

DISCOVERING ROCKS OFF LABRADOR: A Photo Essay

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INTRODUCTION

Canada was one of the more active members of the Third United Nations Conference on the Law of the Sea held at Geneva, New York and Caracas during the 1970s and early 1980s. Slowly States ratified the Convention, and in November 1994, the United Nations Convention on the Law of the Sea came into force. Canada has some 10,000km of coastal perimeter and has much at stake since many of its resources, living and non-living, are located in or under the sea. However, much of this coast is rarely seen and its precise location and details of its features are poorly understood.

HISTORY

In 1964, Canada passed the *Territorial Sea and Fishing Zones Act* that provided for the use of straight baselines. In 1967, *Order in Council, P.C. 1967-2025* defined the specific points for the straight baselines of Labrador and Newfoundland, also listed some low-tide elevations and discrete islands. The territorial sea baselines for southern Canada are now defined in *Consolidated Regulations of Canada, 1978, chapter 1550*, commonly abbreviated: *CRC, 1978, c. 1550*. The baselines, low water line segments and individual rocks and islets in Arctic Canada were explicitly defined in domestic law by an Order in Council issued in 1986. Except for the changes caused by the *Canada/France arbitration* in 1992, there has been no further change to Canada's territorial sea.

THE NEED TO REDEFINE

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In the Orders in Council, the turning points of the straight baselines of the territorial sea are listed with: a geographic name, a geographic position, and a referenced chart. The Canadian Hydrographic Service (CHS) interprets the turning point to be that physical feature, which can be found on that specific chart at that specific location. On other charts and maps, that same feature may be at a different location; yet it is the physical feature that is being described. It does not need a 'rocket science' degree to look at some of Canada's nautical charts and to realise that the coast has been poorly surveyed. Indeed there are several areas where there is a suspicion that the nautical chart omits rocks and islets that could influence the location of the territorial sea baseline (either the normal or straight line versions). The results in just one locality follows.

ISLANDS FOUND AND NOT FOUND

Canada, quite literally, is still discovering its coastal extent. The Labrador coast is a case in point. Any shipping along the coast either stays well offshore or stays in the protected waters behind the fringe of islands and reefs. That fringe is laced with rock pinnacles that give little warning of their existence on the sounder, and the navigation systems, until the advent of GPS, did not provide adequate positioning. The area outside the fringe is ice-covered or thickly strewn with icebergs, bergy bits, growlers, etc. It is a true application of the Norwegian word for "fringe of reefs" or "rock rampart" – *skjærgård*. Other meanings include "collection of reefs and small islands", or "archipelago." Mariners prefer not to enter that fringe area. Without the traffic, there is no need to chart; and without charts, no mariner is going to venture.

Unfortunately, the need to define Canada's territorial sea baselines demands that these areas be examined. Until recently, old charts have provided the only source. They have included individual, weakly positioned, lines of track soundings, reports of breakers, rocks and islands so that the charts are speckled with: "Reported", "Existence Doubtful" (E.D.), "Position Doubtful" (P.D.), "Position Approximate" (P.A.).

A joint project undertaken by CHS and Topographic Survey of Canada in 1976 discovered possible islands along the Labrador coast and provided some speculation

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that charted rocks might not be there. Later, field surveys proved the existence of several islands and some low-tide elevations as were suspected. They also confirmed the non-existence of several charted features, including one island that was being used as a turning point in the straight baselines (LeLievre and Fleming, 1977). One of the found islands has been officially named “*Landsat Island*” to honour the discovery method.

This sort of work was reinstated, under contract to Garry Hunter and Associates, to investigate three possible areas along the Labrador and Baffin Island coasts. Satellite imagery of various types as well as conventional airphotos were examined. The next stage was to carry out a hydrographic survey to positively identify these features and determine their heights. Such an opportunity presented itself in the summer of 1997, when the author searched for, examined, photographed and positioned over 40 rocks and islets along the northern Labrador coast using the helicopter from CCGS *Pierre Radisson*. It is the author’s opinion that the straight baselines should be changed and many low-tide elevations added to the definition of the territorial sea baselines. The other areas of Hunter’s contract still require field verification.

SATELLITE IMAGERY

Because satellite imagery is recorded digitally as the response in various segments of the radio spectrum, ice and rock have different response signatures. These signatures can be used to identify features as rock or ice. However, this is not fool-proof since rocks can be ice covered and ice can be covered by gravel picked up when an iceberg grounded and has subsequently rolled over.

Another test can be the use of images taken on different days or years since the rocks and islands will remain in the same place while the ice will likely have moved. Again this is not fool-proof since it has been reported that a certain harbour entrance in the Baffin Island area has been totally blocked by a grounded iceberg for several years, thus denying the once per year delivery of provisions by ship.

Given the frequency that satellites overfly parts of the world, one would think that there would be plenty of opportunity to obtain hundreds of good images. This is not the case since clouds cover much of Labrador in summer, during the winters the sea is all ice-covered, the blue part of the visible spectrum is very susceptible to haze, and having breaking waves is better than a calm sea. Thus, there are few occasions when there are waves breaking, no clouds and no ice. Also, the cost of satellite images is currently horrendously expensive.

The capability to detect anything is obviously in proportion to its physical size. An object less than one pixel size will likely go undetected, something the size of one or two pixels may well be missed and it may take an object the size of several pixels before identification is guaranteed. In 1976, Landsat Island was discovered by satellite imagery and hydrographic surveys in 1976 determined that it measured 45 by 25 metres. This gives some idea what is capable through satellite imagery.

CONCLUSION

This paper has endeavoured to provide the history behind Canada’s territorial sea baselines that are in existence and to provide some insight into the work in re-examining them. Particular effort in that re-examination has been expended in: 1) the identification of the physical feature in hydrographic surveys, airphotos, satellite and other sources of imagery, 2) the correct position with respect to the most common horizontal datum in use in Canada; namely, the North American Datum 1983, or NAD 83 (which is equivalent to WGS 84).

Acknowledgements

The author wishes to acknowledge the assistance of the Captain, officers, crew and particularly the helicopter pilot of the CCGS *Pierre Radisson* in the fruitful field verification program carried out in 1997 along the Labrador coast. Similar field verification programs are needed elsewhere in Canada to define the most seaward points of land.

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Disclaimer

The views expressed in this paper are not necessarily those of the Department of Fisheries and Oceans or of the Government of Canada.

References

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(1993) *A Manual on the Technical Aspects of the United Nations Convention of the Law of the Sea – 1982*, Special Publication No. 51, 3rd Edition, International Hydrographic Bureau, Monaco.

LeLievre, D.D., and E.A. Fleming, (1977) The use of LANDSAT Imagery to Locate Uncharted Coastal Features, *Proceedings of the 16th Annual Canadian Hydrographic Conference*.

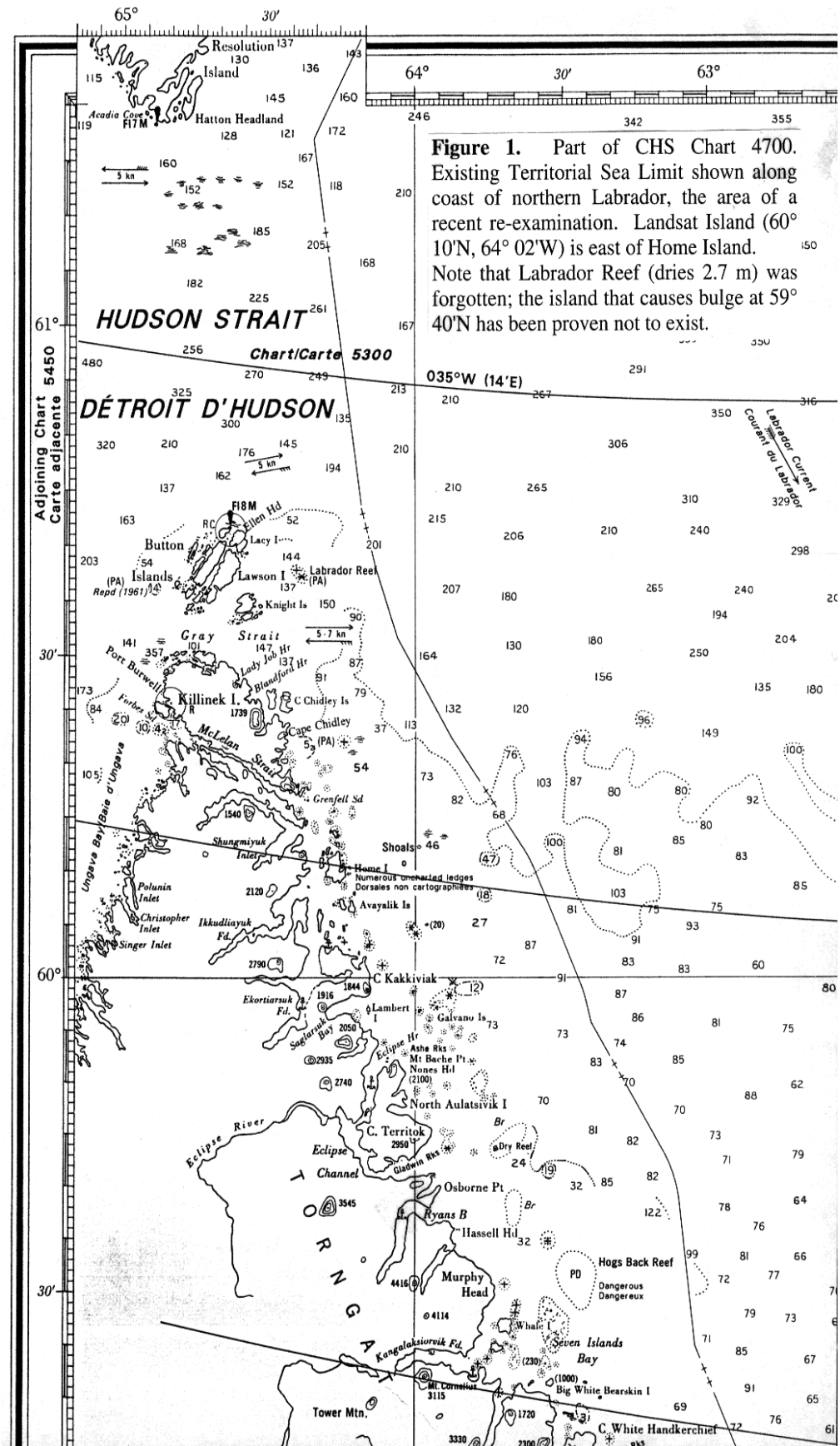


Figure 1. Part of CHS Chart 4700. Existing Territorial Sea Limit shown along coast of northern Labrador, the area of a recent re-examination. Landsat Island (60° 10'N, 64° 02'W) is east of Home Island. Note that Labrador Reef (dries 2.7 m) was forgotten; the island that causes bulge at 59° 40'N has been proven not to exist.



Figure 2. Unnamed rock east of Big White Bearskin Island ($59^{\circ} 21' 54''\text{N}$, $63^{\circ} 25' 22''\text{W}$) as photographed and positioned by GPS in 1997. In 1973, this rock was also positioned by angles and distances of an electronic distance measurement traverse. It is 1.1m above high water.

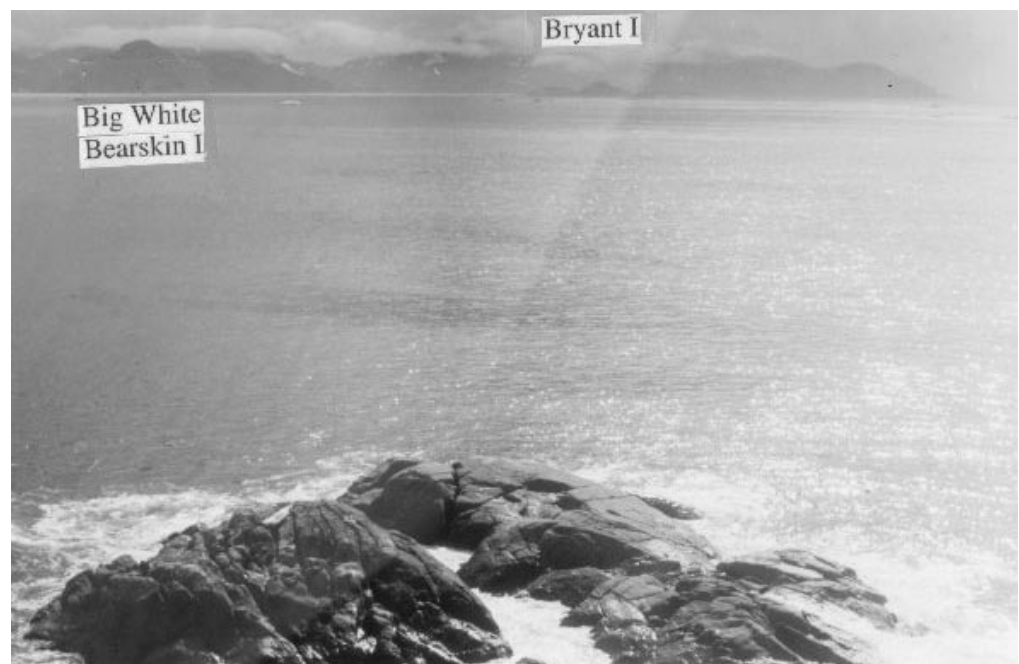


Figure 3. Unnamed rock east of Whale Island ($59^{\circ} 26' 52''\text{N}$, $63^{\circ} 28' 55''\text{W}$) as photographed and positioned by GPS in 1997. It was charted 300m from where it was found, but was not identified in the aerial photography. It is estimated to be 2m above high water.



Figure 4. Same rock as Figure 3. Because helicopter flight happened to occur near the time of low tide, the high water line is clearly visible in this photo. Note the white piece of flotsam on the rock that is also visible in Figure 3.

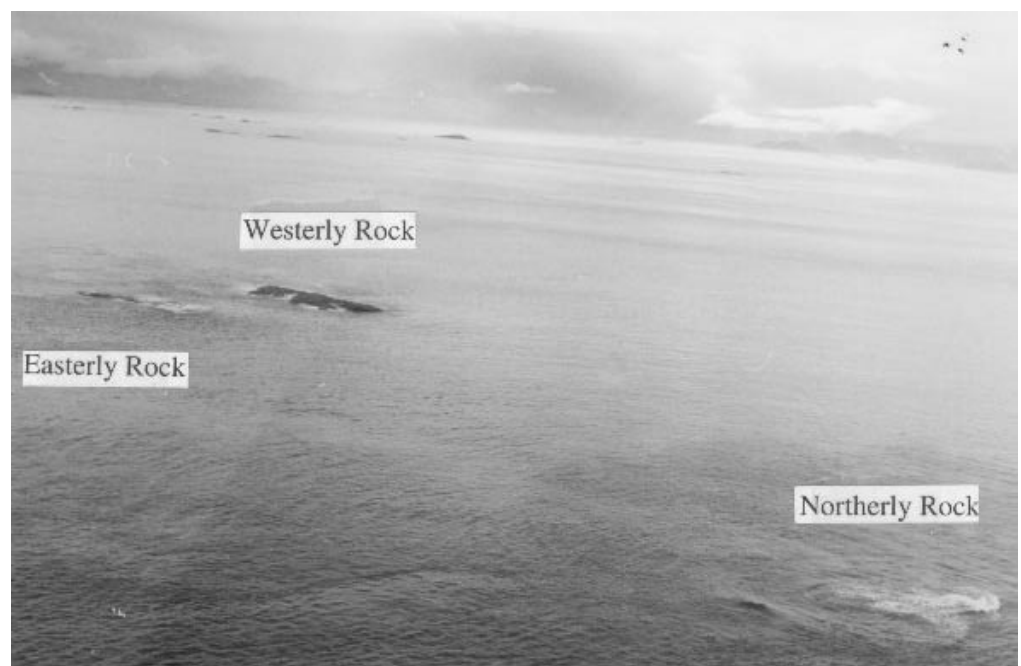


Figure 5. Three unnamed rocks east of Murphy Head. The westerly rock was seen in the airphotos and satellite imagery and had been surveyed as 1.9m above low water. The northerly one was seen only in the airphotos. It is located at 59° 30' 30"N, 63° 31' 27"W and is 0.9m above low water. The easterly rock was not seen in the airphotos or satellite images, but found during this survey to be at 59° 30' 17"N, 63° 31' 24"W and 1.2m above low water.

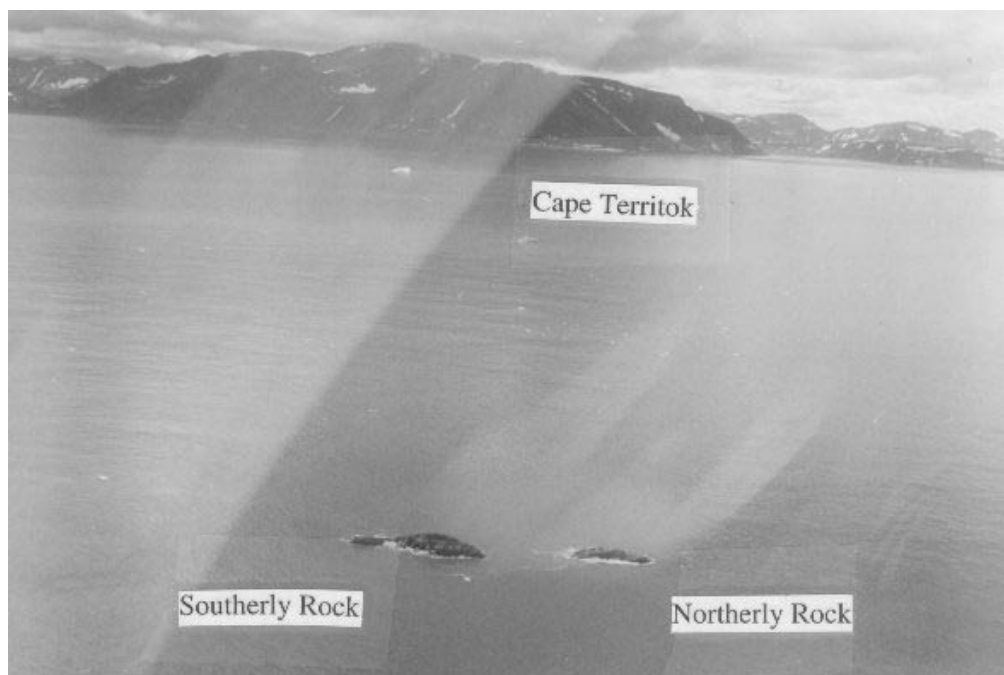


Figure 6. Two unnamed rocks east of Cape Territok. The southerly rock was part of an EDM traverse in 1973 and is 2.0m above high water. The northerly one is located at $59^{\circ} 43' 45''\text{N}$, $63^{\circ} 43' 28''\text{W}$ and is 0.5m above high water.



Figure 7. Unnamed rock east of Cape Territok. The rock was shown on a 1973 field sheet but with no recorded depth or height. It was not spotted in airphotos or satellite imagery. The GPS position of the rock is $59^{\circ} 45' 18''\text{N}$, $63^{\circ} 40' 07''\text{W}$, which is about 575m west of the field sheet position. The rock is 0.5m above low water.

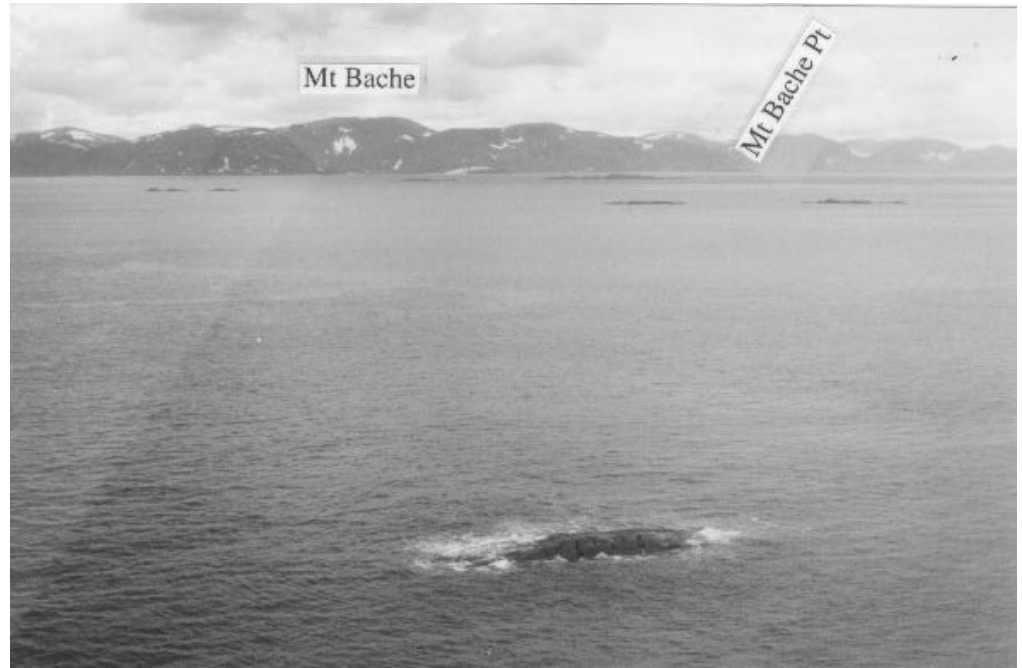


Figure 8. Unnamed rock on the east side of the Galvano Group. The rock was shown on a 1973 field sheet but with no recorded depth or height. It was not spotted in airphotos or satellite imagery. The GPS position of the rock is 59° 55' 19"N, 63° 50' 58"W, which is about 125m east of the field sheet position. The rock is 2.0m above low water.



Figure 9. Unnamed rock on the east side of the Galvano Group. The rock was spotted in airphotos. The GPS position of the rock is 59° 55' 30"N, 63° 52' 55"W, which is about 430m north of the uncontrolled airphoto mosaic position. The rock is 0.5m above high water. Note the common islands in the middle distance 'moving' relative to the hills in the background of Figures 8 and 9.



Figure 10. Unnamed rock on the east side of the Galvano Group. The rock was spotted in airphotos. The GPS position of the rock is 59° 57' 08"N, 63° 53' 01"W, which is about 30m northeast of the 1973 field sheet position. The rock is 0.5m above high water.

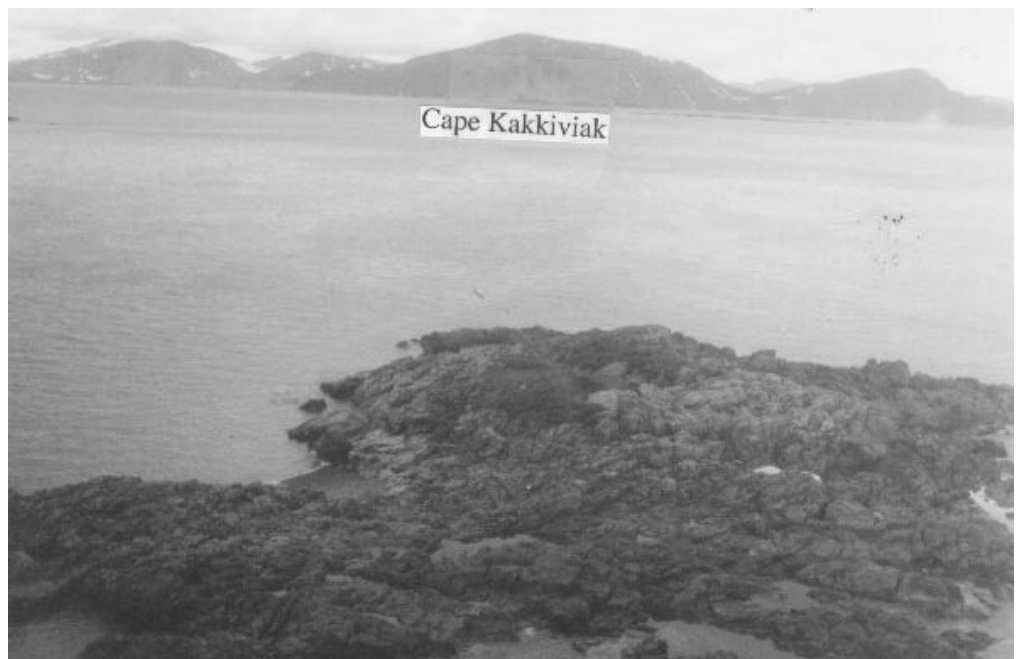


Figure 11. Unnamed rock east of Cape Kakkiviak. The rock was spotted in airphotos. The GPS position of the rock is 59° 57' 59"N, 63° 55' 13"W, which is about 560m north of the uncontrolled airphoto mosaic position. The rock is 3.5m above high water. Vegetation was growing on the rock.

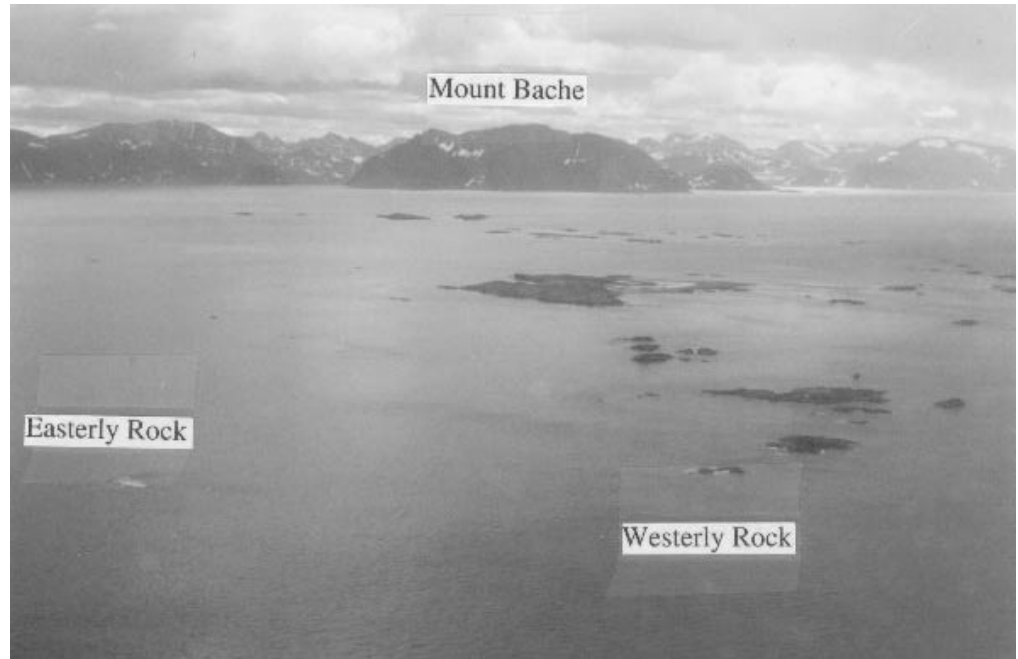


Figure 12. Two unnamed rocks east of Cape Kakkiviak. Neither rock was spotted in airphotos; but rocks to the southwest of the westerly rock were. The GPS position of the easterly rock is $59^{\circ} 58' 03''\text{N}$, $63^{\circ} 54' 30''\text{W}$, and is 0.8m above low water. The GPS position of the westerly rock is $59^{\circ} 58' 08''\text{N}$, $63^{\circ} 54' 52''\text{W}$, and is 1.4m above low water.



Figure 13. Unnamed rock east of Cape Kakkiviak. The rock was not spotted in airphotos. The GPS position of the rock is $59^{\circ} 58' 30''\text{N}$, $63^{\circ} 52' 59''\text{W}$, and is 1.1m above low water. The GPS position is about 610m north of the uncontrolled airphoto mosaic position.



Figure 14. Unnamed rock northeast of Cape Kakkiviak. The rock was spotted in airphotos. The GPS position of the rock is 60° 04' 32"N, 63° 59' 13"W, and is 3.5m above high water. The GPS position is about 200m northwest of the uncontrolled airphoto mosaic position.



Figure 15. Unnamed rock east of Home Island. The rock was spotted in airphotos. The GPS position of the rock is 60° 06' 53"N, 64° 00' 55"W, and is 2.0m above high water.



Figure 16. Landsat Island. The rock was spotted in satellite imagery in 1973, positioned in 1976 by sextant resection angles between distant hill tops. The GPS position of the island is $60^{\circ} 10' 37''\text{N}$, $64^{\circ} 02' 30''\text{W}$, and is 6.6m above high water. The GPS position is 70m east of the resection position. The rock, to the north was not seen in the 1973 imagery, the 1976 field work, nor the 1996 airphoto analysis but only during the 1997 survey. Even then, it was only because the survey was done at low tide. Its GPS position is $60^{\circ} 10' 47''\text{N}$, $64^{\circ} 02' 36''\text{W}$, and its height is 0.8m above low water.



Figure 17. Rock north of Landsat Island. The photograph was taken after hovering over the rock for a minute while GPS readings were taken. The effect of the 'wash' from the helicopter's rotors is plainly visible.