atlantic coastline of Nova Scotia. *Géographie physique et Quaternaire*, 47, 221-238.
- Taylor, R.B., Wittmann, S.L., Milne, S.J. and Kober, S.M. 1985. Beach morphology and coastal changes at selected sites, mainland Nova Scotia. Geological Survey of Canada, Paper 85-12, 59 p.

This document was produced by scanning the original publication. Ce document est le produit d'une numérisation par balayage de la publication originale.

1995