ERTS-1 ROLE IN LAND MANAGEMENT AND PLANNING IN MINNESOTA

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ABSTRACT

Research on applications of ERTS-1 imagery to land use has focused on evaluating the ability of ERTS-1 imagery to update and refine the detail of land use information in the Minnesota Land Management Information System. Work has been directed toward defining the capabilities of the ERTS-1 system to provide information about surface cover by identifying forest, water, and wetland resources; urban and agricultural development: and testing and evaluating data input and output procedures. As capabilities were developed, meetings were held with administrators and resource information users from various agencies of government to identify their information needs.

A full scale systems test for several selected pilot areas in the state is nearly complete. Users have been identified for each test area and they have been instrumental in identifying data requirements and analysis needs for administrative purposes. Users have both rural and urban orientations and provide a basis for evaluation of the results.

INTRODUCTION

The Minnesota State Planning Agency and University of Minnesota are engaged in a cooperative effort to develop and evaluate the utility of the ERTS-1 imagery to update and refine the detail of land use information in the Minnesota Land Management Information System (MLMIS). There are three basic objectives for this work effort.

1. To define the capabilities of ERTS-1 imagery to provide information about surface cover by identifying water and wetland resources, urban development, agriculture, and forestry; and testing data input and output procedures.

2. To utilize ERTS-1 imagery in ongoing research and planning operations of land management agencies in the state.

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3. To transfer the developed capabilities for using remote sensing data to state and regional agencies charged with planning, policy development, and management of land-based resources in Minnesota.

This paper focuses on what has been done and what is being done to achieve these objectives.

SURFACE COVER INFORMATION CAPABILITIES

The ability to extract surface cover information from ERTS-1 imagery of Minnesota is highly variable among the range of surface cover types found in Minnesota. Each broad class of land cover has its own optimal season(s) for interpretation. For an individual class this season may vary as a function of location or local site conditions.

Based on analysis of 12 months of coverage, the ability to add detail to the surface cover classes also varies from place to place. Table 1 shows the kind and detail of information that can be extracted reliably throughout the state and those details that can be added on occasion in some areas.

Many of the second and third land cover classes are limited by the unit size necessary for discrimination and the necessity of coverage in an extremely narrow time period in order to discriminate some features from their surroundings. For example, a small seasonal wetland with open water will probably be detectable for only a few days to a few weeks at most; and seasonal wetlands with uniform emergent vegetation are not reliably detected below 75 acres in size in certain parts of the state. These problems would probably be greatly reduced with thermal infrared band images, more frequent coverage, or reductions in cloud cover.

DEMONSTRATION PROJECTS

Three demonstration projects have been selected to encompass the range of surface cover conditions found in Minnesota. Potential users have been identified and are to provide the basis for evaluation of results. Itasca County was selected because of the importance of forests, iron ore resources, and substantial local interest in information sources for use at the county level. The Twin Cities Metropolitan Area was selected because of the urban uses, rapid change, and user interest. Monitoring of plowing in west central Minnesota was selected as a demonstration solely on the basis of intense user interest.

Table 1

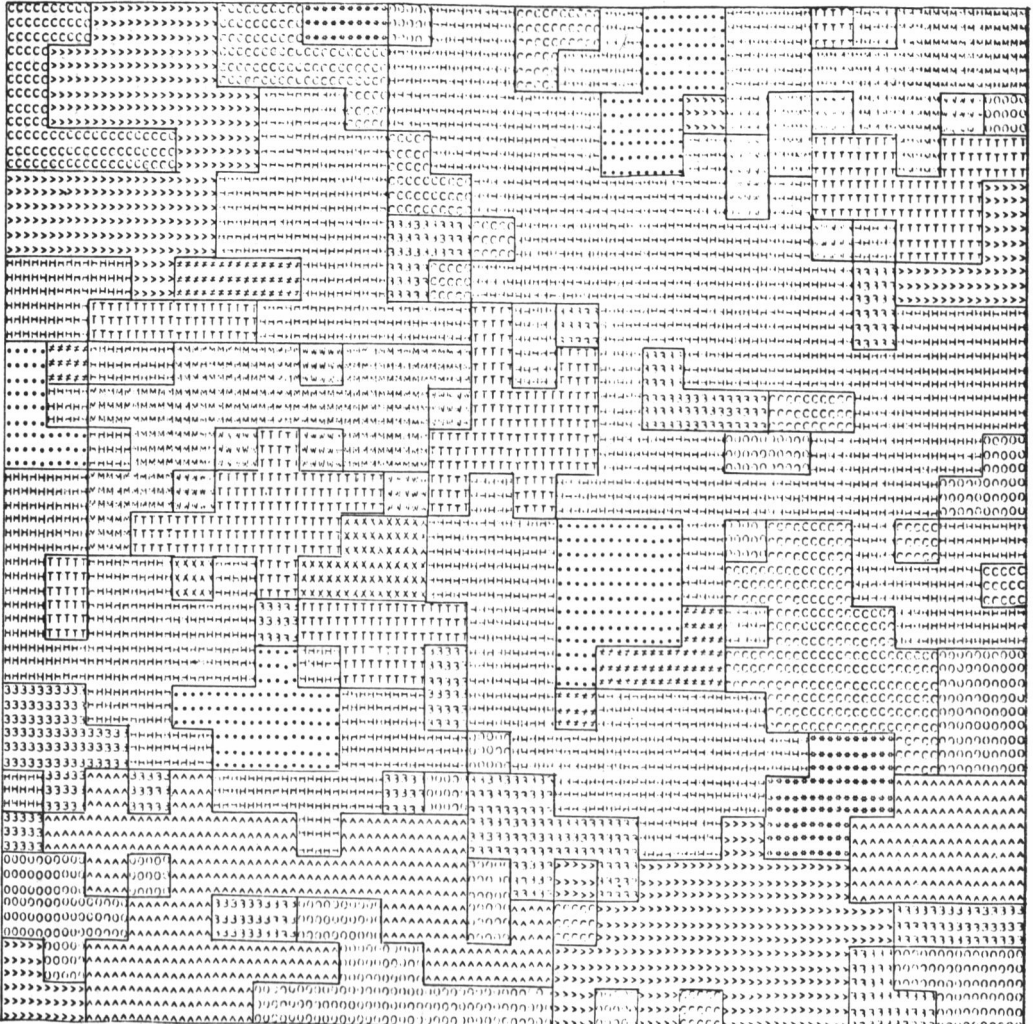Classes of Land Surface Cover for Minnesota Obtained from ERTS-1 Imagery

Level I	Level II	Level III
Extractive	Iron Mining	Tailings pond Tailings basin Tailings & stripping piles Pits
	Gravel Rock Sanitary Landfill*	
Urban	Residential	Mixed single/multiple units Single unit, high density* Single unit moderate density*
	Commercial/Industrial/ Institutional	Commercial core outlying centers and strips
Water	Lakes	Natural basin Excavated basin (mine, pits, etc.)
	Rivers	
Wetlands	Northern Bogs Southern Perennial* Southern Seasonal*	Several vegetation types
Forests	Conifer* Hardwoods* Mixed*	
Cultivated	Season of Tillage	
Open and Other	(non-cultivated farmland, pasture, & open non-farmlands)	

* Indicates classes of cover that can be added locally depending on
   proper seasons of coverage and local environmental conditions.

   Surface cover for the southern one-third of Itasca county was
mapped. Foresters in the county are now evaluating the results
under the direction of Dr. Merle Meyer of the University of Minnesota.
Two townships, having a wide range of cover types, were selected
to test cathode-ray tube entry procedures for ERTS-1 updating of
MLMIS. A sample output of the stored information is shown in Figure
1. The system is capable of producing this output for all townships
in the state and land cover information can be compared with a variety
of environmental information stored for the same area. Data can be
manipulated to map change, non-conforming use, use by type of owner-
ship, etc.

GREENWAY TOWNSHIP, ITASCA COUNTY, MINNESOTA
LAND USE FROM ERTS-1
1972

Figure 1

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ERTS I
METROPOLITAN LAND USE CLASSES
Twin Cities, Minnesota

Commercial Core
Industrial Core
Commercial/Industrial Strip
High Density, Single Family Residential Units
Low Density, Single Family Residential Units
Mixed Single and Multiple Family Residential Units
Urban Open
Extractive
Non-urban
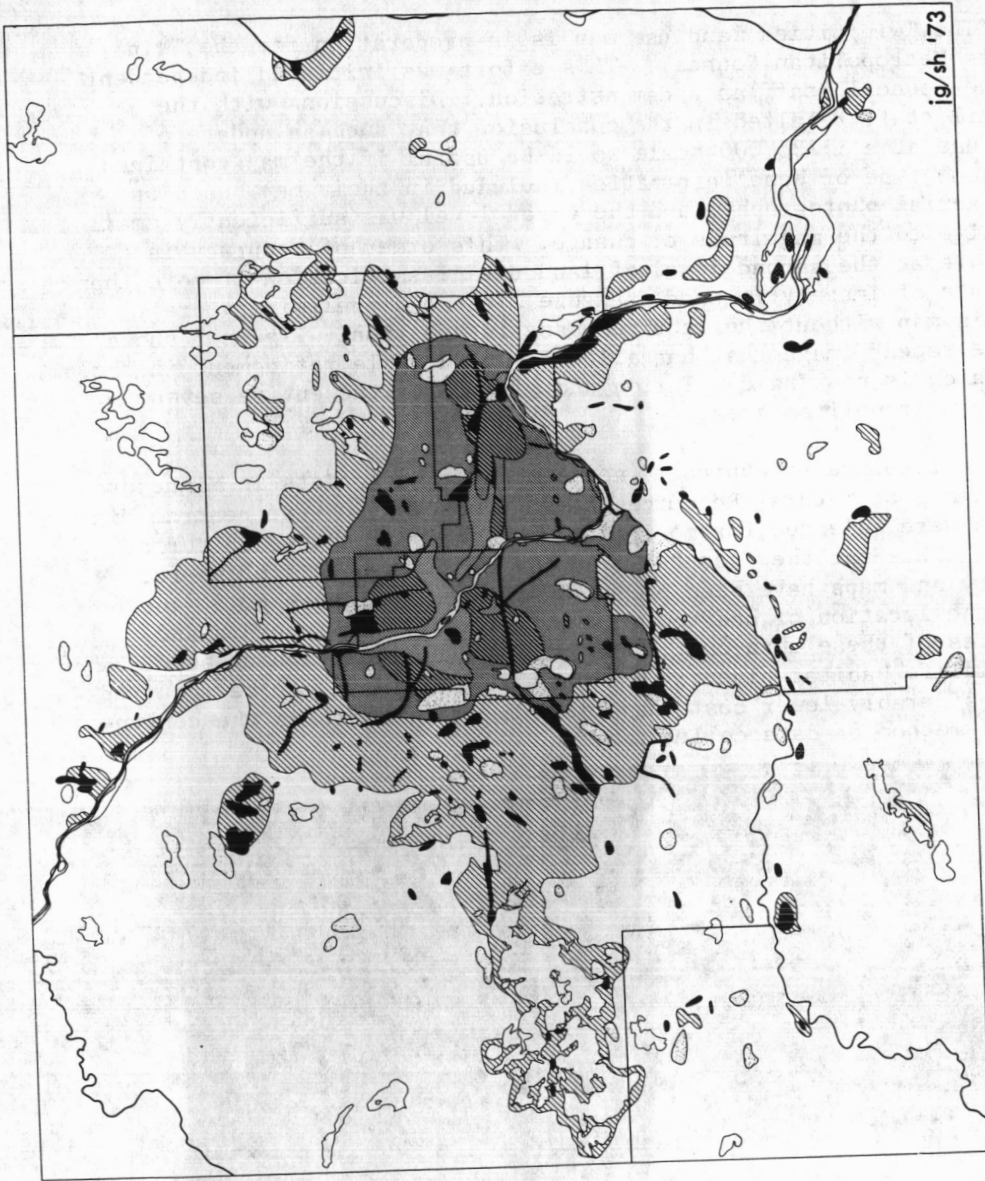
ig/sh '73

Figure 2

The Twin Cities land use map is in preparation for the Twin Cities Metropolitan Council. This effort was initiated independent of the Council staff as a demonstration. Discussions with the Council staff resulted in the conclusion that such an update of land use at a 1:125,000 scale would be useful if the map contained the same type of base information included in their map based on 1966 aerial photography, and the error level was sufficiently small relative to the magnitude of change. This order of accuracy is possible at the second level of land use classification if more than one date of imagery is used. Figure 2 shows a preliminary draft of this map without the required base information. Figure 3 shows a more recent image that has allowed considerable refinement in the map which is nearing completion and will cover the entire seven county metropolitan area.

In response to expressed needs of game biologists in Minnesota Department of Natural Resources seven townships in west central Minnesota were selected for monitoring the seasonal change in surface cover. Thus far the area has been covered by ten sets of useful imagery and maps have been prepared for each. Figures 4, 5, and 6 show the location of one township in west central Minnesota and examples of these changes. These maps are currently being used in wildlife habitat planning projects, and the data can be acquired at considerably lower cost than field mapping, which is the conventional method of data collection.
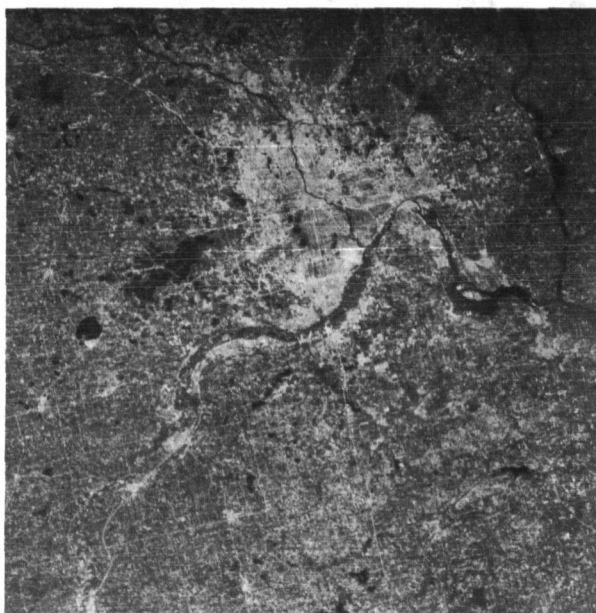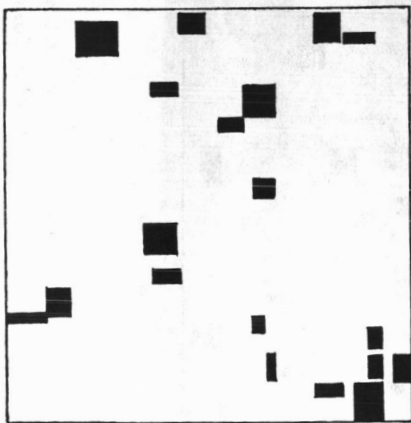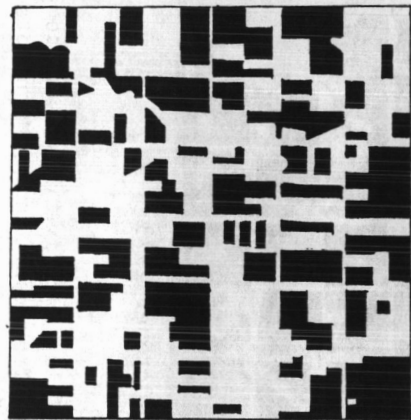

Figure 3. Twin Cities Minnesota color combined bands 5 and 7, July 3, 1973.

Figure 4. West Central Minnesota location of Croke township, Traverse County. September 21, 1972 color combined ERTS-1 image.
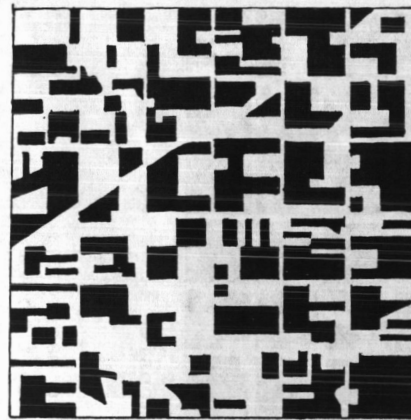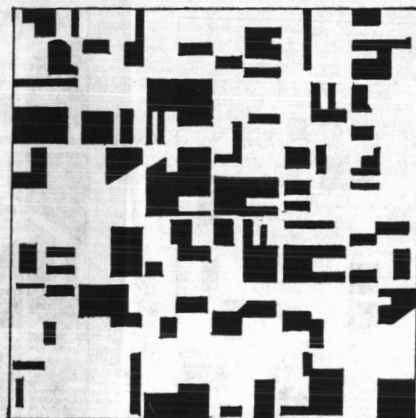
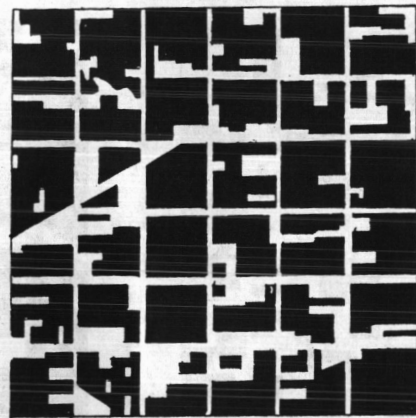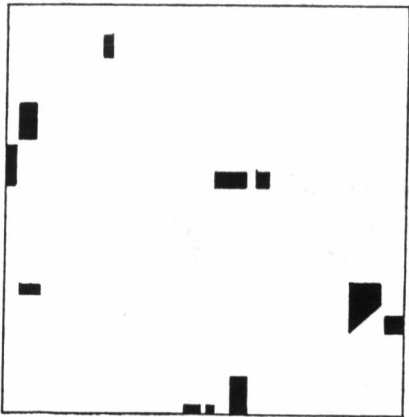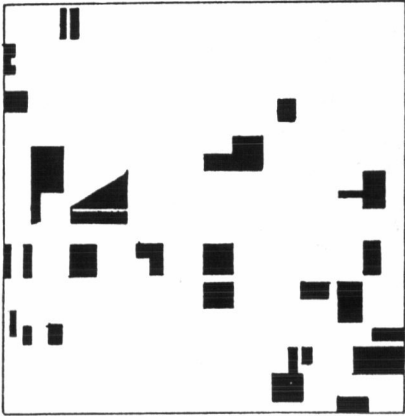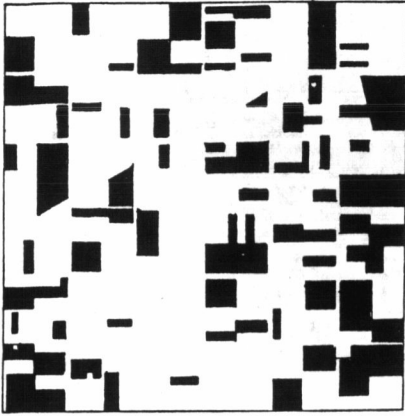Figure 5. Bare, plowed fields for five dates and composite map for Croke Township, Traverse County, Minnesota. August, 1972 – June, 1973.

8, 9 October 1972

Composite

21 September 1972

17 June 1973

16 August 1972

30, 31 May 1973

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28,29 August 1973

Composite

10 August 1973

22 October 1973

5,6 July 1973

4 October 1973

Figure 6. Bare, plowed fields for five dates and composite map for Croke Township, Traverse County, Minnesota. July through October, 1973.

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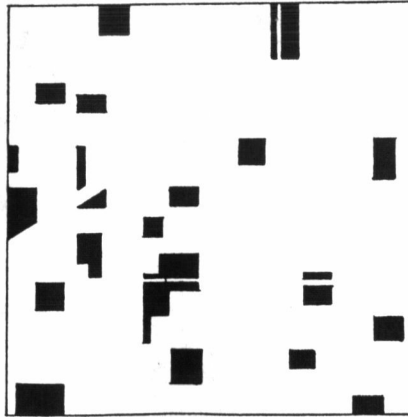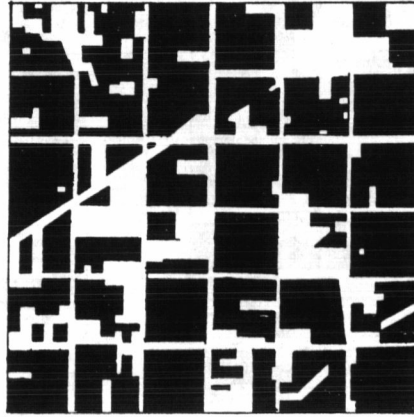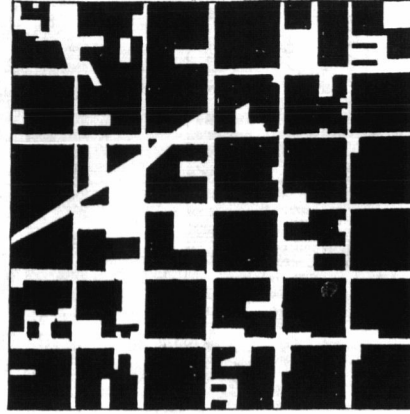## TRANSER OF CAPABILITIES

In order to transfer ERTS-1 information capabilities to govern-
mental agency users we have worked through local units of government
and the new regional development commissions which encompass the
entire state. The required development commissions have as a major
function the coordination of planning within their geographical
boundaries. Two of these regional units offer unique opportunities
to explore, demonstrate, and transfer the ability to use ERTS-1
imagery in their development, planning, and resource management
programs.

The regional unit covering the Twin Cities Metropolitan area
is particulary concerned with the rate and location of developmental
activities in the Twin Cities Metropolitan area.

Because of the capability of seasonal monitoring, the ERTS-1
imagery provides the opportunity for the Metropolitan Council to
identify open space and wetlands that require some level of pro-
tection. Monitoring urban growth further allows the identification
of major service corridors in an effort to guide development and
to adjust plans for areas in the initial stages of development. The
first effort of cooperation has been the development of an updated
land use map as a demonstration project.

The Commission covering northeastern Minnesota, which includes
the second largest metropolitan area, the largest forested area,
and the entire Mesabi Iron Range, is concerned with extractive
operations and the management of forest resources. The apparent
capabilities of ERTS-1 imagery to identify forest and extractive
resources and to monitor their changes led to the early selection
of a demonstration project in this area.

In addition to the two regional unit studies, we have been
working closely with Department of Natural Resources and State
Highway Department personnel to develop user capabilities for managers
in a variety of fields. Thus far, limited funds have allowed one
demonstration project in this area dealing with seasonal change in
surface cover.

Efforts to transfer capabilities to the user community are in
the formative stages. We have been working with personnel in the
State Planning Agency, State Highway Department, and Department of
Natural Resources to identify the information needs and to specify
user personnel in each agency. Key personnel in these agencies
are assisting in this effort and are being trained to serve as
continuing faculty for state and local unit training programs.

The lists of specific personnel and resource management application areas have been identified for several working units in the above agencies. These problem areas will serve as the focus for the first in a series of workshops for resource management staff, to begin in early February.

The Minnesota State Legislature has shown interest in the materials produced by the ERTS-1 program. They have held a special hearing for a presentation on ERTS-1 applications to Minnesota resource management problems. As a follow-up, the House Appropriations Committee toured the EROS data center and met with their staff personnel to identify the kind of product support that EROS could provide to Minnesota users. The Legislature has also provided an initial $25,000 to one agency to begin development of a broad based remote sensing program.

State-wide programs now under way in land use planning and water resource planning are beginning to employ imagery where adequate coverage exists. It is anticipated that the imagery will be used in the coastal zone planning program scheduled to begin in Spring, 1974.

IMAGE IDENTIFICATION

Figure	Image Type	Date	I. D.	Band
1	Color Combined	7 Oct. 72	1076-16370	4,5,6
2	Color Combined	6 Oct. 72	1075-16321	5,7
3	Color Combined	3 July 73	1345-16322	5,7
4	Color Combined	21 Sept. 72	1060-16485	5,7
5	70mm Bulk (+)	16 Aug. 72	1024-16484	7
5	70mm Bulk (+)	21 Sept. 72	1060-16485	7
5	70mm Bulk (+)	8 Oct. 72	1077-16431	7
5	70mm Bulk (+)	9 Oct. 72	1078-16490	7
5	70mm Bulk (+)	30 May 73	1311-16435	7
5	70mm Bulk (+)	31 May 73	1312-16493	7
5	70mm Bulk (+)	17 June 73	1329-16434	7
6	70mm Bulk (+)	5 July 73	1347-16432	7
6	70mm Bulk (+)	6 July 73	1348-16491	7
6	70mm Bulk (+)	10 Aug. 73	1383-16430	7
6	70mm Bulk (+)	28 Aug. 73	1401-16424	7
6	70mm Bulk (+)	29 Aug. 73	1402-16482	7
6	70mm Bulk (+)	4 Oct. 73	1438-16473	7
6	70mm Bulk (+)	22 Oct. 73	1456-16470	7