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CENSUS OF NORTHERN GANNET COLONIES IN THE ATLANTIC REGION IN 1999

John W. Chardine

Canadian Wildlife Service, P.O. Box 6227, Sackville, New Brunswick, E4L 1G6, Canada

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Copies may be obtained from:

John W. Chardine
Canadian Wildlife Service
P.O. Box 6227
Sackville, New Brunswick, E4L 1G6
Canada

Phone: (+1) 506 364-5046
Fax: (+1) 506 364-5062
e-mail: john.chardine@ec.gc.ca

Summary

The three Northern Gannet colonies in Atlantic Canada (Funk Island, Baccalieu Island, Cape St. Mary's) were censused again in 1999. The last census took place in 1994. Aerial photographs of the colonies were taken in a fixed-wing aircraft and counted later. In 1999, Atlantic Region colonies were photographed on 15 July, and a new method of counting photographs with the help of a computer was used (described here). The method produced results that compared favourably with a duplicate count of the Funk Island reference photograph conducted in the traditional manner. Counts of photographs tend to over-estimate the actual number of breeding pairs because breeding status cannot be determined unequivocally. Thus some non-breeders were inevitably included in the counts. The unit of all counts given here is "site-holding pairs" and does not imply that all were actually breeding. Counts of site-holding pairs in 1999 were all up substantially from 1994. Funk Island (9,837 site-holding pairs in 1999) has steadily increased since 1972 at a rate of about 3% per annum, and increased 30% from 1994 to 1999. Baccalieu Island (1,712 site-holding pairs in 1999) and Bird Rock, Cape St. Mary's (6,759 site-holding pairs visible from air in 1999) remained stable or slightly decreased between 1972/73 and 1984, but both have increased since then at rates of 6% and 2% per annum respectively. Baccalieu Island increased by 64% from 1994 to 1999, and Bird Rock, Cape St. Mary's by 19%. In addition to the birds nesting on Bird Rock, an estimated 4,519 site-holding pairs nested on the mainland, east and west of Bird Rock, Cape St. Mary's in 1999 (these were not included in the comparison with counts from earlier years because of previous inconsistencies in assumptions about breeding status for mainland nesting birds). The inclusion of the mainland nesting birds at Cape St. Mary's brings the total there to 12,156 site-holding pairs, and the Atlantic Region total to 23,705 site-holding pairs, or 31% of the estimated total for North America in 1999 (ca. 78,000 site-holding pairs).

Résumé

Les trois colonies de Fous de Bassan de la région de l'Atlantique (île Funk, île Baccalieu, cap St. Mary's) ont encore fait l'objet d'un recensement en 1999. Le dernier recensement remonte à 1994. Des photographies aériennes des colonies ont été prises depuis un aéronef à voilure fixe, puis on a procédé par la suite au dénombrement des oiseaux. Les colonies de la région de l'Atlantique ont été photographiées le 15 juillet 1999, et on a utilisé une nouvelle méthode de dénombrement à l'aide d'un ordinateur (la méthode est décrite ci-après). Cette méthode a donné des résultats qui se comparent favorablement à ceux obtenus au moyen d'un dénombrement en double à partir de la photographie de référence de l'île Funk, qui a été réalisé de la manière traditionnelle. Les dénombrements à partir des photographies ont tendance à surestimer le nombre réel de couples nicheurs puisqu'il n'est pas possible de déterminer sans l'ombre d'un doute s'il y a ou non nidification. Certains oiseaux non nicheurs sont donc inévitablement inclus dans le dénombrement. L'unité de tous les dénombrements qui est donnée dans ce document est un « couple occupant un site » et ceci n'implique pas nécessairement que tous étaient en nidification. Les dénombrements de couples occupant un site en 1999 ont connu une hausse considérable en 1999 par rapport à 1994. Ainsi à l'île Funk, on recensait en 1999 9 837 couples occupant un site, ce qui représentait depuis 1972 une augmentation constante d'environ 3% par année. Ce taux a grimpé en flèche de 30% de 1994 à 1999. Dans l'île Baccalieu, il y avait 1 712 couples occupant un site en 1999, alors qu'au rocher Bird et au cap St. Mary's, on apercevait en 1999 du haut des airs 6 759 couples occupant un site. Les effectifs dans ces deux derniers endroits sont demeurés stables ou ont légèrement diminué entre 1972-1973 et 1984, mais ils ont augmenté depuis lors à des taux de 6 % et 2 % respectivement par année. Dans l'île Baccalieu, les effectifs ont augmenté de 64% de 1994 à 1999 et au rocher Bird de même qu'au cap St. Mary's, l'augmentation a été de 19%. Outre la nidification au rocher Bird, on évalue qu'environ 4 519 couples occupant un site ont niché sur la terre ferme, à l'est et à l'ouest du rocher Bird et du cap St. Mary's en 1999. Ces données n'ont cependant pas été incluses dans la comparaison avec les dénombrements des années précédentes en raison d'incohérences constatées dans les hypothèses relatives à la nidification pour les oiseaux nichant sur la terre ferme. L'inclusion des oiseaux nichant sur la terre ferme au cap St. Mary's porte le total là-bas à 12 156 couples occupant un site, et le total de la région de l'Atlantique à 23 705 couples occupant un site, ce qui correspond à 31 % du total estimé pour l'Amérique du Nord en 1999 (environ 78 000 couples occupant un site).

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Introduction

There are currently six main colonies of Northern Gannets (*Morus bassanus*) in North America, all of which occur in eastern Canada. Three colonies are situated in the Gulf of St. Lawrence (Bonaventure Island, Bird Rocks, Magdalen Islands, and Anticosti Island), and three are in eastern Newfoundland (Funk Island, Baccalieu Island and Cape St. Mary's; Figure 1). Recently a single pair was found breeding on White Horse Islet, south of Grand Manan in the Bay of Fundy (A.W. Diamond pers. comm.).

Gulf of St. Lawrence colonies have been regularly censused since 1969 and Newfoundland colonies less regularly since 1972 (see Nettleship and Chapdelaine 1988), using aerial photography and subsequent photographic counts of the entire colony (except Cape St. Mary's where some nesting gannets cannot be seen from the air). This work has provided a more complete picture of colony sizes and trends for gannets than perhaps for any other Canadian seabird. Since 1984, all colonies have been censused every 5 years, with the exception of the Atlantic colonies in 1989.

Trends at each of the colonies have differed but some generalisations can be made. Gulf of St. Lawrence colonies declined from 1969 to 1976 and have steadily increased since then (Nettleship and Chapdelaine 1988, G. Chapdelaine pers. comm.). The decline in numbers at the largest Gulf colony at Bonaventure Island was the result of poor breeding success, which was thought to be caused by high toxic chemical loads (Chapdelaine et al. 1987). Numbers at the Cape St. Mary's and Baccalieu Island colonies in Newfoundland remained stable from the early-1970s to 1984 (only one count in each of these years was conducted), but have increased since 1984, while the Funk Island colony has steadily increased from 1972 to the last census in 1994 (CWS unpubl. files).

Since 1984 the North American gannet survey has been a joint effort of the Canadian Wildlife Service, Quebec and Atlantic Regions. Each region has three colonies and responsibilities for photography, photographic counts and overall costs are divided accordingly. In this report, I present results for the three colonies in the Atlantic Region.

Methods

1. Aerial survey and photography

The Atlantic Region portion of the North American gannet survey for 1999 was conducted on 15 July by John Chardine from Atlantic Region (photographer), and Gilles Chapdelaine and Jean-François Rail from Quebec Region. Funk Island, Baccalieu Island and Cape St. Mary's were each over-flown in turn, in a twin-engine, Britten-Norman Islander aircraft operated by Air Montmagny, Montmagny, Quebec (pilot: Jean Gosselin). Photographs were taken through an open window on the forward port side of the aircraft using a medium-format Pentax 645 camera with either 75 or 150 mm lenses. The camera and lenses produce very high quality images at a negative size of 55 x 41 mm (smaller than the negative size of the Pentax 6x7 [69 x 54 mm], which was used for previous surveys). The film used was Kodak TMAX 100 black and white negative film and the exposure was 1/500 sec. at f5.6 or f6.7 for all images. Altitude above or distance away from nesting birds was designed to minimise disturbance to the birds and optimise photographic quality (details below). On 15 July the weather was sunny with a light breeze blowing all day. A few fog patches lay offshore of Cape St. Mary's in the afternoon but these did not affect visibility of the birds. Weather conditions for the survey were considered ideal.

Funk Island was reached at 1100 (all times NDT). The island was approached from the west, after which we conducted an orientation fly-by, well off the south shore of the island. We then flew out past the eastern extent of the island and turned to port 180°, aligning the aircraft along the long axis of the island and flying approximately west. A series of five exposures was made with the 75 mm lens of the entire island from an altitude of approximately 1200'. The lens was then quickly changed to 150 mm

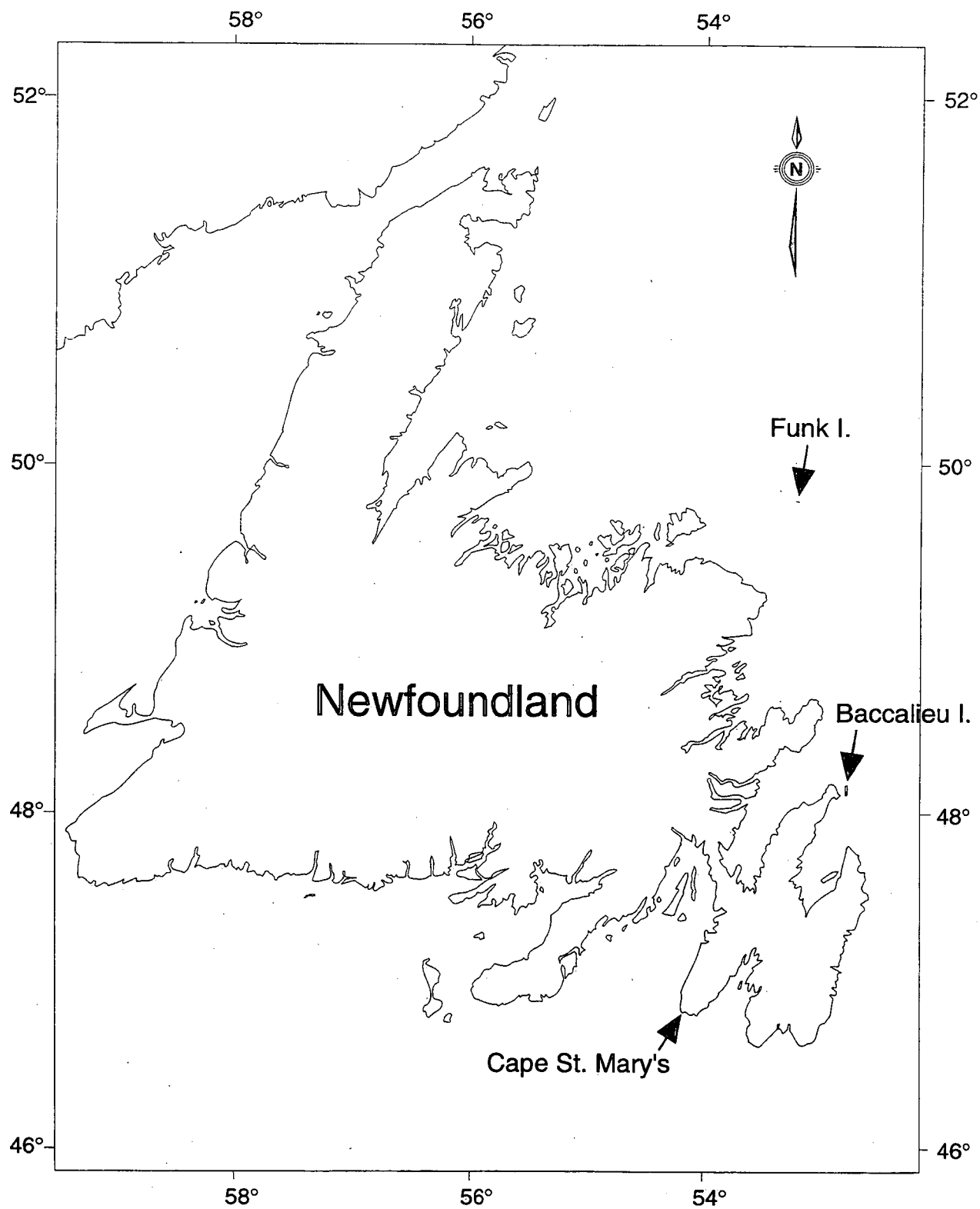


Figure 1. Locations of the three Northern Gannet colonies in the Atlantic Region

and a further nine exposures taken from the same altitude of the murre and gannet colonies in a second pass over the island.

We then flew to Baccalieu Island, arriving at 1200 and commenced photography at 1206. We approached the island from the north, flew down the western shore, around the southern point and up the eastern shore. We used the 150 mm lens throughout and took two exposures of the north and south colonies from an altitude of about 400'. We then circled twice and took two more sets of 4 photographs each, at an altitude of about 600'. We had no way to measure the distance out from the island when we took the pictures but it was sufficient to prevent disturbance to the gannets. We noticed that some kittiwakes flushed from their nests when we flew by.

At about 1215 we flew to St. John's airport to re-fuel and have lunch, arriving at 1240. We took off again at 1523 and arrived at Cape St. Mary's at 1609. A series of 8 exposures were taken of the gannet colony with the 150 mm lens at an altitude of 700', starting from the "Bill of the Cape" flying east to Bird Rock and beyond. We then circled out over the water and took another series of seven exposures at an altitude of 600'. Photography was completed by 1617 at which time we flew to Stephenville to re-fuel, then on to Gaspé, Quebec, arriving at 2128.

The entire gannet colonies at Funk and Baccalieu Islands can be seen from the air, however, this is not the case at Cape St. Mary's, where some birds are only visible from land. To include these birds in the 1999 census I visited Cape St. Mary's on 1 July from 1120-1615 and photographed all gannets visible from land. These birds were mainly located on the landward side of Bird Rock. A total of 20 exposures using TMAX 100 film were taken with the Pentax 645 camera mounted on a tripod, using the 75 or 150 mm lens as appropriate. The weather was sunny with a moderate breeze from the southwest.

2. Counting the photographs

A new method was used to count the photographs. Negatives selected for their coverage and high quality were scanned onto a Kodak Pro Photo CD, at various resolutions up to a maximum of about 100 pixels/mm of negative. This service was provided by Appleby Colour Labs of Fredericton, New Brunswick.

Only the highest resolution scans provided on the Kodak Pro Photo CD were counted. In the case of Funk and Baccalieu Islands, one and two images respectively, provided complete coverage of the colony. Cape St. Mary's is a more complicated colony and a total of 11 images were needed to provide complete coverage. Care was taken not to double-count birds on images that overlapped. Scans for each image were read into a computer using Adobe Photoshop version 4, and adjusted to optimise brightness and contrast. In preparation for counting, a new, transparent layer was created in Photoshop above the scan, through which the image could be viewed on the computer monitor. Onto this new layer were placed dots, each made up of a square array of 3 x 3 pixels, above each target using the Photoshop pencil tool. A target was defined as one individual or a pair of gannets that were considered to be nest-site holders. Two birds were judged a pair if they were closer together than the normal spacing of birds in adjacent nests. From the photographs it was not possible to determine if nest-site holders were actually breeding, although birds obviously standing on bare ground with no obvious nest material below were not counted. Also birds or pairs irregularly spaced at the periphery of the colony were assumed to be non-breeders and were not included in the count.

Once all targets were "dotted", the Histogram command in Photoshop was used to count the number of pixels on the new layer. The pixel count was divided by the number of pixels per dot (9) to obtain a count of the total number of dots on the image.

To check the computer methods used to count photographs, I sent the Funk Island reference negative from 1999 to Jean-François Rail, CWS Quebec Region, who was responsible for counting the Quebec gannet colonies in 1999. He employed standard techniques used in Quebec Region to

count gannet colony photographs. He enlarged the negative to a size of 8" x 10" and overlaid an acetate sheet. The image was viewed with a low-power binocular microscope and an electronic pen attached to a counter was used to mark each site-holder or pair of site-holders. Clicking the pen over each target created a visible indentation on the acetate sheet and at the same time the device kept a running-total of the number of clicks. Jean-François was not informed of my tally for Funk Island or the colony outline I used (i.e., which birds were excluded as non-breeders).

Results

Table 1 shows the counts of Northern Gannet site-holders at the three colonies surveyed in 1999 and counts from previous aerial surveys. For comparative purposes, only birds nesting on Bird Rock, Cape St. Mary's, and which were visible from the air, are shown in the table. This is because consistent criteria have been used for Bird Rock in all survey years to decide if birds should be included as breeders, and previous surveys did not include birds visible only from land. Appendix 1 shows printouts of the photographs used to conduct the counts. Counts in 1999 of site-holding pairs for Funk Island, Baccalieu Island and Bird Rock, Cape St. Mary's were 9,837, 1,712, and 6,726 respectively.

The estimate for Funk Island received from Jean-François Rail was 9,340 site-holders, or 5% fewer site-holders than I counted. This difference is within the error expected between re-counts of photographs using the traditional, visual method (G. Chapdelaine pers. comm.). A comparison of colony outlines that we both used showed much similarity so the difference in the two counts was likely due to differences in what we each decided was a pair of birds vs. a single bird.

Figure 2 shows the trends in numbers of site-holders at the three Atlantic Region colonies since regular aerial surveys began in 1972/73. The trend of log-transformed counts for Funk Island was linear from 1972 to 1999 and represented a growth rate of 3% per annum. Log-transformed trends at Baccalieu and Funk Islands were not linear. Both colonies remained relatively stable between the early 1970s and 1984 and then grew. The average growth rate from 1984 to 1999 was 6% at Baccalieu Island and 2% at Bird Rock, Cape St. Mary's.

Table 2 shows a breakdown of the number of site-holding pairs for easily definable locations or sub-colonies within each of the colonies. The Funk Island colony has comprised a main colony and satellite sub-colony to the northeast at least since 1972 (see Appendix 1). Since 1994 the satellite has increased from 442 site-holders to 729, or 65%, whereas the main colony has increased by 28% (from 7,123 to 9,108). At Baccalieu Island, gannets nest on three cliff faces referred to as 1, 2, and 3 in Montevecchi and Tuck (1987, p. 166). As Faces 1 and 2 look continuous from the air (see Appendix 1), I refer to them together as the South sub-colony, and Face 3 as the North sub-colony. The North sub-colony increased by 32% from 1994 to 1999 (from 608 to 802 site-holders). In comparison, the South sub-colony increased by 110% (433 to 910 site-holders). The Cape St. Mary's colony can be conveniently divided into Bird Rock and the mainland cliffs, and the cliffs can be further divided into east and west of Bird Rock (see Appendix 1). Historically, gannets only nested on Bird Rock (Montevecchi and Tuck 1987), however, in 1972 some birds started to nest east of Bird Rock on adjacent mainland cliffs (Nettleship and Chapdelaine 1988). It is clear that growth at this colony over the past five years has occurred to a large degree on the mainland cliffs, which increased by 144% (1,349 to 3,294) east of Bird Rock, compared to only 19% (5,671 to 6,759) on Bird Rock itself.

A total of 23,705 site-holding pairs currently reside in the three Atlantic Region colonies; 51% at Cape St. Mary's, 42% at Funk Island, and 7% at Baccalieu Island (Table 2). Combined with the estimated 54,000 site-holding pairs residing in Quebec Region colonies (G. Chapdelaine, pers. comm.) this gives a total North American population of about 78,000 site-holding pairs, of which about 31% breed in the Atlantic Region.

Table 1. Number of Northern Gannet site-holding pairs counted on photographs at each of the Atlantic Region colonies since aerial, photographic surveys started in 1972. Data from 1972-84 are from Nettleship and Chapdelaine 1988; 1994 data are from unpubl. CWS files.

Year	Funk I.	Baccalieu I.	Cape St. Mary's Bird Rock ¹
1972	4,051		5,260
1973		673	
1975	4,300		
1980	4,925		
1984	6,075	677	5,117
1994	7,565	1,041	5,671
1999	9,837	1,712	6,726

1. Only includes birds at sites visible from the air.

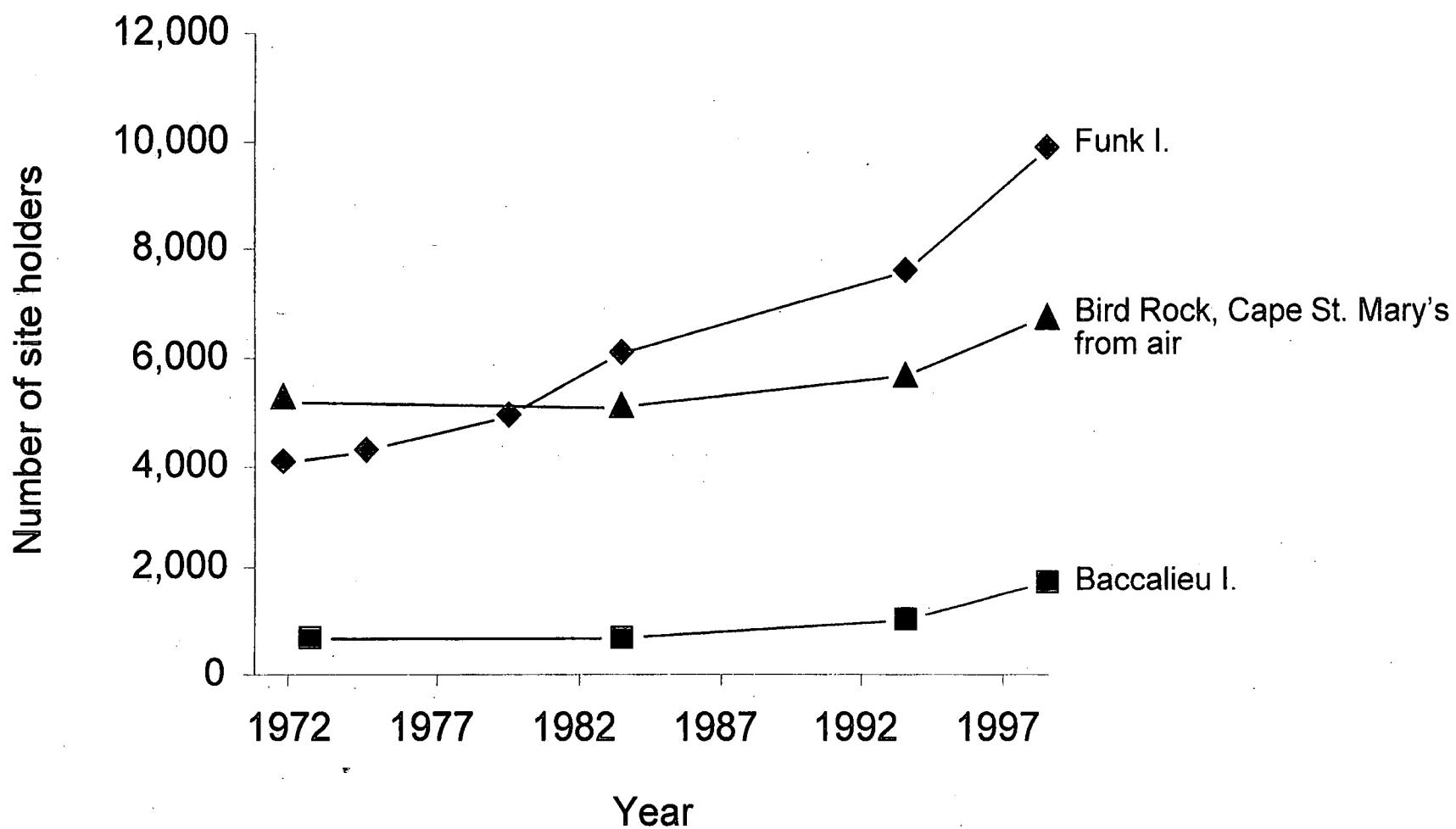


Figure 2. Number of Northern Gannet site holders at each colony since aerial surveys started

Table 2. Breakdown of counts of Northern Gannet site-holders at Atlantic Region colonies by location within colony

Colony and location	Number of site-holding pairs		% change
	1994	1999	
Funk Island			
Main colony	7,123	9,108	+28
Satellite	442	729	+65
Funk Island total	7,565	9,837	+30
Baccalieu Island			
North sub-colony	608	802	+32
South sub-colony	433	910	+110
Baccalieu Island total	1,041	1,712	+64
Cape St. Mary's			
Bird Rock sites visible from air	5,671	6,726	+19
Bird Rock sites not visible from air	na ¹	911	
Bird Rock total	-	7,637	
Mainland cliff east of Bird Rock	1,349	3,294	+144
Mainland cliff west of Bird Rock	na	1,225	
Mainland total	na	4,519	
Cape St. Mary's total	at least 7,020	12,156	
Atlantic Region total	at least 15,626	23,705	

1. Not available

Discussion

Since 1972, similar methods have been used to census Northern Gannet colonies in North America. These involve aerial surveys and photography, with photo counts being done in a variety of ways in the lab. In 1999, I counted the Atlantic Region photographs using a computer technique analogous to the traditional technique of counting the photographic enlargements directly. A comparison of the traditional technique and the computer technique revealed close agreement, well within that expected between repeat counts of the same photograph using the traditional method. Thus, I conclude that using the computer counting technique did not bias the results. It is important to note that as breeding status cannot be determined from these photographs, counts will include non-breeding birds and thus be inflated to some degree. The level of inflation will likely be high in rapidly expanding colonies that have a large number of immature prospecting birds in attendance.

Northern Gannets are increasing dramatically at all Atlantic Region colonies. A similar trend is occurring at the two large gannet colonies in the Gulf of St. Lawrence- Bird Rocks, Magdalen Islands, and Bonaventure Island. Numbers are stable at the small colony on Anticosti Island (G. Chapdelaine pers. comm.). These increases suggest that North American gannets are currently experiencing both high breeding success and high survival rates. Breeding success data from Bonaventure Island in 1999 support the first suggestion (G. Chapdelaine pers. comm), however, we have no estimates for adult gannet survival for any North American population to date.

Although Atlantic Region colonies increased between 1994 and 1999, trends since 1972 differed amongst the three. Funk Island has steadily increased since 1972, with a suggestion that the rate of increase is accelerating as would be expected in an exponentially growing population. The Funk Island colony is on a relatively flat surface and a comparison with a previous photograph taken in 1972 (see Birkhead and Nettleship 1980, p. 9) shows that the colony has expanded at the edges and at its western margin. Steady expansion might be expected in situations where the habitat is more or less continuous and relatively homogeneous as it is at Funk Island.

At Baccalieu Island, gannets remained relatively stable between 1973 and 1984 but have increased dramatically over the past five years, as they have at Cape St. Mary's. Red Foxes (*Vulpes vulpes*) occur on Baccalieu Island and on the mainland at Cape St. Mary's, and may have dissuaded gannets from nesting there in the past through predation and disturbance. At Cape St. Mary's, Red Foxes are not seen during the breeding season as frequently now as they were in the past perhaps due to local trapping of foxes (F. Shuhood, pers. comm.). This may have allowed the mainland segment of the colony to expand rapidly, as it has done over the past five years. Furthermore, it is possible that as populations increase and birds expand into areas previously unused, their numbers reach a threshold beyond which foxes do not act as a significant deterrent to breeding.

Gannet colonies in North America will likely continue to grow if breeding success and survival remain high, and if food supplies and nesting habitat do not become limiting. Whatever the actual trend, it will be important to maintain the five-year, regular survey in order to track changes in this important Atlantic Canada seabird.

Acknowledgements

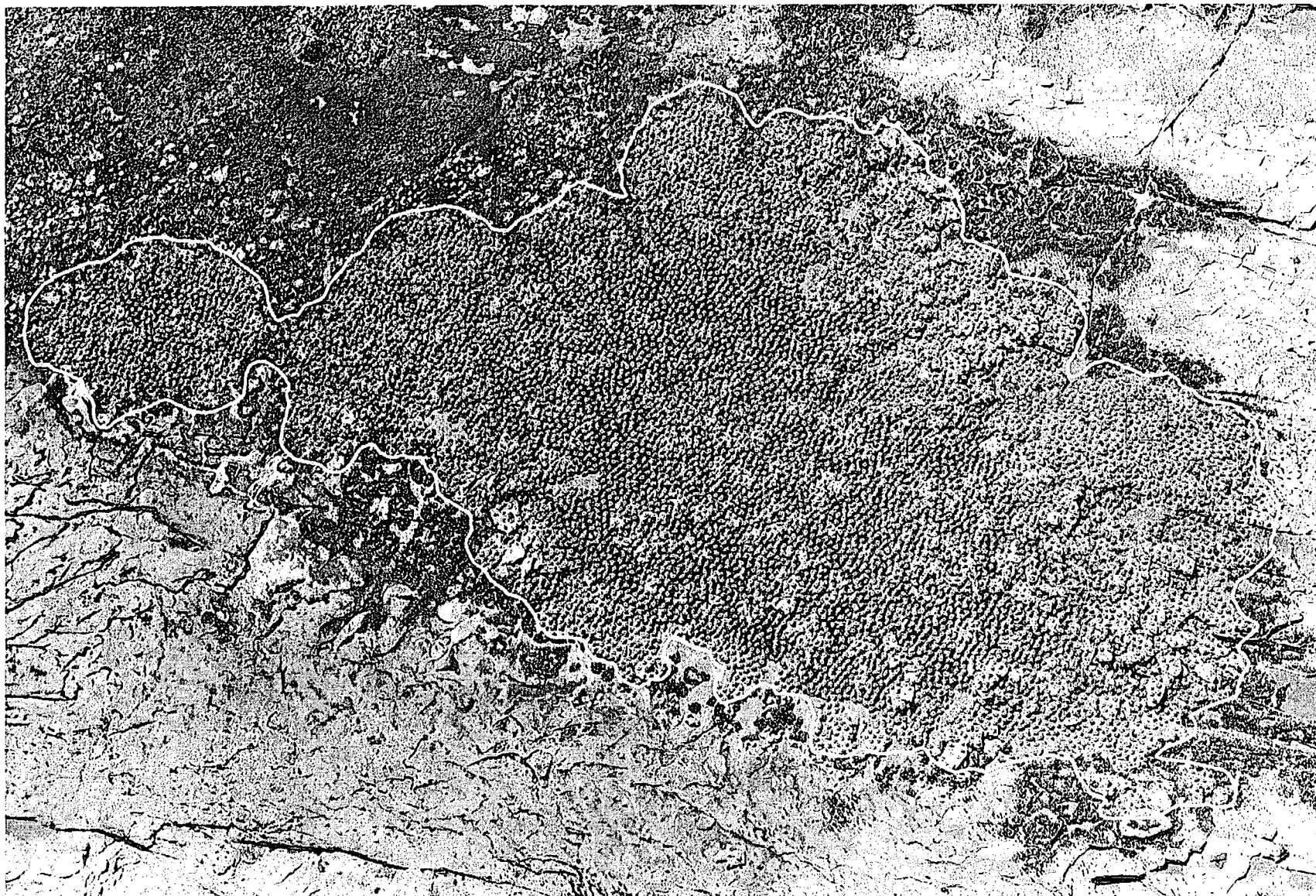
I thank several people who helped me with the work reported here. Gilles Chapdelaine initiated my involvement in the regular Northern Gannet surveys in Canada, and together with Jean-François (Jeff) Rail provided useful comments on an earlier version of this report. Richard Elliot and Andrew MacFarlane also provided comments on an earlier draft and Andrew discussed earlier counts he had done of previous gannet census photographs. The Newfoundland Department of Tourism, Culture and Recreation, Parks and Natural Areas, provided a permit to conduct the aerial surveys. It is through the dedication and efforts of provincial ecological reserve staff that the Atlantic colonies of

Northern Gannets have a bright future. Fyzee Shuhood, Manager of the Cape St. Mary's Seabird Ecological Reserve has generously hosted me whilst at the "Cape" over the past few years.

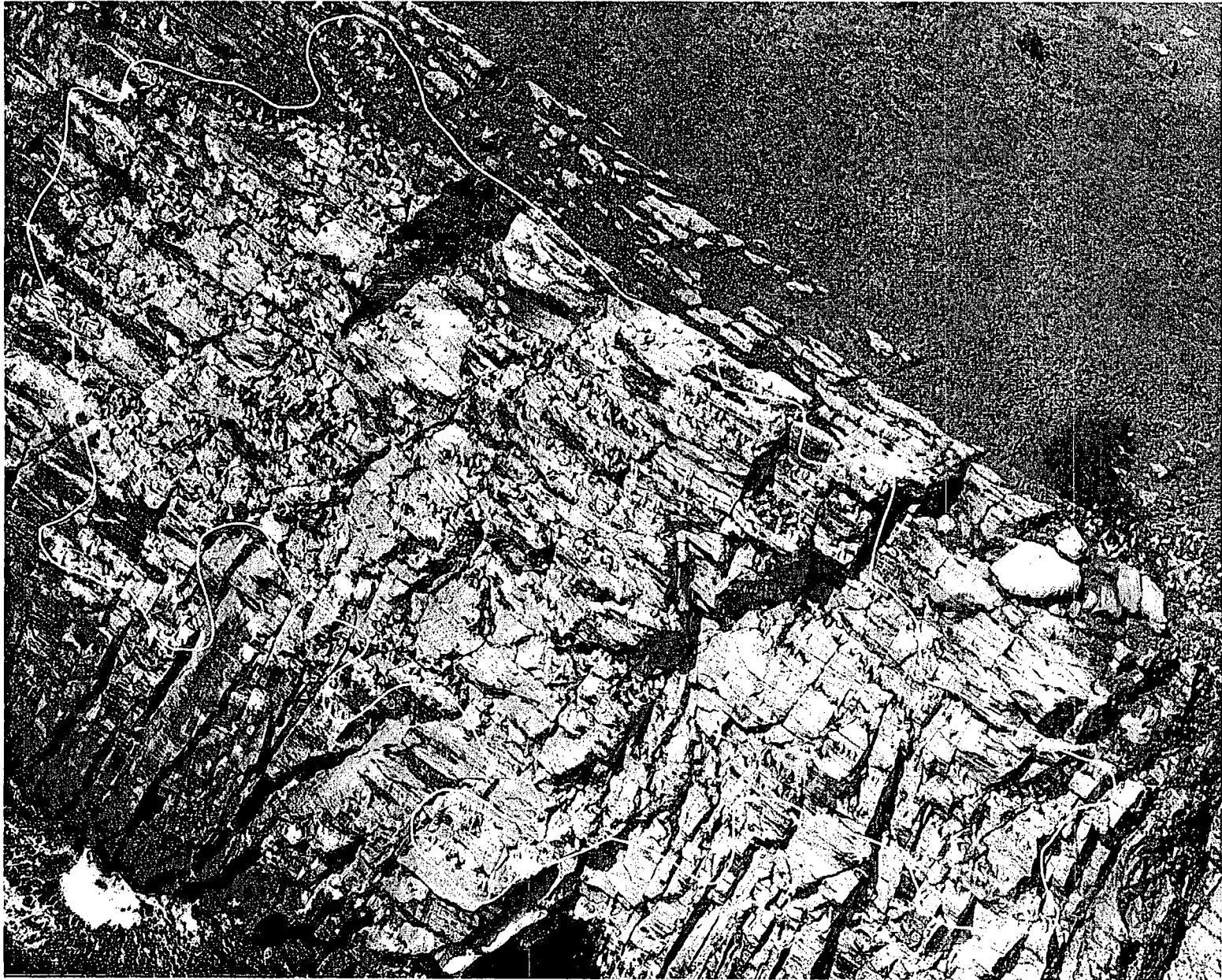
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Appendix 1. Printouts of images of Northern Gannet colonies in the Atlantic Region taken in 1999.
The line encircles birds that were considered site-holders and included in the counts.



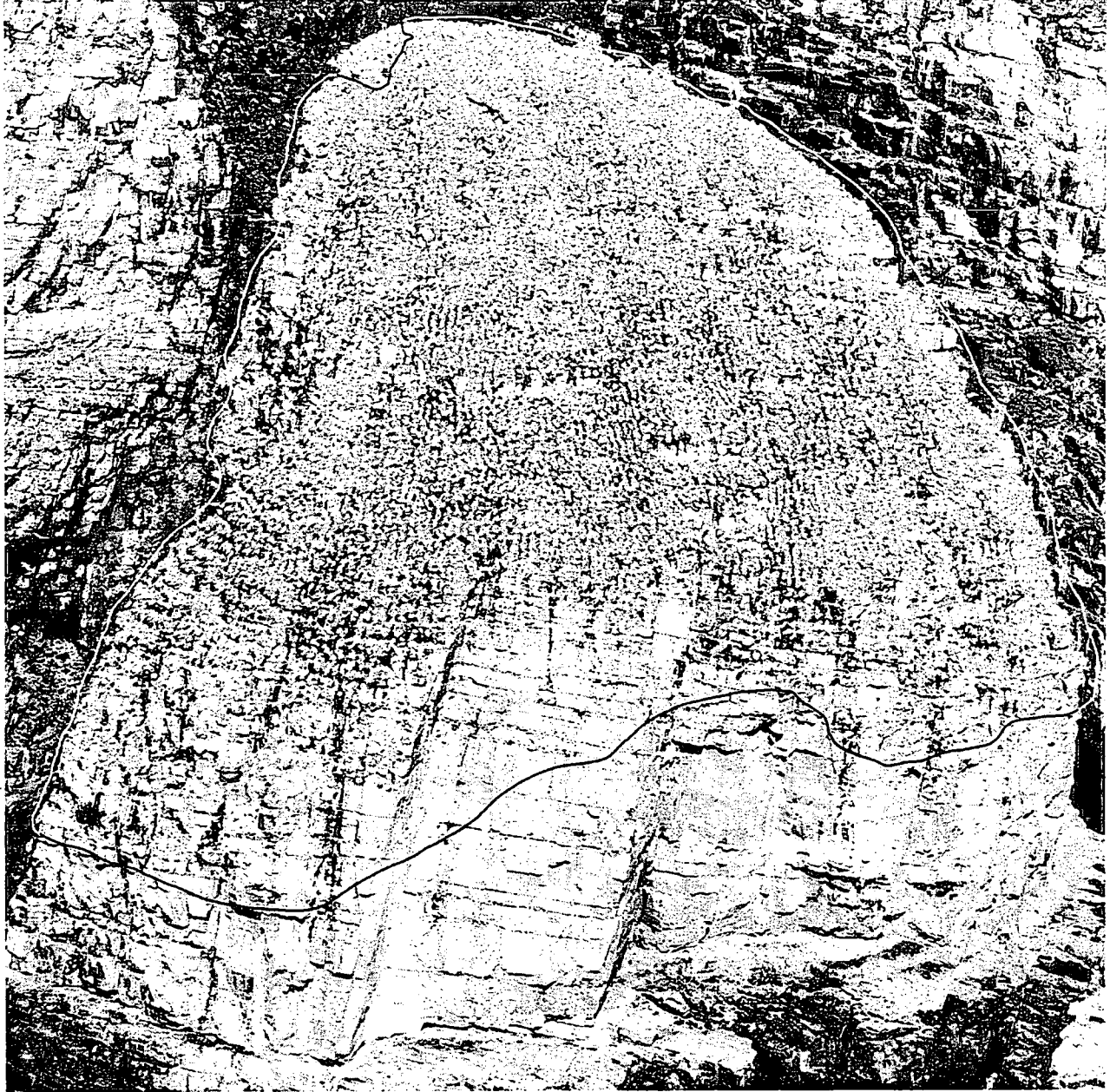
Funk Island. 15 July 1999. The satellite sub-colony is to the left.



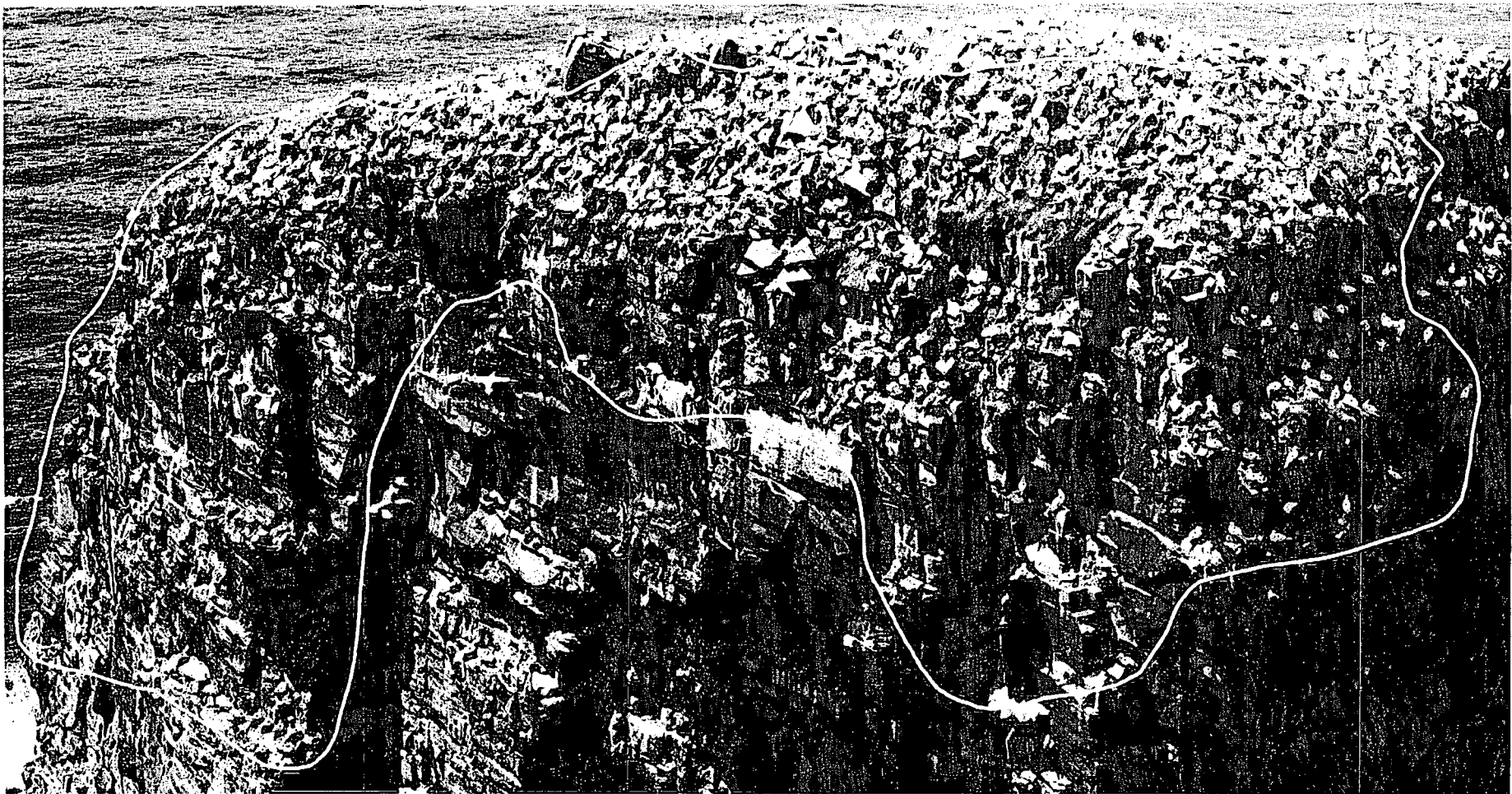
Baccalieu Island. North sub-colony. 15 July 1999. This was referred to as Face 3 in earlier references (see Montevecchi and Tuck 1987).



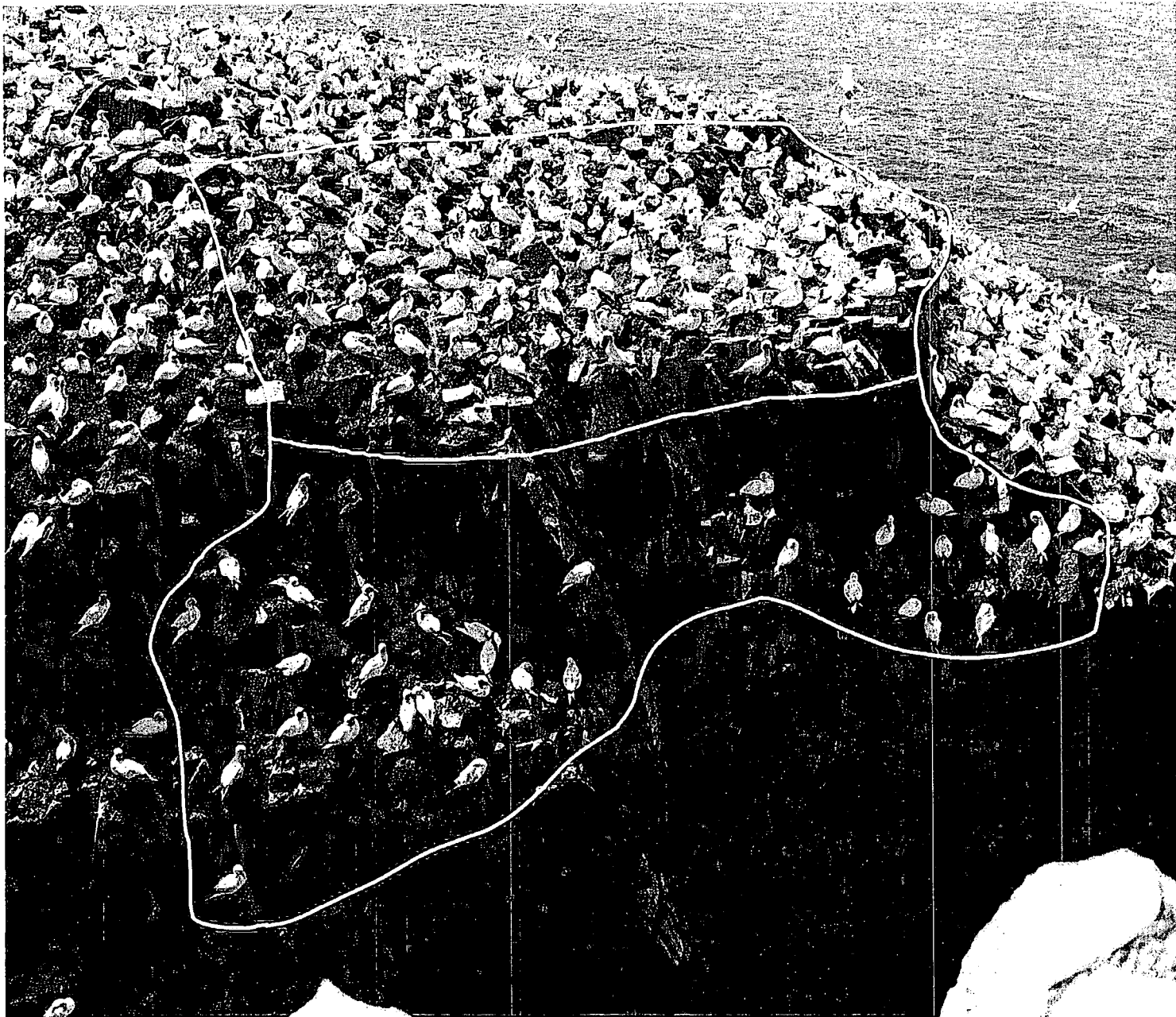
Baccalieu Island. South sub-colony. 15 July 1999. This was referred to as Faces 1 and 2 in earlier references (see Montevecchi and Tuck 1987).



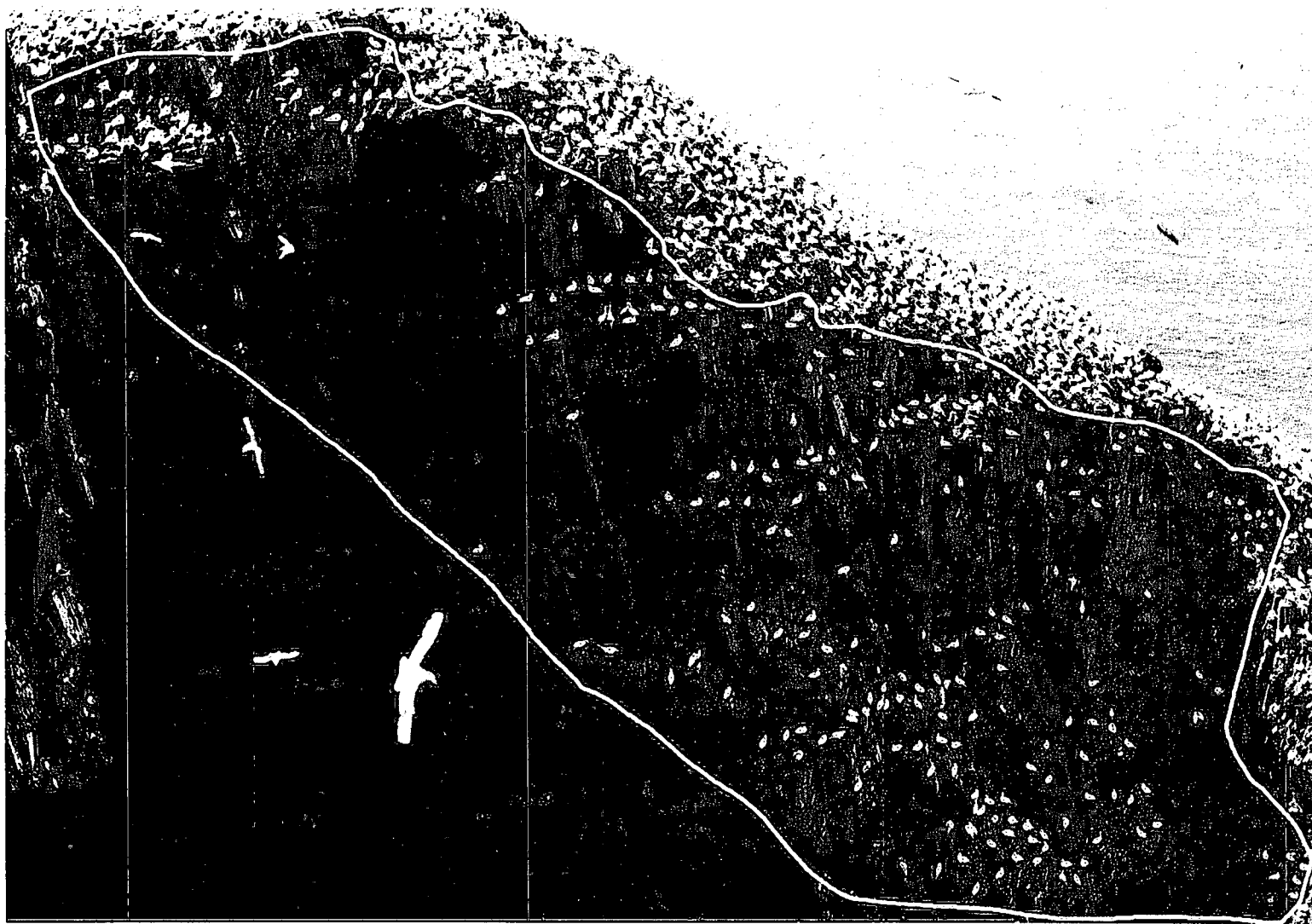
Cape St. Mary's. South face of Bird Rock from air. 15 July 1999.
The area at the top left was better counted from a photograph taken from the land.



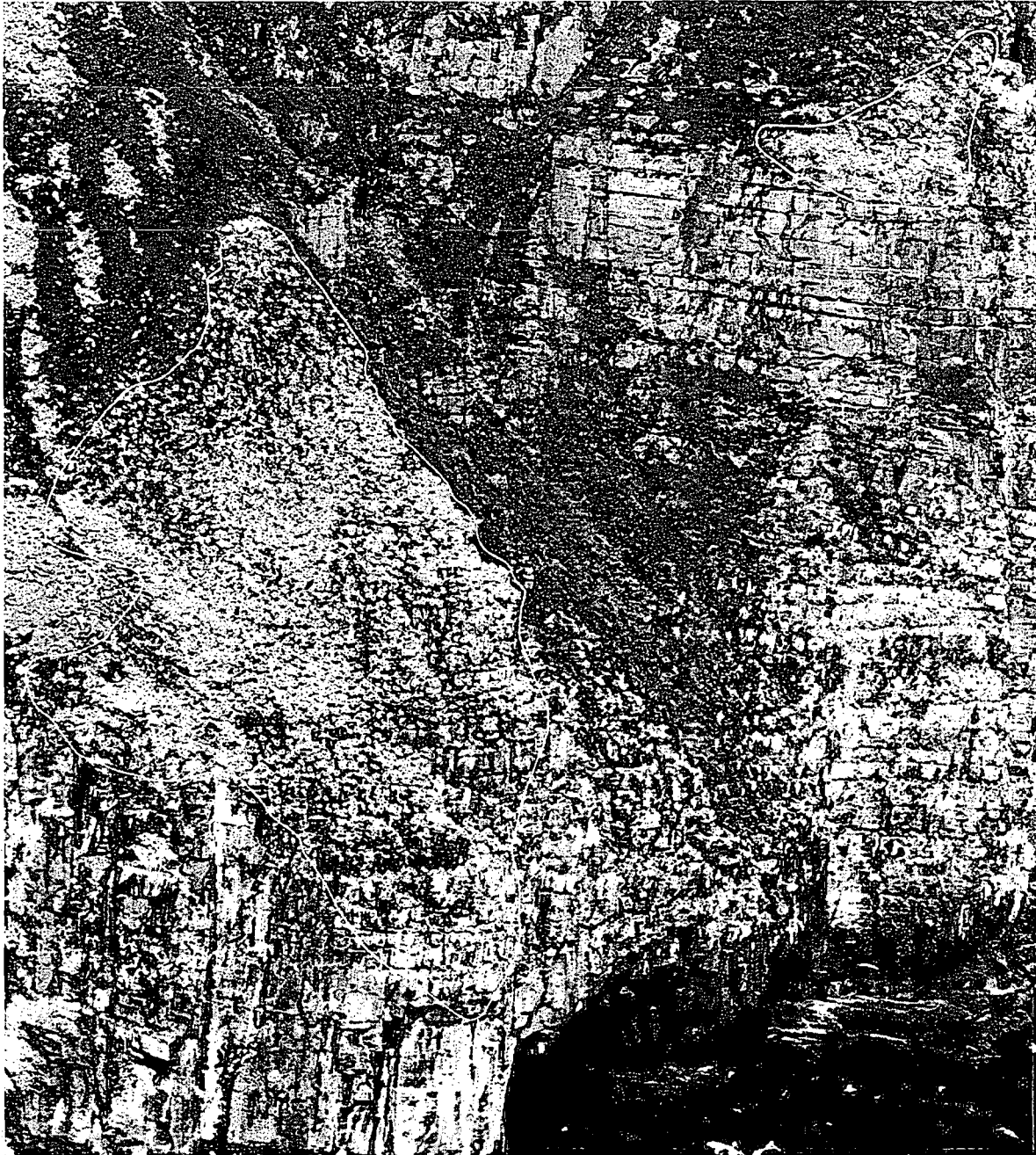
Cape St. Mary's. East side of Bird Rock from land. 1 July 1999.



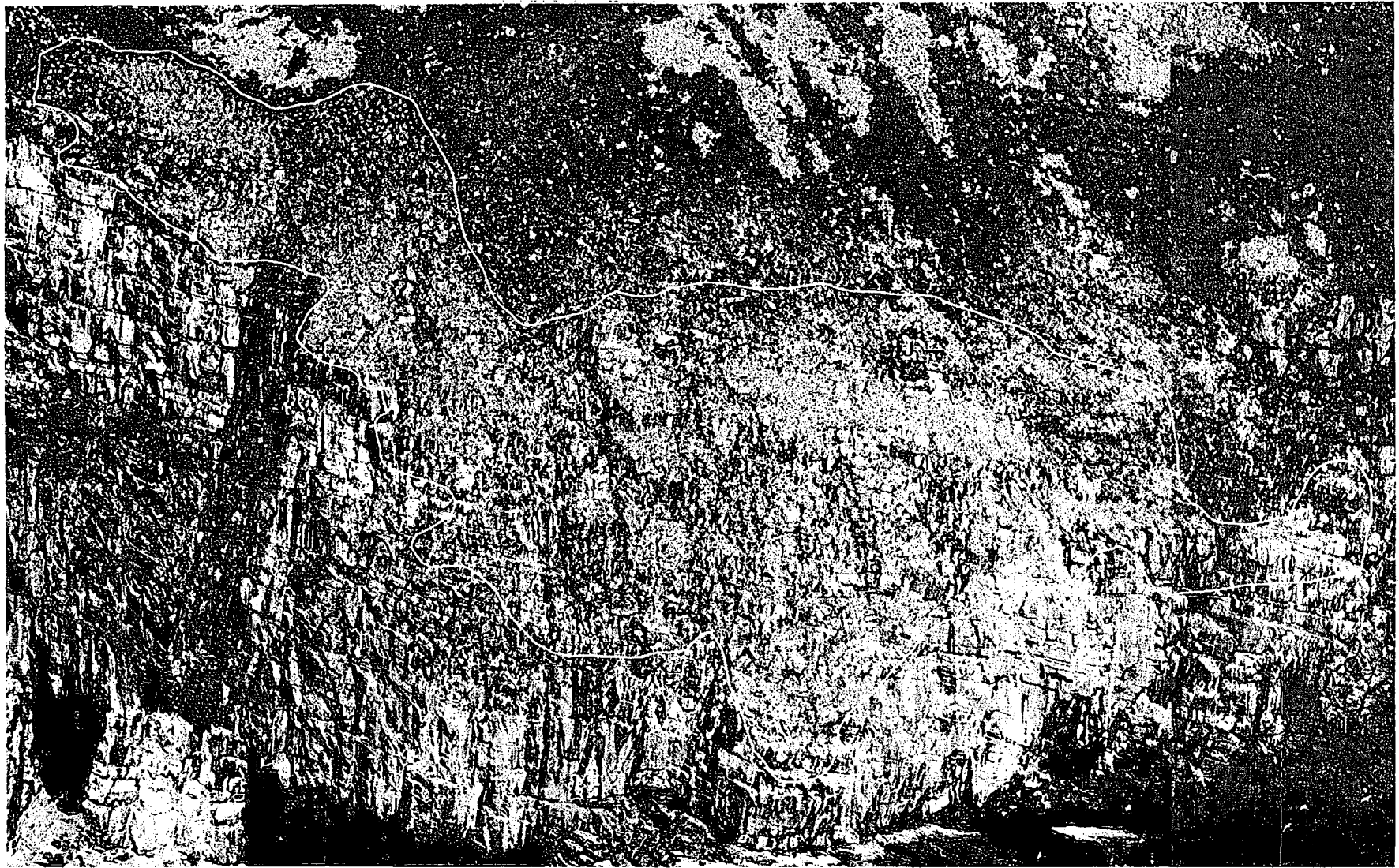
Cape St. Mary's. Back of Bird Rock from land. 1 July 1999.
The upper portion of the outline was visible from air but better counted here.



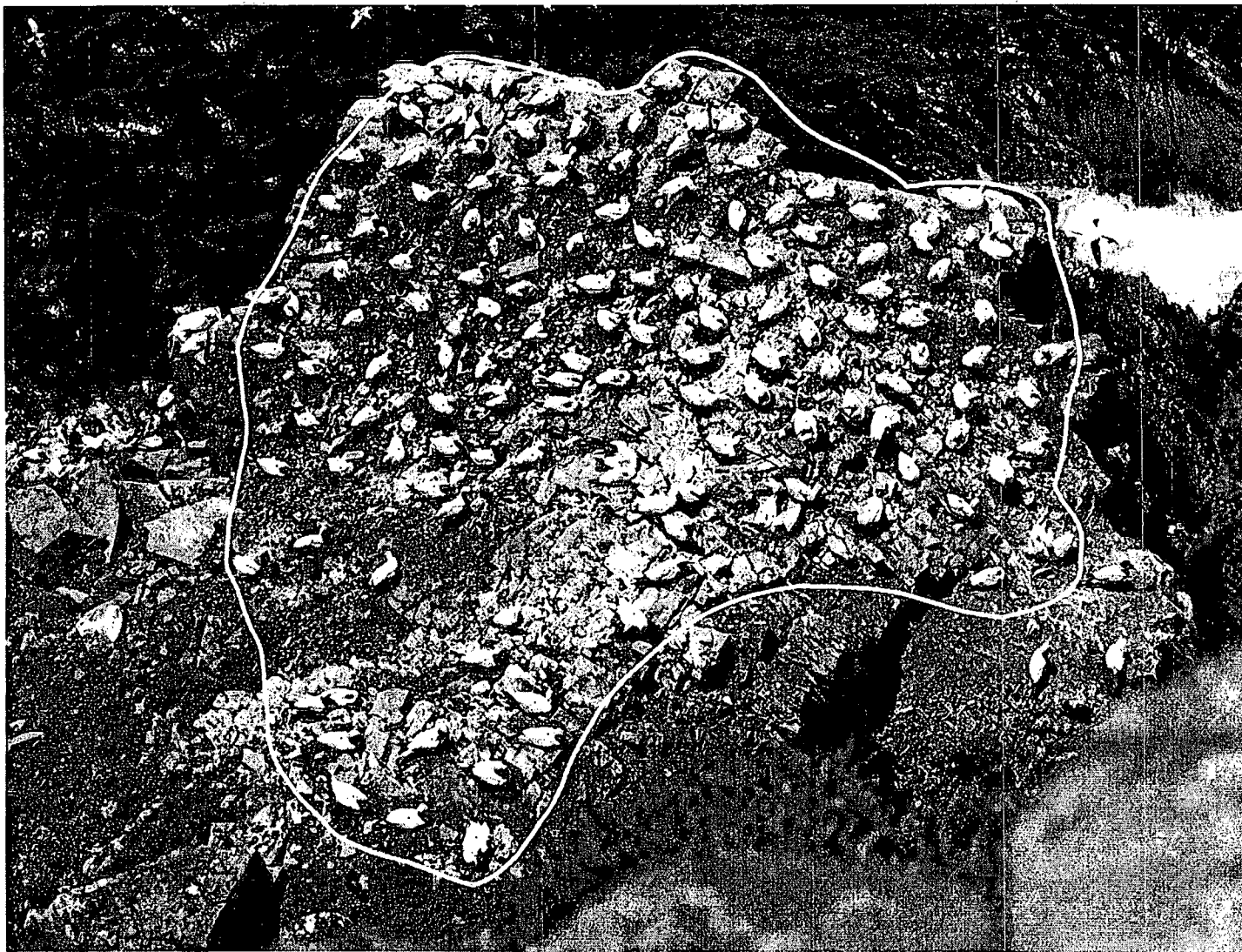
Cape St. Mary's. West side of Bird Rock from land, 1 July 1999.



Cape St. Mary's west of Bird Rock from air. 15 July 1999.



Cape St. Mary's east of Bird Rock. 15 July 1999. Site of first mainland nesting in 1972 was at top left of outline.



Cape St. Mary's. Small group from land, nesting on flattish ground at far eastern extent of nesting on mainland to east of Bird Rock. 1 July 1999.