SHIPPING SURVEILLANCE DATA FOR CHURCH GABBRO

Eric L. Sander

Raff Associates, Incorporated

Prepared for:
Office of Naval Research

15 March 1973

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SHIPPING SURVEILLANCE DATA FOR CHURCH GABBRO

15 March 1973
Report No. 73-7

Sponsored by:
LRAPP
Office of Naval Research
Code 102-OSC
Department of the Navy

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ASSOCIATES, INC.
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GENERAL RESEARCH CORPORATION
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This report presents the shipping surveillance data gathered during the CHURCH GABBRO Exercise in December 1972 under the sponsorship of LRAPP. The report contains a description of the surveillance methods used and the areas covered. The shipping data are presented on maps and in tabular form for each day of surveillance. The tabulated data include length and speed estimates for some of the ships surveyed.
SHIPPING SURVEILLANCE DATA
FOR CHURCH GABBRO

March 15, 1973

Eric L. Sander

Submitted to:
Office of Naval Research
Code 102-OSC
Department of the Navy
Arlington, Virginia 22203

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Contract # N00014-71-C-0118

RAFF ASSOCIATES, INCORPORATED
912 Thayer Avenue
Silver Spring, Maryland 20910
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A SUBSIDIARY OF GENERAL RESEARCH CORPORATION
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SHIPPING SURVEILLANCE

1. Summary of Operations. The aircraft schedule was carried out in accordance with the exercise plan, by the units which were designated therein, and at the geographic locations which had been specified. The number of aircraft sorties each day is summarized as follows:

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* Includes one aborted sortie -- engine trouble

This exercise schedule provided a built-in redundancy in shipping surveillance over most of the area of interest, with particular emphasis on December 4 and 6. As it turned out there were no apparent gaps in the area coverage of the actual operations despite modifications of the planned survey tactic in five sorties due to difficulties arising on station.

In general, the aircraft crews proved to be capable, motivated and hard working. It is believed that their navigation was excellent, facilitating a knowledge of the ships' locations. For a large fraction of the area surveyed, the use of radar navigation was possible. This more than made up for the poor functioning of the inertial navigation systems and inadequate LORAN coverage. In areas where land was more distant, however, the poor navigation performance will continue to limit the data accuracy. The crews and the PIs modified the planned surveillance tactics in some flights to overcome difficulties due to equipment failures and poor weather. All the surveillance areas were covered, but in some cases the modified
tactics could not provide the quality of data that the original tactic could have provided. Although the crews performed well, the frequency of equipment failures, particularly in the VP 16 aircraft, must be described as disappointing.

The principal technical difficulty of the shipping surveillance was that caused by false radar contacts — the incorrect identification of clouds as ship contacts. In the exercise, this problem was caused by scattered clouds in generally clear weather areas and probably could have been minimized by reducing the radar range and flying at altitudes of 2000 feet or less, below the clouds. This would, of course, have reduced the surveyed area slightly; but the net effect would have been beneficial. Despite difficulties with equipment failures and false contacts, there are no major gaps in the intended area coverage and the data should provide adequate inputs for modelings of ambient noise.

2. Tactics Descriptions. Three basic surveillance tactics were used.

The first is the Radar Only Tactic (ROT). As the aircraft flew a prescribed path, the crew recorded the range and bearing to each radar contact and the aircraft position and the local time at that moment. The APS-50 radar could provide good coverage out to about 60 n.m. and some contacts were recorded at distances greater than twice that range. This method provides only contact positions and was used only in transit to and from surveillance areas of major importance; in sorties in which environmental measurements were the primary objectives which dictated the aircraft track and on the first day when only two aircraft were used to survey the entire area. Naturally, false contacts here would create an inaccurately high ship count.

The second tactic was the Radar Survey Tactic (RST) and it is planned for use in the surveillance areas of major importance. The aircraft crew drops an SSQ 43 sonobuoy at a designated spot, returns to it using the on-top indicator, and records the local time and the range and bearing of all the radar contacts visible on the scope at the moment they pass over the sonobuoy. The aircraft then flies to another location 60 n.m. away and
repeats this procedure. The plane continues to fly back and forth between the two locations making these radar maps for a period of about four hours. Some time is reserved in the middle of this period to visually observe the radar contacts and obtain the ship's name and visual estimates of speed, course, and length. The series of positions of the radar contacts can be used to reconstruct excellent determinations of ship position, speed, and course. False contacts complicate reconstruction; but they are eliminated by reconstruction, because they do not form ship tracks.

The final method is the Visual Survey Tactic (VST). It was used when equipment failure or bad weather prevented the use of the RST. The aircraft followed a nominal ladder search pattern covering the area with a track spacings out to 30 n.m. depending on the radar or visual range available. When a contact was detected whose position was less than half the track spacing away from the intended track, the aircraft flew to it to obtain the name and visual estimates of length, speed, and course. Speed and to a lesser extent course estimates using the VST are not as good as those obtained using the RST tactic. Although false radar contacts do not contaminate VST data, time can be wasted chasing them.

3. Data. The shipping data collected for each day are presented in the following manner:

For 2, 5, and 7 December 1972, the following figures and tables are given for each plane:

1. A figure showing the approximate flight path and RST coverage.
2. A figure showing the approximate positions of the RST contacts.
3. A table of the latitudes, longitudes and sighting times of the RST contacts.

Finally, a figure for the RST contact density for each day is given. The following assumptions were made in the creation of these maps:

1. If three-fourths or more of a one degree square was within 60 n.m. of a RST track the square was considered to have been observed by the plane.
2. The square may have been observed by the same plane at a later time or by another plane.

3. The contact density for that square is the total number of contacts observed in that square divided by the total number of observations.

For 4 and 6 December 1972, the following figures and tables are given for each plane:
1. A figure showing the approximate flight paths and RST, VST and or ROT coverage.

2. A figure showing the approximate positions of all contacts.

3. A table of the latitudes, longitudes, and sighting times of the ROT contacts (none were obtained by P3#3).

Also, a table showing the speed, course, position, and size estimates of the VST and RST contacts for all the planes on that day is given. The positions here are the dead reckoned positions for a standard time (1500 Z for the 4th, 1700 Z for the 6th). Also, estimates of the uncertainty in the RST speed and course estimates are expressed as plus or minus one standard deviation and are based on the conservative assumption that the relative positions of the multiple contacts on a single ship are known with a standard deviation of error of 4 n.m. Finally, a figure for the ROT contact density for each day is given. When this data is used in an ambient noise model for a particular hydrophone, the VST or RST data for the nearby squares should be used and these densities for the squares farther out should be used.
A. Data for 2 December 1972
FIGURE I -- The Approximate Flight Path and ROT Area Coverage for P374 (VXN 8) on 2 December 1972. The Greenwich Mean Time (Zulu) When the Plane Reached Key Positions are Given.
FIGURE 11 - The approximate positions of the radar contacts (o) made by P-44 (102) on 2 November 1972.
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FIGURE III -- The Approximate Flight Path and ROT Coverage for P385 (NRL) on 2 December 1972. The Greenwich Mean Time (ZULU) when the plane reached key positions are given.
### Table 2 - HOT Contacts

**Plane:** P3#5 (NRL)

**Date:** 2 December 1972

**Pilot:** LCDR Hutchins

**PI:** Barrett

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Date: 2 December 1972
Pilot: LCDR Hutchins
PI: Barrett

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*It is believed that these are two destroyers maneuvering within 13 n.m. of this position. Only Contact 22 was sighted and no straight tracks could be obtained from the RST.*
FIGURE VII -- The Approximate Positions of the Rot (●) and RST (→—1500 Greenwich Mean Time) Contacts Made by P3/1 (VP-16) on 4 December 1972.
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FIGURE VIII -- The Approximate Flight Path and VST and RST Coverage for P3B2 (VP-10) on 4 December 1972. The Greenwich Mean Times for Key Positions are Given.
FIGURE IX — The Approximate Positions of the ROT (•) and YST (→) Mean Time Contacts Made by P392 (VP-16) on 4 December 1972.
### TABLE 5 - ROT CONTACTS

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**Date:** 4 December 1972  
**Pilot:** Harvey  
**PI:** Lackie

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FIGURE X -- The Approximate VST Area and VST Contact Positions Dead Reckoned to 1500 Greenwich Mean Time for P3#3 (VP-16) on 4 December 1972.
FIGURE XII — The Approximate Positions of the Radar Contacts for P-X4 (WKN 8) on 4 December 1972.
### TABLE 6 - ROT CONTACTS

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**Date:** 4 December 1972

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### TABLE 6 - ROT CONTACTS (Cont)

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**Date:** 4 December 1972

**Pilot:** Lt. Lamb  
**PI:** R. Beckner

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C. Data for 5 December 1972
FIGURE XVI -- The Approximate Flight Path ROT Coverage and Survey Area for P3#4 (OX7 3) on 5 December '972. The Greenwich Mean Times for Key Positions are Given.
TABLE 8 - ROT CONTACTS

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Date: 5 December 1972
Pilot: Lt. Lamb
PI: R. Beckner

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**TABLE 9 - ROT CONTACTS (Cont)**

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**Date:** 5 December 1972  
**Pilot:** Hutchins  
**PI:** E. Sander

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FIGURE XX — The Observed Density for One Degree Squares of ROT Radar Contacts on 5 December 1972 (Average Density: 1.4 Contacts Per One Degree Square).
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FIGURE XXI -- The Approximate Flight Path and RST and ROT Coverage for P3J1 (VP-15) on 6 December 1972. The Greenwich Mean Times for key positions are given.
FIGURE XXII -- The Approximate Positions for the ROT Contacts (*) and VST Contacts (←→ 1700 Greenwich Mean Time) for P3/1 on 6 December 1972.
TABLE 11 - ROT CONTACTS

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Date: 6 December 1972

Pilot: Brockley
PI: J.I. Bowen

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FIGURE XXIII -- The Approximate Flight Path and VST and ROT Coverage Areas for P3#2 on 6 December 1972. The Greenwich Mean Times for Key Positions are Given.
# TABLE 12 - ROT CONTACTS

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**Date:** 6 December 1972

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FIGURE XXV — The Approximate VST Area and VST Contact Positions Dead Reckoned to 1700 Greenwich Mean Time for P3#3 on 6 December 1972.
FIGURE XXVII — The approximate positions for the ROT (*) and RST (→ 1970 Greenwich Mean Time) contacts for P285 on 6 December 1972.
### TABLE 13 - ROT CONTACTS

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**Date:** 6 December 1972  
**Pilot:** Hutchins  
**PI:** Kane

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E. Data for 7 December 1972
FIGURE XXX -- The Approximate Positions of the Radar Contacts Made by P3#4 (VXN 8) on 7 December 1972.
### TABLE 14 - ROT CONTACTS

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**Date:** 7 December 1972  
**Pilot:** Lt. Lamb  
**PI:** E. Sander

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### TABLE 14 - ROT CONTACTS (Cont)

**Plane:** P3#4 (VXN 8)  
**Date:** 7 December 1972  
**Pilot:** Lt. Lamb  
**PI:** E. Sander

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IV -- REFERENCES

1. Office of Naval Research, "CHURCH GABBBRO Exercise Plan(U)", Maury Center Plan MC-010 of 26 October 1972, CONFIDENTIAL


8. Naval Oceanographic Office (Fenner and Bucca), "CHURCH GABBBRO Sound Velocity Analysis and Environmental Data Summary", NAVOCEANO Technical Note No. 7005-3-73, May 1973


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