A Remote Sensing Technique For Quantifying Lobster Fishing Effort

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CONTENTS

ABSTRACT

Pringle, J.D. and R.E. Duggan. 1983. A remote sensing technique for quantifying fishing effort. Can. Tech. Rep. Fish. Aquat. Sci. 1217: v + 16 p.

There is a paucity of data on both the geographic distribution and amount of effort expended in the eastern Canadian inshore lobster fishery. Mandatory logbooks were deemed impractical; consequently, remote sensing techniques were investigated. Both color-positive (Kodak No. 2448) and black and white infrared (Kodak No. 2424) films were employed in Wild aerial cameras from a fixed-wind aircraft at heights of 305 m, 458 m, 763 m, and 1,220 m. Lobster buoys of traditional material, size, and color were distinguished with 100% accuracy (based on ground truthing) at the lower three heights. Color film was superior to infrared.

The effort expended in lobster grounds along 2 km of shore was assessed with color film from a height of 915 m. The error recorded in assessing lobster buoys was 11.3%. The use of aerial photography for assessing trap distribution and number is recommended.

Key words: Infrared, color film, lobsters, fishing effort, buoys, camera, airplane.

RÉSUMÉ

Pringle, J.D. and R.E. Duggan. 1983. A remote sensing technique for quantifying lobster fishing effort. Can. Tech. Rep. Fish. Aquat. Sci. 1217: v + 16 p.

Il y a un manque de données concernant la répartition géographique ainsi que l'importance des efforts consacrés à la pêche côtière du homard dans l'est du Canada. On a jugé peu pratiques les livres de bord obligatoires et on a par conséquent étudié les méthodes de télédétection. On a utilisé des films positifs couleur (Kodak n^{o} 2448) et infrarouge noir et blanc (Kodak n^{o} 2424) dans des chambres de prises de vues aériennes Wild à bord d'appareils à voilure fixe à des altitudes de 305 m, 458 m, 763 m, et 1,220 m. Les bouées de trappes à homards de fabrication, de taille et de couleur classiques étaient distinguées avec une précision de 100% (d'après une vérification sur place) aux trois plus faibles altitudes. Le film couleur donnait de meilleurs résultats que le film infrarouge.

L'effort de pêche consacré aux bancs de homards le long d'un segment de côte de 2 km a été évalué au moyen du film couleur d'une altitude de 915 m. L'erreur au niveau de l'évaluation des bouées de trappes à homards était de 11.3%. On recommande l'utilisation de la photographie aérienne pour l'évaluation de la répartition et des nombres des trappes à homards.

INTRODUCTION

The lobster fishery in the Scotia-Fundy Region is carried out over thousands of miles of coastline, making it difficult for biologists to make independent assessments of abundance through traditional research techniques. Frequently the latter is a problem in finfish assessment which has been circumvented, to a certain extent, by employing good catch and effort data (Ricker 1975). The latter are recorded by fishermen in daily logbooks. Canadian lobster landings have been recorded since 1869 (Prince 1899), and recently the system was upgraded (Cormier 1980). Nevertheless, parameters required by fisheries scientists such as location of harvest, trap number, soak time, bait type, and so on are not recorded. The lack of these types of data was noted in the proceedings of a U.S./Canada lobster workshop (p. 92 - Anthony and Caddy 1980). Here the delegates appealed for a statistical reporting system that reflects the needs of scientific resource management. They highlighted the need for effort data. The introduction of mandatory logbooks was deemed impractical by both the delegates at the latter workshop and by Conan and Maynard (1983).

Effort assessment via remote sensing (aerial reconnaisance and aerial photography) has been employed in the following Canadian Atlantic fisheries: Irish moss (Pringle and Semple 1980; G.J. Sharp and D.L. Roddick pers. comm.[1]), herring (Messieh and MacPherson 1981), scallop (Jamieson et al. 1981; Robert et al. 1982), and lobster (Conan and Maynard 1983). Miller and Colodey (1983) employed helicopters to monitor sea urchin diebacks. Conan and Maynard (1983) counted and photographed lobster buoys in Northumberlad Strait from a fixed-wing aircraft. They found, however, that black and white photographs did not yield sufficient resolution, particularly during wind-swept seas. Color photography gave good results, but the airplane was not equipped to routinely handle it. Reported here are the results of experiments carried out to determine the usefulness of color and black and white infrared photography to discriminate various colored lobster buoys from various camera heights. The results of the technique applied to a small portion of the St. Margarets Bay, Halifax Co., lobster fishery are given as well.

MATERIALS AND METHODS

EXPERIMENTS

Rectangular wooden buoys 35 cm x 10 cm x 10 cm and Downey's Plastics No. 4 styrofoam buoys 15 cm high x 18 cm dia. with the bottom half tapering to 10 cm dia., were painted in colors and color combinations used by lobster fishermen (Table 1). Each

[1]G.J. Sharp and D.L. Roddick, Fisheries Research Branch, Scotia-Fundy Region, Halifax Fisheries Research Laboratory, Department of Fisheries and Oceans, Halifax, N.S. B3J 2S7

Table 1. Number, color scheme, and construction of buoys.

	White	Yellow	Red	Blue	Green	F red	F orange	F green	F red
White	S W	S W	S W	S W	S W				
No.	4 4	4 4	4 4	4 4	4 4				
Yellow		S W	S W	S W					
No.		4 4	4 4	4 4					
Red			S W	S W					
No.			4 4	4 4					
Blue				S W	S W				
No.				4 4	4 4				
Green					S W				
No.					4 4				
F red						S			
No.						4			
F orange							S		
No.							4		
F. green								S	
No.								4	
F. red									P
No.									6

F - flourescent
P - plastic
S - styrofoam
W - wood

color scheme was repeated four times for each type of buoy construction. Three replicate strings using each buoy type and color scheme were prepared. Buoys were spaced at 5 m intervals along a line anchored at both ends. The remaining buoys were attached to lines with individual anchors.

St. Margarets Bay, Halifax Co., was chosen as an experimental area (Fig. 1). The area south of Boutilier Point and to the east of Strawberry, Wood, and Croucher Islands was chosen as a test site. The area provided a ready reference to land masses for charting buoy locations, a variety of depths in a small area, and availability of a workboat already under charter for fisheries research. Both the replicate strings of buoys and the individual buoys were placed haphazardly throughout the site. The sea-based crew recorded buoy locations in relation to landmarks to permit an assessment of the accuracy of the aerial photography.

Aerial photography was performed from a twin-engine Piper Aztec (PA-23) chartered from Atlantic Canada Airborne Sensing, Chatham, N.B. The aircraft had a Wild RC-8 aerial camera mounted in a vertical convex port. The camera was equipped with a 15.24 cm lens and a navigational sight which could be adjusted for tilt and drift angles. Photographs were taken to provide 60% forward overlap. Two types of films were employed: Kodak No. 2424 black and white infrared and Kodak No. 2448 color-positive. Photographs were taken from altitudes of 305 m, 458 m, 763 m, and 1,220 m to give scales of 1:2,000, 1:3,000, 1:5,000, and 1:8,000 respectively. The first flight was conducted November 28, 1982. Clear skies, light winds, and calm seas prevailed.

The film was sent to the manufacturer for processing. The returned prints were examined by a professional photographic interpreter using a hand lens (x 8). Interpretation of color prints was further enhanced by placing them on a light table during examination. The color of the prints was adversely affected by the type of filter used [Kodak Wratten 12 (520 nm)]; however, interpretation was not affected. The interpreter was able to detect and identify buoys on both kinds of prints at scales of 1:2,000, 1:3,000, and 1:5,000 but felt the color prints were superior to the infrared. All buoys could not be detected at the 1:8,000 scale. This was thought to be due to insufficient resolving power of the camera at 1,220 m. A mosaic was made of the color prints and a digitizer was employed to quantify the buoys and plot their distribution in relation to the islands. The MRMS[2] Geobased Mapping System was employed to prepare the maps.

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[2]MRMS (Maritime Resource Management Service), P.O. Box 310, Amherst, N.S. B4H 3Z5.

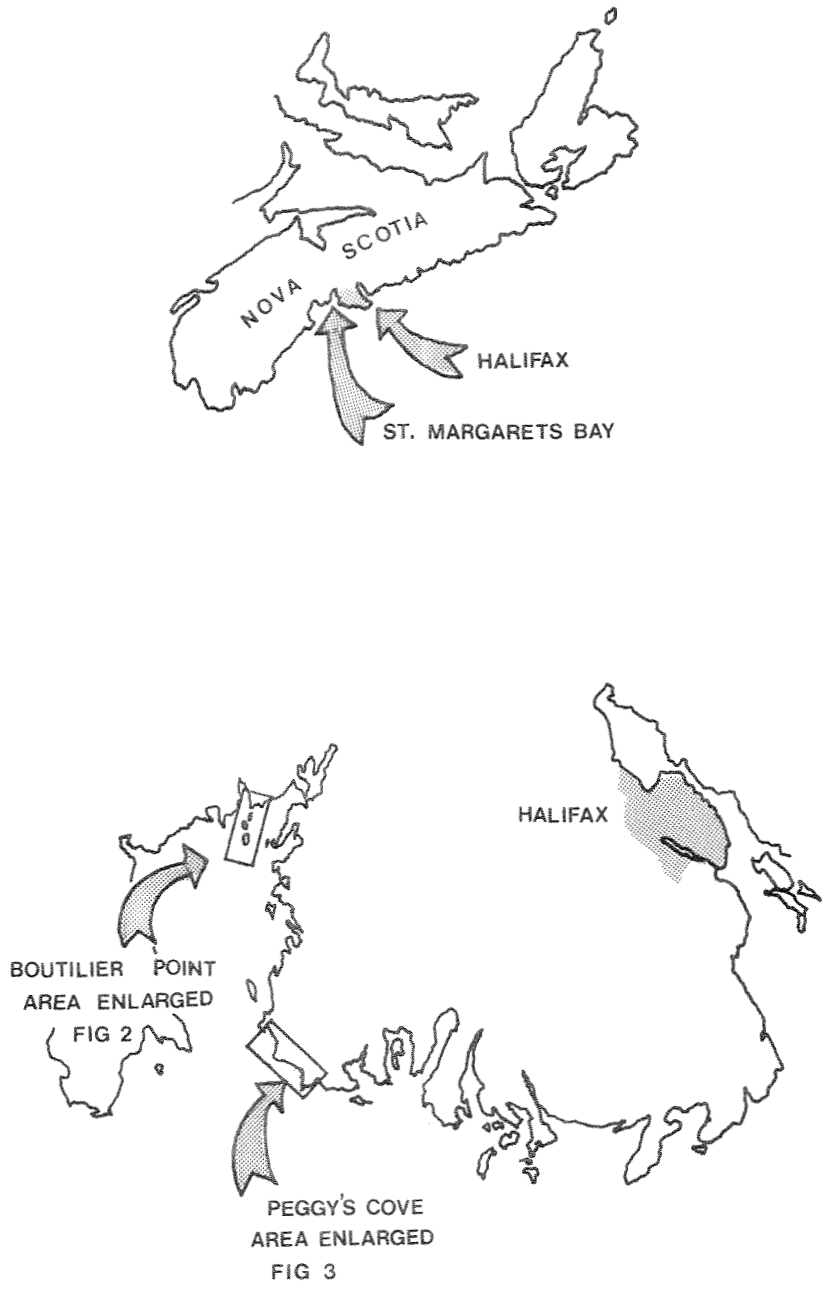

Figure 1. Locations of test sites.

FISHERY

Based on the results of the above trials it was decided to adopt the color-positive technique from an altitude of 915 m giving a photograph at a scale of 1:6,000 and a coverage of 1,840.2 m^2. To test the technique in the lobster fishery a 2 km stretch of coastline along St. Margarets Bay from Paddys Head to Peggys Point was chosen. A flight over this site was flown December 14, 1982, using a Fairchild K-17 aerial camera with capabilities similar to a Wild RC-8, and a Kodak HF-3 (425 nm) filter. The following day, Department of Fisheries and Oceans personnel conducted a surface count of buoys in the area. Because of sea conditions at the time, exact locations of buoys in relation to nearest land was not determined. A map of observed buoy locations was made using the MRMS Geobase mapping system.

RESULTS

The techniques employed were successful but it is recommended that future flights be done with a sun angle of 25° or less. All buoys placed on the test site were located on both the color-positive and black and white infrared photographs (Fig. 2) from heights of 305 m, 458 m, and 763 m. However, 18 buoys used by fishermen to mark fish trap anchors were also located and plotted. These appear as a cluster off the south end of Croucher Island (Fig. 3) and apparently are indistinguishable from test buoys. The photography also revealed a herring net, easily recognizable because of the buoy configuration, which was not recorded.

Results of the second flight are shown on Figure 3. There was difficulty in conducting the ground truthing due to poor weather conditions. Buoys were difficult to see and the area photographed was larger than that covered by boat. The total count from surface was 404 and from aerial photography was 565, an error of 28.5%. However, there was one enclosed area, Indian Harbour, where ground truthing recorded a total of 69 buoys: 63 lobster buoys, 2 mooring buoys, and 4 channel markers; 71 buoys were recorded by the interpreter. Again, buoy types were not distinguishable; thus, an error of 11.3% was noted for lobster buoys.

DISCUSSION

Aerial color photography using a Wild RC-8 or a Fairchild K-17 aerial camera, a 15.24 cm lens, Kodak No. 2448 color-positive film, and a Kodak HF-3 filter from a maximum height of 915 m gives sufficient resolution to detect lobster

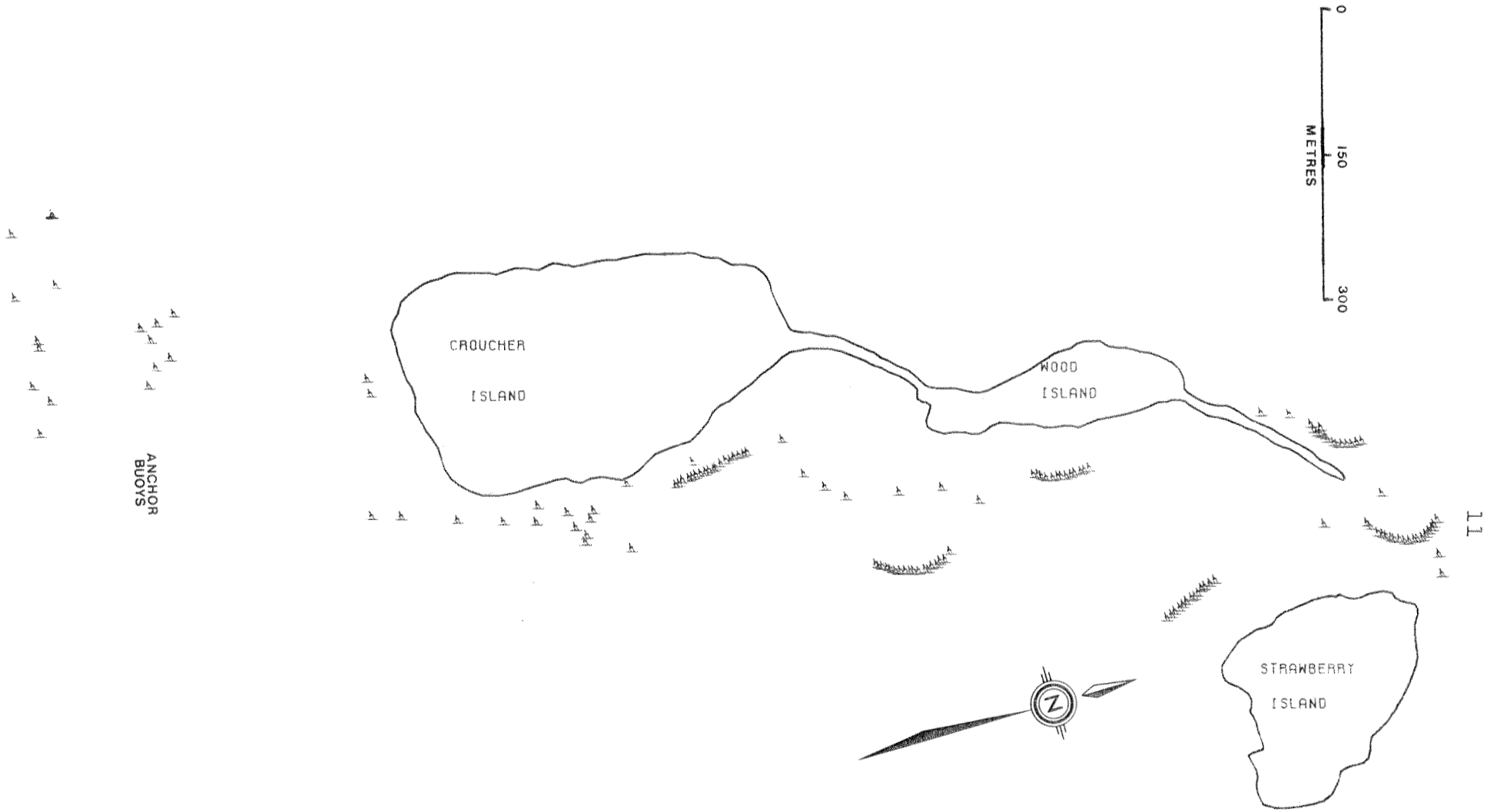

Figure 2. Map of buoy locations - simulation.

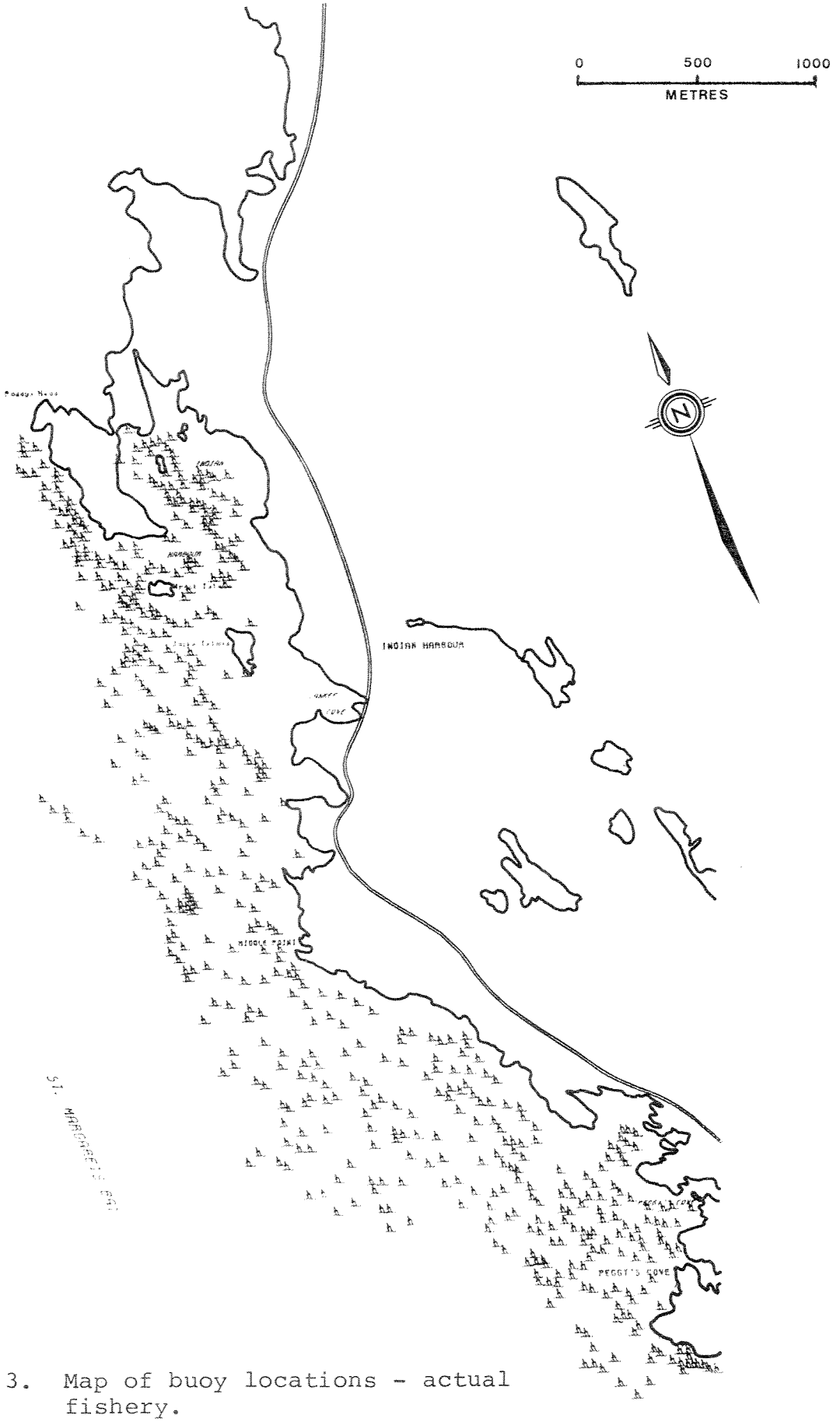

Figure 3. Map of buoy locations - actual fishery.

buoys constructed of traditional materials and painted traditional colors. To enhance interpretation the sun should be low angled. The height of 915 m permits a linear coverage of 1,840.2 m. The cost per kilometer is approximately $17. This figure is for the flight time and photography only and does not include flying time to the research area or photograph interpretation. The cost of direct visual counts employed by G. Conan and D. Maynard (pers. comm.) would be approximately $1.50/km. The major advantage of using aerial photography versus aerial visual counts is that a flight plan can be given to a contractor such as MRMS; there need be no further involvement on the part of the contractee until data are presented. During preparation of this paper the contractor acquired a new Zeiss aerial (RMK 15/23) camera which they feel can provide similar resolution from higher altitudes. This capability would result in lower costs (approximately $15/km) to conduct similar programs.

There are drawbacks with aerial photography, however. Flights can only be made during calm weather conditions and at low sun angle (maximum 30°) or cloudy periods. As well, if other fisheries in the area employ a large number of surface buoys then the error component may be large. Fortunately, most inshore fishermen are lobster fishermen; consequently, during the lobster season in most areas there would only be a minor amount of other buoyed gear. Nevertheless, prior to any aerial survey it is recommended that an assessment be made of the latter.

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