APPLICATIONS OF REMOTE SENSING DATA TO THE ALASKAN ENVIRONMENT

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PREFACE

Recent events on the national and international economic scene have shifted attention to the location, development, and exploitation of the natural resources in the State of Alaska. There has been rapid growth of petroleum and forest products outputs, and marine and anadromous fisheries are still a mainstay of Alaska's economy. Mineral ore production does not currently share a major role, but it might well regain and surpass its former status as a major industry.

The increasing demands upon the land and environment create critical issues for decision makers who manage Alaska's natural resources. What should be the best distribution of land ownership in Alaska? Where are the resources located, and how can they be developed? How can we enhance the quality of human life while maintaining the quality of the environment? Fortunately, some of these considerations are amenable to the application of satellite remote sensing.

The ERTS program provides a means to overcome the formidable logistic and economic costs of preparing environmental surveys of the vast and relatively unexplored regions of Alaska. There is an excellent potential in satellite remote sensing to benefit federal, state, local, and private agencies, by providing a new synoptic data base which is necessary for the preparation of the needed surveys and the search for solutions to environmental management problems.

One approach in coupling satellite data to Alaskan problems is a major program initiated by the University of Alaska and funded by NASA's Goddard Space Flight Center (NAS5-21833). This included 12 projects whose aims were to study the feasibility of applying ERTS data to the disciplines of ecology, agriculture, hydrology, wildlife management, oceanography, geology, glaciology, volcanology, and archaeology.

Equally important are the activities performed under NASA grant NGL 02-001-092 from the Office of University Affairs. This grant extends the disciplinary concepts entailed in the NAS5-21833 contract to the operating needs of mission-oriented agencies of the federal, state, and local governments, as well as private industry in some instances. The goal of this grant is to involve the active participation of public and private groups in applying remote sensing data to existing resource management problems in such form as may be most appropriate. During the first annual grant period, the implementation of this central objective has been effected by encouraging user participation in the program at a variety of levels appropriate to the users' interests. These levels are:

1 - Observation, coordination and information exchange
2 - Training courses and workshops in the interpretation of remote sensing data
3 - Data exchange
4 - Consulting services
5 - Data processing services
6 - User participation in University ERTS projects
7 - Coordination of University research with users' operational projects
8 - University participation in the user agencies operational projects.

More than two dozen agencies have participated in the program at one or more of the above levels. Of necessity during the first phase of the program the widest agency participation has been at levels 1 through 5.

ACTIVITIES

Remote sensing short courses were conducted in Fairbanks, Anchorage, and Juneau with the goal of orienting resource managers to the interpretation of multispectral imagery and the applications of ERTS data in various technical disciplines. The attendance figures were 65 at Fairbanks, 90 at Anchorage, and 45 at Juneau. While each session in the three localities varied in specific format to best meet the needs of the attendees, they followed the general pattern of the Anchorage topics listed in Appendix A. Also, included is a summary of written comments provided by the participants in the Anchorage course (Appendix B). Most of the attendees were novices in remote sensing and especially in ERTS applications. In addition, they were from field offices of mission-oriented agencies with no vested interest in the ERTS program.

Another aid to new users of remote sensing has been the services of the centralized facilities for remote sensing data processing and handling at the University. It would be wasteful were each user agency to establish laboratory facilities and technical personnel to perform its own analysis and interpretation. A most practical activity of the University is the processing of remote sensing data either photographically or digitally to the specifications of the user agencies. This is handled by our facilities on a job order basis as parellel work to the research already under way. In some instances, the user agency is able to bear the costs of such direct services, but selected cases with high benefit/cost potential or demonstration projects may be funded from this proposed budget for direct services support. The justification for this funded support is that the benefit should not be denied to the public for lack of provision in current agency budgets for such an unforeseen opportunity. Care is used to avoid supporting what should be internal funding for the long-run requirements of each user agency.

Frequently it is the case that specific signatures, leading to specific thematic classification, are the essential elements that a user requires. These signature patterns are discernable only after extensive processing and interpretation of quantities of earlier data. The service of data processing with University computer facilities and the expertise of our personnel might long remain a necessary part of the services that user agencies must seek outside their own staff. Making our capability as widely available as possible throughout the state has enabled agency users to make much more significant progress in applying remote sensing technology than if they had to wait for liaison with some agency located outside the state. Also, owing to the wide flexibility of our own work with ERTS data, we are not likely to fall into stereotyped patterns of interpretation and data handling. The broader our interests in applications are spread within Alaska, the more alert and creative we become in working with each user's needs.

As it is discussed in the "results" section and in the appendixes to this report, the services provided to agency users ranged widely from a quick response to an agency's limited need (e.g., the Chirikof Island survey by the Bureau of Land Management based in part on one ERTS image) to longer-term assistance (e.g., resources surveys by the Joint Federal-State Planning Commission based, in part, on many ERTS scenes in different formats).

Another important service to the community of users within Alaska is the publishing of information catalogs and listings of available imagery. While all data are available from national data banks, the University archives only low-cloud-cover Alaskan data which are most relevant to Alaskan needs. The user agency needs to know what data are available when gathering information for problem solving. Part of the University's coordination effort includes the distribution of catalogs which meets the user's need for browsing among available data or searching for some specific regional coverage. As the body of locally stored data grows, providing an up-to-date bibliography of the total Alaskan library remains a significant part of our activities. A typical catalog of Alaskan ERTS data is included as Appendix C.

RESULTS

Training Courses and Workshops

Even though they were not always measurable in direct economic benefit, much of the first year's activities necessarily involved laying an educational foundation for later cooperative projects that have paid and will pay off handsomely. We pursued this goal vigorously and organized and presented in-depth short course/workshops in Fairbanks, Anchorage and Juneau in December, February, and April, respectively. These were both intensive and broad so as to bridge the remote sensing "education gap" quite prevalent in the state. The courses drew on the talents of seven University specialists and one each from the Resource Planning Team of the Joint Federal-State Land Use Planning Commission and the U.S. Forest Service's Pacific Southwest Forest and Range Experiment Station in Berkeley, California. In each city, the response received was extremely enthusiastic as attested by Appendix B which lists the comments from participants in the Anchorage short course and workshop.

Another very real accomplishment, yet intangible and difficult to evaluate, is the appreciation for ERTS benefits that we were able to develop in the Office of the Governor of Alaska. This appreciation extends to enthusiasm right up to Governor William A. Egan himself, who responded to our invitation to visit the University ERTS facility and stretched a scheduled five-minute presentation into a half-hour tour of our ERTS facility and generated wide ranging discussion about the utility and applications of ERTS to the needs of Alaska. The governor was so impressed he subsequently communicated his support of the ERTS program to key congressional leaders and NASA officials by letters of record.

Chirikof Island Survey

More tangible results extend from the major, well-planned and thoroughly executed cooperative program to the spur-of-the moment, quick-reaction collaboration. As an example of the latter, the Bureau of Land Management encountered a short-notice problem concerning the accuracy of map locations of Chirikof Island, obscure and uninhabited in the North Pacific Ocean, 175 miles south of Kodiak. The manner in which the 1875 and 1942 survey positions on the island had been obtained were unknown, and the BLM needed further survey work done there. If the existing data were known to be sufficiently reliable, this would reduce the survey party's time in the field from six weeks to two weeks, and ERTS images appeared to offer a rapid check against the existence of any gross map errors. The BLM notified us of this possible application on April 18 and we searched our archives for a suitably cloud-free scene which contained both Chirikof Island and part of the mainland of the Alaska Peninsula to the west. We prepared on a high priority basis a 1:500,000 scale enlargement and mailed it April 20 to the BLM Anchorage office.

Using triangulation from survey stations identified from 1:250,000 scale maps, BLM personnel determined the position of the north end of a lake visible on the ERTS image of Chirikof Island by comparison with the map. Results showed no gross errors in the ground survey, so BLM decided to accept the existing survey data base and thereby saved 24 man-weeks of field party operation. In this application, which lacked advance planning, a $20 ERTS product generated a cost saving conservatively estimated from $25,000 to $30,000, depending upon how one evaluates the modified field party techniques relative to surface travel versus helicopter operation.

This quick reaction response is an important capability which we possess and should not be overlooked. Obviously, all users, both public and private, have access to the ERTS data from the EROS Data Center. In situations similar to the BLM experience cited above, the user may well know exactly what he needs for a given application and yet the established product sources may be totally inadequate solely from the aspect of lead-time involved in filling orders. Other Department of the Interior agencies, including the Geological Survey itself, regularly uses ERTS prints we provide to them as standard field party equipment, but it is difficult to document such cost benefits. By unanimous agreement, all organizations doing field work in Alaska find that scales of 1:100,000 to 1:250,000 ERTS prints indispensable to curtail costly field work by making the time spent in the field many times more productive. Typical of this type of benefit is an appreciative letter from Resource Associates of Alaska, Inc., a nongovernment organization dealing with mineral exploration and development. This letter states "(ERTS imagery) has great benefit in our work of mineral exploration, surface resource evaluation, and land planning. ERTS provides a mapping and data base which is both a primary information source and a valuable analytical tool. We estimate that ERTS imagery can provide us with cost savings up to $50,000 per year in addition to furnishing the analytical tool not otherwise available, resulting in an increase in effectiveness that cannot be stated in dollar terms."

<u>Assisting The Land Use Planning Commission</u>

The Federal-State Land Use Planning Commission was formed by the Congress and the Alaska State Legislature in 1972 at a time when the land ownership of Alaska began a drastically changing pattern, and when the wise use of management of the environment resources became a central issue of public concern. Probably the scope and importance of this Commission is not very widely recognized by those outside of Alaska, and likely not even by many Alaskans. It is important to understand that after the withdrawal and selection rights provided for by the Alaska Native Claims Settlement Act of 1971 and the Alaska Statehood Act of 1959, there will be only three major landowners in Alaska--The Federal Government, The State Government, and various village and regional native corporations. Apart from the lands under its ownership and management, each of these major landowners has interests in the use and management of the other lands in Alaska.

Because of the immense area of Alaska, the impact and importance of the Land Use Planning Commission's recommendation are not appreciated by many persons. The general impression is that with some 375 million acres, what difference is made by the controversy surrounding the 80 million acres of so-called national interest lands? The short-range view is that these lands largely are uninhabited, undeveloped and of relatively little value to anyone compared to investments and values that pertain in other sections of the United States. In this context, the planning and ownership patterns that develop are somewhat academic.

In essence, the circumstances of Alaskan today resembles that of the New World in the 1700's, with the role of the Federal-State Land Use Planning Commission bearing the solemn responsibility for recommending which classifications should apply to a significant part of the total lands in Alaska. Evaluating the validity of the Commissions data base by considering the impact of its recommendations on future generations of Alaskans tends to be conjectural and speculative. Nevertheless, these benefits, although intangible, are more important than the purely logistic and administrative benefits.

In order to establish defensible criteria to guide its decisions, the Commission needs to gain an understanding of the long-range interests of the nation and state so as to design a planning process that will place the lands of Alaska into categories of use patterns that are sound and that will sensibly maximize the interests of all parties concerned.

The information base the Commission inherited was entirely inadequate for the challenge facing it. The state does not yet have full coverage of aerial photography, and most of the photos that exist were made in the 1940's and 1950's and technically are inadequate for careful interpretation and analysis by today's standards. Thematic maps of the national atlas and Army map series are at scales of 1:7,500,000 and 1:2,500,000; the best 1:250,000 vegetation map series was prepared over a decade ago by one individual (Lloyd Spetzman) after spending 16 years at work in the state. While this work is of excellent quality considering the limited investment it represents, the available data base was totally inadequate without the benefit of ERTS.

One of the major steps the Commission has taken with the vital aid of ERTS images is the production of a major ecosystems map of Alaska (Figure 1) which shows the plant communities which have evolved or persisted over long periods of time and which show sufficient stability for mappable features. The map identifies and describes the terrestrial and marine ecosystems, and will eventually include topographic, physiographic, geologic and climatic features of Alaska. Also part of the Commission's work during the past year was the development of inventory information on the 80 million acre "national interest" lands. By fall

MAJOR ECOSYSTEMS OF ALASKA

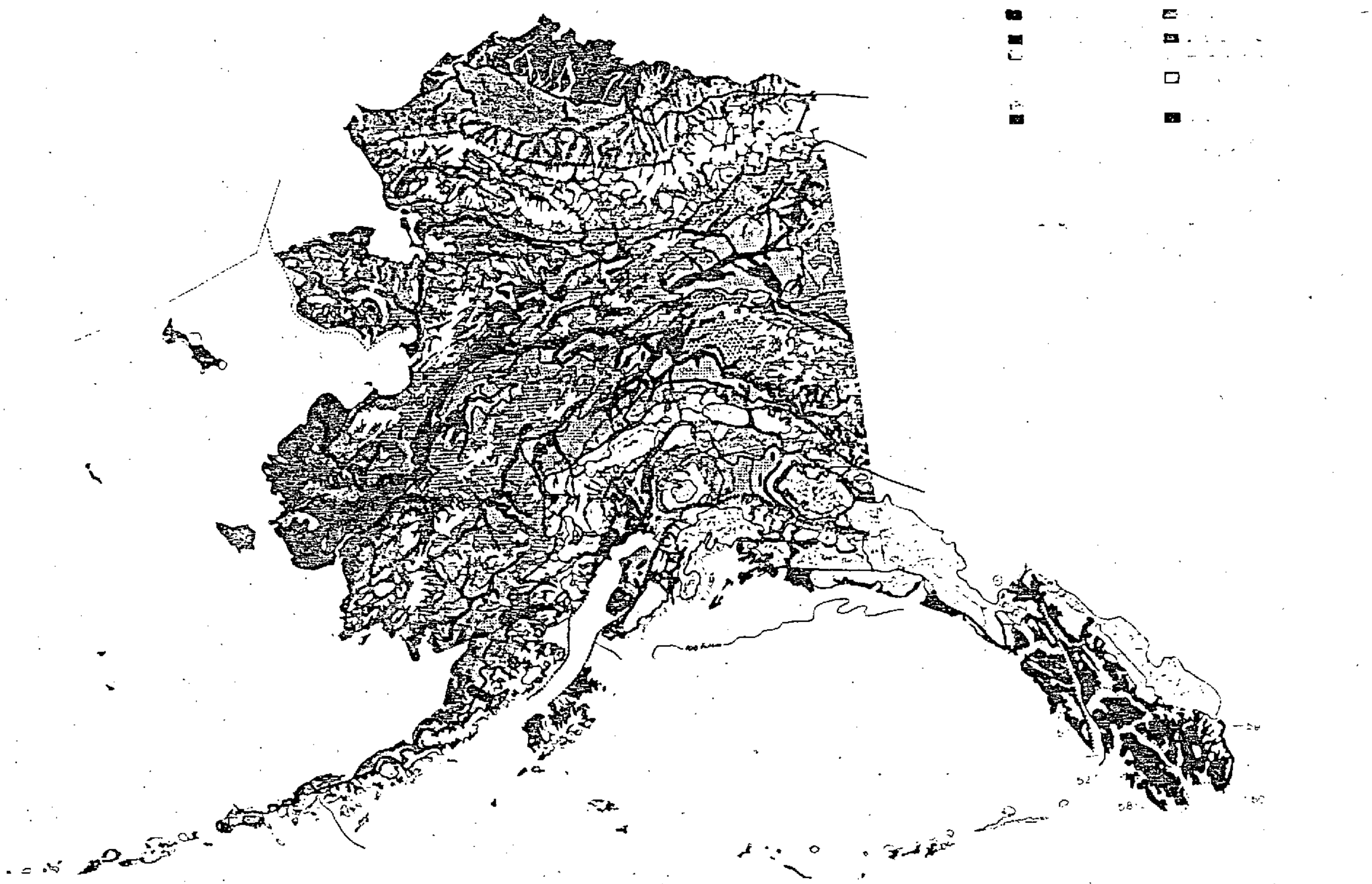

Figure 1 - Map of major ecosystems of Alaska prepared by the Joint Federal-State Land Use Planning Commission for Alaska.

NASA C-74-C3558

of 1973, the Resource Planning Team of the Commission hopes to complete a comprehensive statewide baseline inventory of resources.

Another Team accomplishment is the compiling of fact sheets on the national interest lands identified in the Alaska Native Claims Settlement Act. These fact sheets (Appendix D) served as background information during extensive public hearings held throughout Alaska and the United States in May and June, 1973. Mr. Larry Ouellette, Resource Planning Team Leader, states that ERTS is enabling his 25-man Team to accomplish five years of work in one year. The University's cooperative ERTS activities initially generated the Commission's interest in the use of ERTS and then translated $10,000 worth of images, workships, and consultative effort into savings of 100 man-years of effort, conservatively valued at $2,000,000, not even taking into account the astronomical cost of acquiring equivalent coverage from aerial photography, were the technology available to produce it.

One might note that the recommendations and decisions made by the Commission would have been made, ERTS notwithstanding, in the same general time scale because of the pre-existing politically established deadlines, and thus imply the actual cost benefit of the ERTS contribution to be not nearly so consequential. This conclusion would be quite invalid, for as discussed previously, the ERTS contribution measurable as $2,000,000 of value actually becomes multiplied many times over, assuming that the Commission's actions bring significantly improved benefits throughout future decades, and even centuries. It remains a growing investment with never-ending benefits.

Evaluating Forest Insect Infestations

Another major cooperative effort joined with the U. S. Forest Service and the Alaska Department of Natural Resources and aimed at satellite surveillance of a widespread spruce beetle infestation throughout the entire Cook Inlet basin. It is estimated that two billion board feet of spruce has been killed, and the resources to monitor the spread of this disease by conventional means is lacking because of the great areal extent involved (Figure 2). There is also reason to suggest that there may be widespread infestations also occurring in interior Alaska, but these regions are inaccessible and no one has yet inspected other areas for beetle infestation.

We learned of this potential application of ERTS during the Anchorage remote sensing short course and workshop, and hoped by this time to have some definitive results using satellite data. We have been hampered thus far by lack of good summertime imagery of Cook Inlet, and all our analyses thus far have been done using a snowy November scene in which vegetation is senescent. Therefore, it is very difficult to classify stressed and non-stressed spruce.

Another hindrance was the lack of key digital data analysis system in the University's ERTS facilities. Delivery of a rather powerful digital color display unit was scheduled for late November, but as of June 15, the supplier was still debugging the system. Three dimensional spectral analysis, which would be very easy with the color display unit, is awkward and time consuming on the University's IBM 360 computer. Our interim results on the spruce beetle project are encouraging, but we have yet to demonstrate the validity of a first attempt at signature analysis of heavily infested predominantly spruce stands.

Once we derive a reliable method for recognition of diseased spruce using ERTS data, forestry managers in the state will have an invaluable tool. Control measures of the spruce beetle include mostly harvesting of

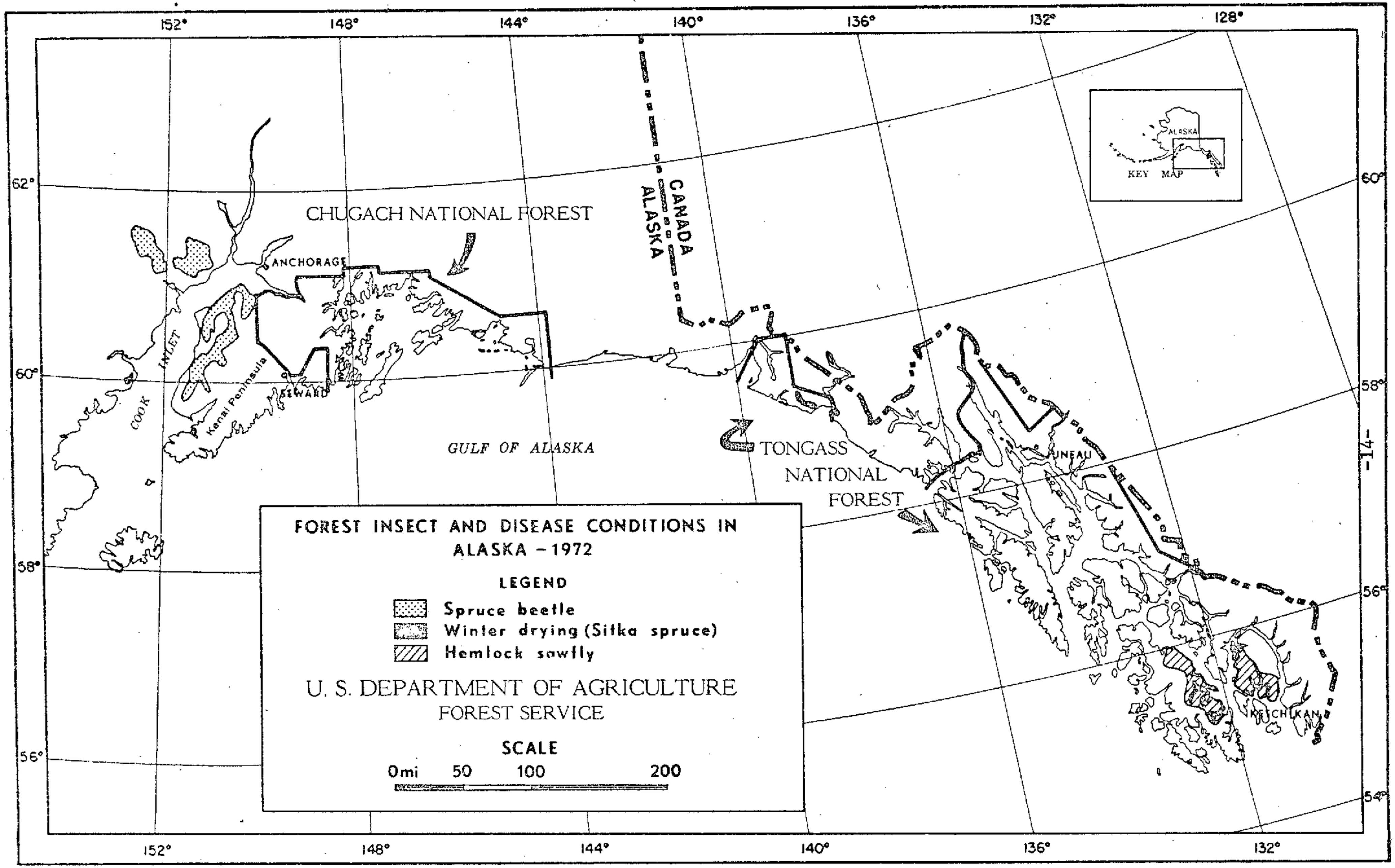
FOREST INSECT AND DISEASE CONDITIONS IN ALASKA - 1972
LEGEND
Spruce beetle
Winter drying (Sitka spruce)
Hemlock sawfly
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
SCALE
0mi 50 100 200
CHUGACH NATIONAL FOREST
TONGASS NATIONAL FOREST
CANADA
ALASKA
ANCHORAGE
SEWARD
Kenai Peninsula
COOK INLET
GULF OF ALASKA
JUNEAU
KETCHIKAN
KEY MAP
152°
148°
144°
140°
136°
132°
128°
62°
60°
58°
56°
54°

Figure 2

diseased trees and removal of deadfall where appropriate. The Alaska Department of Natural Resources currently is scheduling a salvage timber sale of old kill areas west of Cook Inlet, and they very much would like to acquire surveillance data of other regions of Alaska from ERTS to aid in similar resource management decisions in the future. Appendix E contains a fact sheet of the planned salvage timber sale.

Services and Cooperation With Other Agencies

Other agencies and organizations not previously discussed that we served with ERTS data products and recommendations for applications included the following:

Federal Government Agencies

U.S. Army Corps of Engineers
USDI/Bureau of Mines
USDI/National Park Service
DOT/Federal Highways Administration
DOT/Federal Aviation Administration
U.S. Air Force/Alaskan Command
U.S. Coast Guard
USDI/Bureau of Indian Affairs
USDI/Bureau of Sport Fish & Wildlife
USDI/Alaskan Power Administration
NOAA/Auke Bay Fisheries Laboratory
NOAA/National Weather Service

State Government Agencies

Department of Highways
Department of Fish & Game
Department of Education/State Library
Dept. of Natural Resources/Geol. Survey
Dept. of Economic Devel./Indust. Devel.
Dept. of Public Works/Div. of Aviation
Dept. of Environmental Conservation
Office of the Governor/Planning & Research

Other Organizations

Kross & Associates
Woodward, Lundgren & Associates
Alyeska Pipeline Service Company
CH_2M/Hill Alaska, Engineers
Lost River Mining Corp. Ltd.
Humble Oil & Refining Co.
Woodward-Envicon Inc.
Environment/Alaska
Resource Associates of Alaska, Inc.
U.S. Steel Corporation
Marathon Oil Company
Tanana Chiefs Conference
NANA Regional Corporation
Arctic Environmental Information & Data Center
Fisheries Extension Services

These lists of agency users who benefitted from the services provided by the grant, is too long to allow detailed descriptions of the individual requests for assistance and our technical response to them. In lieu of such descriptions, we include as Appendixes F and G, two reports which provide summaries and illustrative examples of ERTS data applications in Alaska. Some of these examples are derived from University ERTS projects, others were entirely supported by the present grant; but in all cases there was substantial agency interest and participation in the reported investigations.

CONCLUSIONS AND RECOMMENDATIONS

By the very nature of this program, its objectives must remain highly flexible and, therefore, they tend to be couched in general terms. Such generalization is intended to permit the maximum exploitation of targets of opportunity as the interest of agencies develops. There should be some redirection of emphasis, however, based upon our first year's experience. For example, the need for distribution of general ERTS bulletins containing novel applications ideas should be re-evaluated. While the intent is to enhance the spread of new ideas, this also attracts casual interest as well as the more cost beneficial operational applications that we are looking for.

User requests for consultation, data, and services should be screened to identify in advance, if possible, those applications which have greater than average probability of tangible and measurable operational benefits. This does not imply that potential users of ERTS information be turned away because their intended use may seem to be too generalized and theoretical, but it does mean they be offered more limited subsidized support. We have gained a profound respect for the fact that a small program such as this can quickly dissipate its resources by spreading them too widely.

There is a strong need for a color additive viewer operable by the non-technical user be provided by this program. In line with the desire to encourage agencies to delve more deeply into the power of multispectral data analysis, we find that it is a handicap not to be able to encourage them to produce their own reconstitute color images from the multiband 70 mm transparencies. Currently we rely on photographic laboratory processes, but this frequently cannot offer the direct user interaction with the formation of the color product. In spite of our best efforts to establish rapport between the customer desires and the custom photo process, the end result is that the customer is presented with a finished product which may or may not help him attain his goal. His tendency is to accept this product as the best that is possible. Even if he realizes it is not exactly what he wants, color processing is an expensive operation and he may hesitate to experiment further.

In other areas, such as the use of the zoom transfer scope has abundantly demonstrated, the "hands-on" approach of the user directly with analysis equipment greatly enhances the value of the results as well as building enthusiasm and respect for the utility and power of remote sensing. By virtue of direct user interaction with the image-forming process, the user himself can, without involving additional costs, experiment with many different reconstituted color combinations. Our first year indicates that procurement of an easily operated commercial color additive viewer for ERTS 70 mm chips should have a very high priority.

Appendix A

REMOTE SENSING SHORT COURSE EMPHASIZING THE USE OF ERTS IMAGERY IN ALASKA

Anchorage, Alaska
January 15-26, 1972

Sponsored by: Joint Federal-State Land Use Planning Commission for Alaska and The University of Alaska

First Week Session: January 15-19

Location: Holiday Inn, 239 W. Fourth Avenue, Anchorage, Alaska

Monday, January 15

9:00 a.m.	Introduction: Co-chairman Josephson and co-chairman Horton, Joint F-S LUPC
10:00 a.m.	Review of ERTS imagery available for Alaska today and application
11:00 a.m.	The Physical Basis for Remote Sensing
1:30 p.m.	Spectral Characteristics of Natural Material
2:30 p.m.	Systems Approach to Remote Sensing
3:30 p.m.	Review and Discussion

Tuesday, January 16

9:00 a.m.	Radiation and Sensor Characteristics
10:00 a.m.	Spacecraft and Orbit and Sensors
11:00 a.m.	ERTS Imagery: Availability, Where, How, What to Order and Cost
2:30 p.m.	Principles of Photo Interpretation
3:30 p.m.	Review and Discussion

First Week Session Continued:

Wednesday, January 17

9:00 a.m.	Interpretation of Multispectral Data
10:00 a.m.	Atmospheric Effects
11:00 a.m.	Image Enhancement and Color Infrared Interpretation
1:30 p.m.	Image Enhancement and Color Infrared Interpretation continued
2:30 p.m.	Hydrology Application
3:30 p.m.	Review and Discussion

Thursday, January 18

9:00 a.m.	Geology Application
10:00 a.m.	Vegetative Application
11:00 a.m.	Oceanography Application
1:30 p.m.	Land Resource Application
2:30 p.m.	Land Resource Application continued
3:30 p.m.	Review and Discussion

Friday, January 19

9:00 a.m.	Remote Sensing and the Computer
10:00 a.m.	Remote Sensing and the Computer continued
11:00 a.m.	The Color Additive Viewer
1:30 p.m.	The Digital Color Disply Unit
2:30 p.m.	Review of the Application of ERTS Imagery in Land and Resource Planning and Management in Alaska
3:30 p.m.	Summary and Evaluation

Second Week Session: January 22-26

Location: Alaska Land Use Planning Commission
Resource Planning Team's Office - First Floor
733 West Fourth Avenue, Anchorage, Alaska

Hours: 9:00 to 12:00 a.m.
1:30 to 4:30 p.m.

<u>Monday, January 22</u>	Hydrologic Analysis	Yukon River - Rampart
<u>Tuesday, January 23</u>	Geologic Analysis	Wrangell Range
<u>Wednesday, January 24</u>	Vegetative Analysis	Brooks Range
<u>Thursday, January 25</u>	Land Resources	Seward Peninsula
<u>Friday, January 26</u>	Oceanography & Urban	Anchorage & Cook Inlet

The second week is a workshop that will concentrate on the use of ERTS imagery in land and resource planning in Alaska. The subject matter will be covered more intensively and pertinent problems will be assigned in lans use planning for teams to work out feasible solutions.

Appendix B

SELECTED COMMENTS

From

Participants in Remote Sensing Short Course

Utilizing ERTS Imagery

Anchorage, Alaska

January 15-19, 1973

Instructors:

John Miller
Geophysical Institute
University of Alaska

John L. Hall
Land Use Planning Commission

"In general a good course, particularly well-presented as to explanation of technical background in optics. Obviously ERTS info is another tool but not an answer to our problems in itself, nor is it a magnetometer by itself. Course is well-organized as to order of presentation of material.

My interest in ERTS is with mining problems regarding placer stripping discharge into streams, discrimination between silt discharge from placer mines into a stream already silt laden from natural causes."

Mining Engineer, U.S. Bureau of Mines

"My company asked me to sit in on your school to find out something of the availability of ERTS photos, and possible application to geologic interpretation, both generally and to Alaska problems specifically. I believe the week was well-spent.

We are interested, of course, in the sedimentary basins both on and off-shore, but we routinely utilize outcrop information from the surrounding highlands in estimating the types and thicknesses of sedimentary rock units. You have demonstrated any number of possibilities that could be used to differentiate formations (soils, vegetation, moisture content, etc.) and coupled with a knowledge of the attitude of these rocks, thicknesses can be estimated. (We geologists have considerable ground truth).

Structural history as evidenced by uplifts and faulting is an obvious application of satellite photos. The fact that one can see more (rather than less as expected by Shapiro) on ERTS photos vs. aerial photos is of especial interest. The availability of repetition photos of very large areas under instantaneous lighting conditions presents an unprecedented opportunity to the whole field of earth science.

We at Marathon think that a similar school for geologists, and geophysicists both in the private and government sectors in Anchorage would be well attended and appreciated."

Senior Geologist, Marathon Oil Co.

"I appreciate the opportunity to attend this class and feel it will enhance my future work ability.

I can foresee many applications of the use of ERTS Imagery in my work in geology, engineering and logistics.

I am afraid that I am still a bit vague on many of the computer applications and functions associated with ERTS, but hope it will come to me as I get more involved.

Think the class was well carried out and I thank you."

Geologist, Alaska District Corps of Engineers

"The presentation of fundamentals was very good - I would be inclined to want more detail for specific information - obviously more is also gained from those who are used to speaking.

I feel as a result of this school that we will order pictures for quite a few areas immediately. These would cover specific projects and would be used for geologic, vegetative, soil and water general interpretations.

As funds and time for analysis permit, we would get into controlled color reproductions, density slicing and more specifically the digital color density slicing techniques.

Despite the cost of this information, I believe we can save money on many projects by reduction in time in the field.

Weakness is generally in still not having emissive I.R. available, not being able to get consecutive coverage in a short time interval for time limited affects."

Civil Engineer, Alaska District Corps. of Eng.

"Our primary interest at this time in the Kenai Peninsula Borough is for land-use and land management of lands in both the private and public sector of land ownerships.

With this in mind, we are searching for short cuts in developing land use and land management inventories of the borough, there being a limitation in both money and personnel to develop comprehensive plans.

In my opinion we can use the ERTS imagery for regional planning."

Planning Technician-
Kenai Peninsula Borough

"The course seemed well planned and covered as much of the basic technical information as possible in the time available. The instruction by John Miller was particularly valuable to me. I have learned a good deal about ERTS and its possibilities - also its shortcomings which yet need to be overcome. I expect to be able to use the information gained to a good advantage in future investigations where ERTS is concerned. I commend the planners and executors of the course, and am pleased to have been able to take it."

Resource Planning Team
Land Use Planning Commission

"Overall the classes went very well. Not having any background in the ERTS' program and very little in photogrammetry, I found the initial physical theory to be difficult to comprehend. As the week progressed the principles of physics involved began falling into place. It should serve as a good background for the work to be done during the second week. I think the practical application and problem solving will be most helpful to me."

Game Biologist
USDA/BSF & W

"A lot of information was presented in a short time. The use of the handouts is appreciated, it will be helpful in the future to refer to all the information that has been presented this week. I appreciate the "theory" or "non-honey" information. If we know why something is, it is probable that we will really understand and retain the concepts and processed involved.

Cartographer, Resource Planning Team
Land Use Planning Commission

"The course was well planned for the amount of time used. I feel that ERTS will be used by our corporation in land use planning."

Director of Lands
Nana Regional Native Corporation

"My overall evaluation of the course from the standpoint of a geologist, is to rate it excellent. Certain aspects were covered better than others, but I personally feel that enough information has been presented to allow the participant to understand how ERTS may be applied to his professional work.'

Senior Consultant
Environment/Alaska

"I currently work on State minerals resource inventory, Unit Resource Analyses & Management Framework Plans connected with Areal Resource evaluations & proposals.

Having interests in geology, hydrology, soils/parentrock relationships, I feel that ERTS Remote Sensed images, as I've seen this week can be a real aid in evaluating the total resource potentials of specific areas of interest in the State. Am looking forward to utilizing this week's work next weekon actual application.

The course was excellent. I thought the theory was essential, not too much of that. It was well conducted and ran along very smoothly, considering the day-to-day mechanics of such a presentation."

Geologist
USDI/Bureau of Land Management

"A new subject, well presented, created much personal enthusiasm. As a planner dealing with site and regional analysis work, prior to recreation land use/master planning, the applications are obvious.

My particular emphasis will focus on vegetation, water and slope aspects. I feel these subjects were well handled. My single criticism would be that direct comparisons of information gained by ERTS to standard low level and other photography would have been valuable, i.e. compare possibilities of ERTS system to presently used systems a bit more.

Subject generally was well communicated, valuable, and I hope to apply ERTS as the valuable tool it appears to be to recreation resource planning.

If only ERTS could solve the political problems which overshadow so many land decisions.

ERTS for governor (1974)!! "

Regional Planner
Resource Planning Team
Land Use Planning Commission

Appendix C

ERTS CATALOG OF ALASKAN SCENES

with

20% or less Cloud Cover

July 1972 - July 1973

Prepared by:

ERTS Data Library
Geophysical Institute
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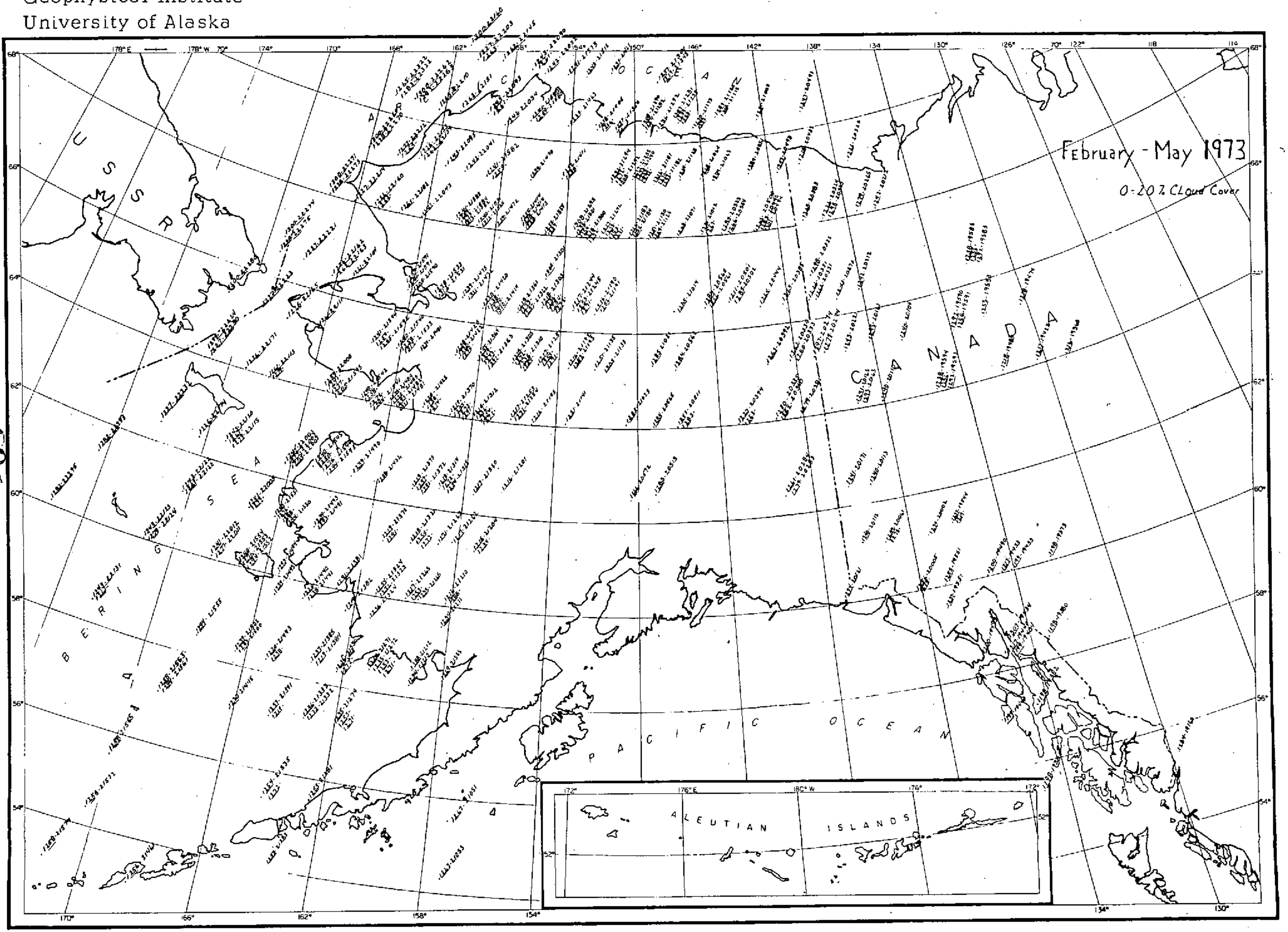
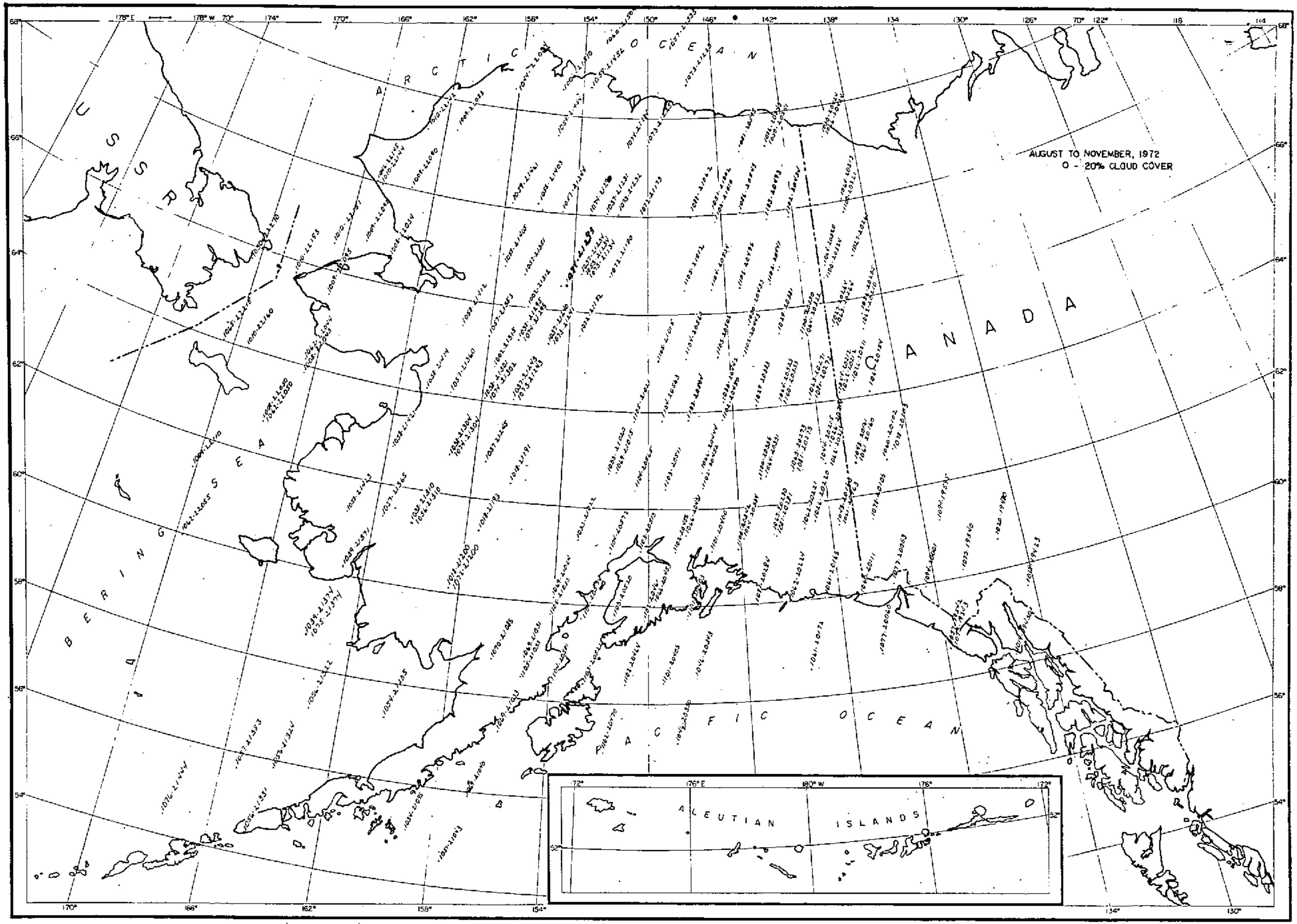
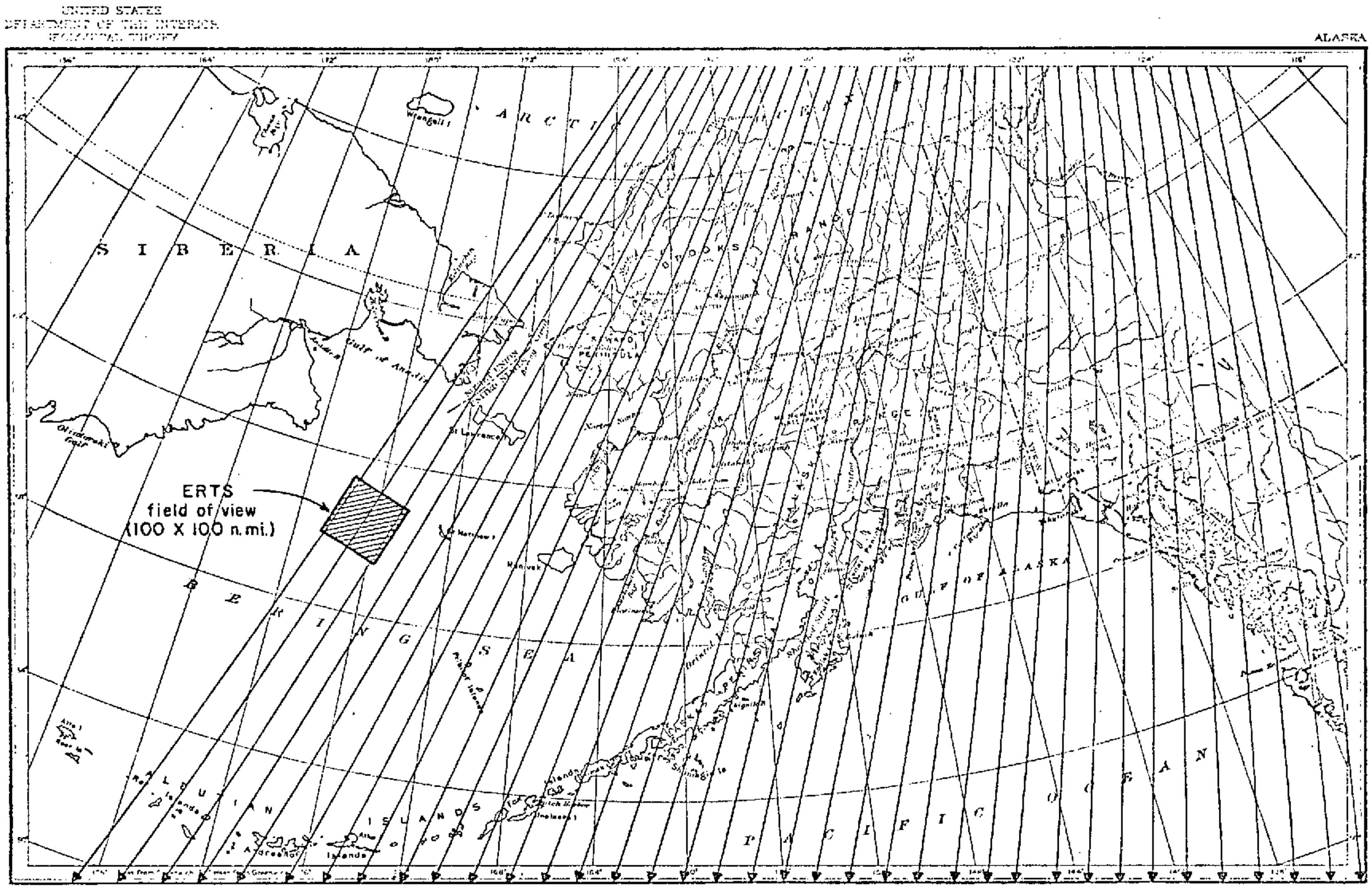




Prepared by:
Geophysical Institute
University of Alaska



DATES IN	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6
AUG. 72	24	23	22	21	20	19						31	30	29	28	27	26	25	24	23	22	21	20	19						31	30	29	28	27	26	25	24
DATES IN	11	10	9	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11
SEP. 72	29	28	27	26	25	24	23	22	21	20	19							30	29	28	27	26	25	24	23	22	21	20	19							30	29
DATES IN	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	18	17
OCT. 72					31	30	29	28	27	26	25	24	23	22	21	20	19						31	30	29	28	27	26	25	24	23	22	21	20	19		
DATES IN	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
NOV. 72	22	21	20	19							30	29	28	27	26	25	24	23	22	21	20	19							30	29	28	27	26	25	24	23	22

ERTS-I ORBITS FOR AUGUST TO NOVEMBER 1972

(based on August 25 ephemeris data)

Scene ID No.	Date	Cloud Cover	Lat. Center Pt.	Long	Sun El.	Sun Az.	Map Description
1002-21310	July 25, 1972	15	67.25N	154.43W	41	162	Walker Lake
1002-21312	July 25, 1972	15	66.06N	156.16W	42	160	Hughes
1002-21315	July 25, 1972	10	64.45N	157.42W	43	158	Nulato
1002-21324	July 25, 1972	15	62.02N	160.09W	45	154	Holy Cross
1006-21510	July 29, 1972	5	60.32N	155.26W	37	168	Barrow
1009-22083	August 1, 1972	5	69.25N	161.30W	37	166	Point Lay
1009-22090	August 1, 1972	2	68.07N	163.21W	39	164	Point Hope
1009-22092	August 1, 1972	0	66.48N	165.00W	40	162	Kotzebue
1009-22095	August 1, 1972	0	65.27N	166.30W	41	160	Seward Peninsula
1009-22101	August 1, 1972	20	64.07N	167.51W	42	158	Nome
1009-22110	August 1, 1972	10	61.23N	170.14W	44	154	Bering Sea
1010-20313	August 2, 1972	10	67.56N	139.29W	39	164	Old Crow
1010-22133	August 2, 1972	10	71.53N	159.04W	35	171	Sea Ice off Barrow
1010-22135	August 2, 1972	0	70.37N	161.21W	36	169	Wainwright, Point Lay
1010-22142	August 2, 1972	2	69.20N	163.22W	37	166	Point Lay
1010-22144	August 2, 1972	2	68.02N	165.09W	38	164	Point Hope
1010-22145	August 2, 1972	5	67.37N	165.26W	39	163	Point Hope
1010-22151	August 2, 1972	5	66.42N	166.47W	40	162	Shishmaref
1010-22153	August 2, 1972	2	65.21N	168.19W	41	160	Teller
1010-22160	August 2, 1972	0	64.01N	169.39W	42	158	St. Lawrence Island
1010-22162	August 2, 1972	10	62.39N	170.53W	43	156	St. Lawrence Island
1016-21045	August 8, 1972	10	71.20N	142.35W	34	171	Arctic Ocean, sea ice
1018-21191	August 10, 1972	5	62.40N	156.24W	41	157	Iditarod
1018-21193	August 10, 1972	0	61.19N	157.32W	42	155	Sleetmute
1018-21200	August 10, 1972	5	59.57N	158.36W	43	153	Dillingham
1019-19423	August 11, 1972	20	59.30N	134.23W	43	153	Atlin
1019-19430	August 11, 1972	20	58.07N	135.20W	44	151	Juneau
1019-21234	August 11, 1972	15	66.24N	153.59W	37	162	Hughes, Bettles
1020-19480	August 12, 1972	0	60.32N	135.04W	42	154	Whitehorse
1026-20211	August 18, 1972	10	64.28N	140.25W	37	160	Eagle
1026-20214	August 18, 1972	10	63.06N	141.40W	38	158	Tanacross
1026-20220	August 18, 1972	5	61.45N	142.50W	39	156	McCarthy
1027-20255	August 19, 1972	10	68.14N	137.29W	33	166	East of Table Mountains
1027-20261	August 19, 1972	20	66.55N	139.08W	34	164	East of Black River
1027-22074	August 19, 1972	5	72.26N	156.23W	30	174	Sea Ice north of Barrow
1028-20324	August 20, 1972	20	64.37N	143.08W	36	160	Eagle
1029-20365	August 21, 1972	20	69.32N	138.38W	32	168	Herschel Island
1029-20381	August 21, 1972	2	65.33N	143.38W	35	162	Charlie River
1029-20383	August 21, 1972	0	64.12N	145.00W	36	160	Big Delta
1030-20424	August 22, 1972	20	69.27N	139.54W	31	168	Demarcation Point
1030-20430	August 22, 1972	10	68.09N	141.45W	32	166	Table Mountains
1030-20433	August 22, 1972	5	66.50N	143.24W	34	164	Black River
1030-20435	August 22, 1972	15	65.29N	144.55W	35	162	Circle
1030-20442	August 22, 1972	10	64.08N	146.17W	36	160	Fairbanks, Delta
1030-22270	August 22, 1972	15	65.52N	170.20W	34	162	Chukotsk Penn.,Siberia
1030-22273	August 22, 1972	20	64.31N	171.44W	35	161	Siberia, St. Lawrence Is.
1033-21020	August 25, 1972	20	62.43N	151.52W	36	159	McKinley
1033-21022	August 25, 1972	10	61.20N	153.01W	37	157	Lime Hills, Tyonek
1033-21025	August 25, 1972	10	59.57N	154.04	38	156	Lake Clark, Illiamna
1034-21095	August 26, 1972	10	55.46N	158.28W	41	151	Stepovak Bay
1037-21231	August 29, 1972	5	68.08N	152.01W	30	167	Chandler Lake, Wiseman
1037-21234	August 29, 1972	2	66.49N	153.40W	31	165	Hughes, Bettles
1037-21240	August 29, 1972	5	65.28N	155.09W	32	163	Melozitna
1037-21254	August 29, 1972	5	64.07N	156.30W	33	161	Nulato, Ruby
1037-21245	August 29, 1972	5	62.45N	157.44W	35	159	Ophir, Iditarod
1037-21252	August 29, 1972	20	61.23N	158.53W	36	158	Russian Mission, Sleetmute
1038-21295	August 30, 1972	5	65.29N	156.35W	32	163	Kateel River
1038-21301	August 30, 1972	0	64.08N	157.57W	33	161	Nulato
1038-21304	August 30, 1972	0	62.46N	159.11W	34	160	Holy Cross, Iditarod
1038-21310	August 30, 1972	20	61.24N	160.19W	35	158	Russian Mission
1039-21371	August 31, 1972	10	60.00N	162.48W	36	157	Kuskokwim Bay
1039-21374	August 31, 1972	5	58.37N	163.48W	37	155	Kuskokwim Bay
1043-20161	September 4, 1972	15	62.42N	140.34W	33	160	Nabesna & east
1043-20163	September 4, 1972	0	61.19N	141.42W	34	159	McCarthy
1044-20201	September 5, 1972	2	68.05N	136.15W	28	167	Aklavik, NWT
1044-20212	September 5, 1972	2	64.04N	140.44W	31	162	Eagle, Tanacross
1044-20215	September 5, 1972	10	62.42N	141.57W	32	161	Tanacross, Nabesna
1044-22824	September 5, 1972	0	70.40N	158.09W	25	172	Meade River
1045-20255	September 6, 1972	0	68.05N	137.39W	27	168	East of Table Mountains
1045-22091	September 6, 1972	10	68.05N	163.30W	27	168	Noatak
1046-20343	September 7, 1972	5	58.31N	148.04W	35	156	Gulf of Alaska
1046-20350	September 7, 1972	10	57.08N	148.58W	36	155	Pacific Ocean
1046-22143	September 7, 1972	20	69.20N	163.12W	26	170	Point Lay

1046-22145	September 7, 1972	10	68.01N	165.02W	27	168	Point Hope
1047-22201	September 8, 1972	20	69.30N	164.20W	25	170	Point Lay
1049-20505	September 10, 1972	20	61.24N	150.16W	31	160	Anchorage, Cook Inlet
1050-20541	September 11, 1972	10	69.28N	142.55W	24	170	Demarcation Point
1054-21205	September 15, 1972	10	57.12N	160.22W	33	157	Bristol Bay
1055-21234	September 16, 1972	0	66.45N	153.39W	25	167	Hughes, Bettles
1056-21310	September 17, 1972	20	61.20N	160.18W	29	161	Russian Mission
1056-21324	September 17, 1972	40	55.47N	164.04W	33	156	Cold Bay
1056-21331	September 17, 1972	20	54.24N	164.52W	35	155	Unimak, False Pass
1057-19542	September 18, 1972	0	58.31N	137.59W	31	159	Mt. Fairweather
1057-21342	September 18, 1972	20	69.31N	153.05W	22	171	Teshekpuk
1057-21344	September 18, 1972	0	68.03N	154.55W	23	169	Killik River, Walker Lake
1057-21351	September 18, 1972	0	66.44N	156.35W	24	167	Shungnak, Hughes
1057-21353	September 18, 1972	0	65.23N	158.04W	25	166	Kateel River, Nulato
1057-21360	September 18, 1972	10	64.03N	159.25W	26	164	Norton Bay, Nulato
1057-21371	September 18, 1972	5	59.55N	162.49W	30	160	Baird Inlet, Kuskokwim Bay
1058-21403	September 19, 1972	0	68.09N	156.14W	22	169	Howard Pass, Killik River
1058-21405	September 19, 1972	0	66.50N	157.52W	23	168	Shungnak
1058-21412	September 19, 1972	0	65.29N	159.22W	25	166	Candle, Kateel
1058-21414	September 19, 1972	0	64.08N	160.44W	26	164	Norton Bay, Unalakleet
1058-21421	September 19, 1972	0	62.46N	161.48W	27	163	St. Michael, Kwiguk
1058-21423	September 19, 1972	0	61.23N	163.07W	28	162	Marshall
1059-21445	September 20, 1972	0	72.01N	151.21W	18	176	Arctic Ocean
1059-21454	September 20, 1972	25	69.28N	155.47W	21	171	Ikpikpuk River
1059-21461	September 20, 1972	0	68.10N	157.39W	22	170	Howard Pass
1060-20102	September 21, 1972	5	62.44N	139.03W	26	163	Wellesley Lake, Dawson
1061-20154	September 22, 1972	0	64.04N	139.13W	25	165	Dawson
1061-20160	September 22, 1972	0	62 43N	140.28W	26	163	E. of Nabesna
1061-20163	September 22, 1972	0	61.21N	141.36W	27	162	McCarthy & East
1061-20165	September 22, 1972	0	59.58N	142.39W	28	161	Icy Bay
1061-20172	September 22, 1972	10	58.35N	143.38W	29	159	Pacific Ocean
1062-20210	September 23, 1972	20	65.26N	139.18W	23	166	Charley River
1062-20212	September 23, 1972	0	64.05N	140.39W	24	165	Eagle
1062-20215	September 23, 1972	0	62.43N	141.53W	26	163	Nabesna
1062-20221	September 23, 1972	0	61.21N	143.01W	27	162	McCarthy
1063-20262	September 24, 1972	20	66.46N	139.16W	22	168	E. of Black River
1063-20264	September 24, 1972	0	65.26N	140.46W	23	167	Charley River
1063-20271	September 24, 1972	0	64.04N	142.06W	24	165	Eagle - Tanacross
1063-20273	September 24, 1972	0	62.42N	143.20W	25	164	Nabesna
1063-20280	September 24, 1972	0	61.20N	144.28W	26	162	Chitina
1063-20282	September 24, 1972	40	59.58N	145.31W	28	161	Valdez, clouds are over ocean
1064-20331	September 25, 1972	20	62.42N	144.46W	25	164	Gulkana, Nabesna
1064-20334	September 25, 1972	0	61.19N	145.55W	26	162	Valdez, Cordova
1066-20424	September 27, 1972	0	69.29N	139.56W	18	172	Demarcation Point
1066-20444	September 27, 1972	0	62.47N	147.35W	24	164	Mt. Hayes
1066-20451	September 27, 1972	10	61.25N	148.43W	25	163	Anchorage, cloud over city
1066-20453	September 27, 1972	20	60.02N	149.46W	26	162	Seward, Kenai
1070-21085	October 1, 1972	0	58.43N	156.24W	26	161	Karluk, Mt. Katmai
1072-21173	October 3, 1972	5	68.07N	150.26W	17	171	Philip Smith Mountains, Chandalar
1072-21180	October 3, 1972	0	66.48N	152.06W	18	169	Bettles, Tanana
1072-21182	October 3, 1972	0	65.28N	153.36W	19	168	Tanana, Ruby
1072-21200	October 3, 1972	20	60.01N	158.23W	24	162	Taylor Mts., Dillingham
1073-21223	October 4, 1972	0	70.46N	147.55W	14	175	Beechey Point
1073-21225	October 4, 1972	0	69.28N	150.01W	15	173	Umiat, Sagavanirktok
1073-21232	October 4, 1972	0	68.09N	151.52W	17	171	Chandler Lake, Wiseman
1073-21241	October 4, 1972	20	65.29N	155.00W	19	168	Melozitna, Ruby
1074-21290	October 5, 1972	0	68.08N	153.18W	16	171	Killik River, Chandler Lake
1074-21293	October 5, 1972	5	66.48N	154.57W	17	170	Hughes
1074-21295	October 5, 1972	5	65.28N	156.23W	19	169	Kateel River, Nulato
1074-21302	October 5, 1972	20	64.07N	157 48W	20	167	Ophir, Nulato
1075-21345	October 6, 1972	10	68.05N	154.46W	16	171	Killik R., Survey Pass
1075-21351	October 6, 1972	0	66.46N	156.25W	17	170	Shungnak, Kateel River
1076-21444	October 7, 1972	0	54.28N	167.42W	27	159	Unalaska, Dutch Harbor
1077-20033	October 8, 1972	0	66 50N	133.21W	16	170	Canada
1077-20035	October 8, 1972	10	65.30N	134.52W	17	168	Canada
1077-20042	October 8, 1972	5	64.09N	136.15W	19	167	Mayo Lake
1077-20053	October 8, 1972	0	60.03N	139.43W	22	163	Yakutat
1077-21453	October 8, 1972	5	70.42N	153.43W	13	175	Teshekpuk, Harrison Bay
1078-20085	October 9, 1972	0	68.11N	133.10W	15	172	Sitidgie Lake, Canada
1078-20091	October 9, 1972	0	66.52N	134.50W	16	170	Canada
1078-20094	October 9, 1972	0	65.32N	136.20W	17	168	Canada
1078-20100	October 9, 1972	0	64.10N	137.42W	18	167	Dawson
1078-20103	October 9, 1972	0	62.49N	138.57W	19	166	Dawson
1078-20105	October 9, 1972	00	61.27N	140.06W	21	165	Mt. St. Elias
1078-20112	October 9, 1972	5	60.05N	141.10W	22	163	Icy Bay, Yakutat
1081-20263	October 12, 1972	5	66.48N	139.13W	15	170	E.of Black River
1081-20270	October 12, 1972	0	65.28N	140.43W	16	169	E. of Charlie River

1081-20272	October 12, 1972	0	64.06N	142.04W	17	167	Eagle
1081-20275	October 12, 1972	0	62.45N	143.19W	18	166	Nabesna
1081-20281	October 12, 1972	0	61.22N	144.28W	20	165	Cordova, McCarthy
1081-20284	October 12, 1972	0	60.00N	145.31W	21	164	Cordova
1082-20324	October 13, 1972	0	65.28N	142.06W	16	169	Eagle, Charley River
1084-19042	October 15, 1972	0	54.22N	127.36W	25	160	Smithers - Canada
1085-19094	October 16, 1972	0	55.47N	128.15W	23	161	E. of Ketchikan
1085-19100	October 16, 1972	0	54.23N	129.03W	24	160	Kitimat, S.E.
1086-19152	October 17, 1972	0	55.45N	129.41W	23	161	Woodcock, S.E.
1086-20543	October 17, 1972	5	69.20N	143.00W	11	174	Demarcation Point
1086-20545	October 17, 1972	5	68.01N	144.50W	12	172	Christian, Table Mountains
1087-20595	October 18, 1972	0	70.38N	142.23W	9	176	Barter Island
1087-21004	October 18, 1972	0	68.03N	146.17W	11	172	Philip Smith Mountains
1088-21062	October 19, 1972	0	68.01N	147.47W	11	172	Philip Smith Mountains
1088-21071	October 19, 1972	20	65.22N	150.54W	14	169	Tanana, Livengood
1088-21074	October 19, 1972	20	64.00N	152.15W	15	168	Kantishna River
1091-19414	October 22, 1972	0	64.00N	138.42W	14	168	Dawson
1094-19581	October 25, 1972	5	66.37N	132.14W	10	171	Canada
1094-19583	October 25, 1972	15	65.17N	133.43W	12	169	Canada
1094-19590	October 25, 1972	0	63.56N	135.05W	13	168	Mayo Lake, Canada
1094-19595	October 25, 1972	0	61.12N	137.27W	15	166	Kluane Lake, Canada
1094-20001	October 25, 1972	0	59.50N	138.29W	16	165	Mt. Fairweather
1096-20112	October 27, 1972	0	61.14N	140.18W	15	166	McCarthy, Mt. St. Elias
1096=20114	October 27, 1972	0	59.51N	141.20W	16	165	Yakutat
1100-20315	October 31, 1972	50	69.14N	137.31W	06	174	Herschel Island, land clear
1100-20324	October 31, 1972	0	66.36N	140.58W	08	171	Black River
1100-20330	October 31, 1972	5	65.16N	142.26W	10	170	Charley River
1100-20342	October 31, 1972	0	61.12N	146.07W	13	166	Valdez
1101-20403	November 1, 1972	0	59.48N	148.31W	14	165	Blying Sound
1102-20434	November 2, 1972	20	67.51N	142.13W	07	173	Coleen
1102-20441	November 2, 1972	0	66.31N	143.50W	08	171	Black River, Charlie River
1102-20443	November 2, 1972	20	65.11N	145.19W	09	170	Circle
1102-20450	November 2, 1972	0	63.50N	146.39W	10	168	Mt. Hayes
1102-20452	November 2, 1972	0	62.29N	147.52W	11	167	Talkeetna Mtns
1102-20455	November 2, 1972	0	61.06N	148.59W	13	166	Anchorage, Cook Inlet
1102-20461	November 2, 1972	0	59.44N	150.01W	14	165	Seldovia
1102-20464	November 2, 1972	0	58.21N	150.58W	15	164	Pacific Ocean
1102-20470	November 2, 1972	0	56.59N	151.52W	16	163	Kaguyak
1103-20493	November 3, 1972	0	67.50N	143.39W	06	173	Coleen, Black River
1103-20495	November 3, 1972	0	66.31N	145.17W	07	171	Ft. Yukon, Circle
1103-20502	November 3, 1972	0	65.11N	146.45W	09	170	Fairbanks
1103-20504	November 3, 1972	0	63.50N	148.05W	10	168	Healy, Talkeetna Mts.
1103-20511	November 3, 1972	0	62.28N	149.19W	11	167	Talkeetna Mts., Anchorage
1103-20513	November 3, 1972	0	61.06N	150.27W	12	166	Anchorage, Cook Inlet
1103-20520	November 3, 1972	0	59.44N	151.30W	14	165	Kenai Peninsula
1103-20522	November 3, 1972	0	58.21N	152.28W	15	164	Kodiak, Afognak
1104-20554	November 4, 1972	0	66.30N	146.45W	07	171	Fort Yukon
1104-20560	November 4, 1972	0	65.10N	148.12W	08	170	Fairbanks
1104-20563	November 4, 1972	0	63.49N	149.31W	10	169	McKinley
1104-20565	November 4, 1972	0	62.28N	150.44W	11	167	Talkeetna
1104-20572	November 4, 1972	0	61.06N	151.15W	12	166	Cook Inlet, Tyonek
1104-21574	November 4, 1972	0	59.44N	152.53W	13	165	Illiamna, Seldovia
1105-21010	November 5, 1972	0	67.50N	146.32W	06	173	Christian, Fort Yukon
1105-21012	November 5, 1972	0	66.30N	148.09W	07	171	Beaver
1105-21015	November 5, 1972	0	65.10N	149.38W	08	170	Minto
1105-21021	November 5, 1972	0	63.50N	150.50W	09	169	Mt. McKinley
1105-21033	November 5, 1972	20	59.44N	154.18W	13	165	Illiamna, Mt. Katmai
1105-21035	November 5, 1972	20	58.21N	155.16W	14	164	Karluk, Mt. Katmai

Scene I.D.	Date	Cloud Cover	Lat. Center Pt.	Long.	Sun El.	Sun Az.	Map Description
1198-19373	February 6, 1973	0	60.06N	132.38W	12	158	Atlin
1198-19380	February 6, 1973	0	58.43N	133.37W	13	157	Juneau
1198-19382	February 6, 1973	5	57.19N	134.32W	14	156	Sitka - Sumdum
1198-19385	February 6, 1973	0	55.56N	135.23W	15	155	Port Alexander
1199-19432	February 7, 1973	0	60.03N	134.07W	12	158	Atlin
1199-19434	February 7, 1973	0	58.40N	135.06W	13	157	Juneau
1199-19441	February 7, 1973	0	57.17N	136.01W	15	156	Sitka
1200-19490	February 8, 1973	0	60.00N	135.37W	13	158	Skagway
1200-19493	February 8, 1973	2	58.37N	136.35W	14	157	Mt. Fairweather
1205-21590	February 13, 1973	0	66.51N	162.17W	09	164	Kotzebue
1205-21592	February 13, 1973	0	65.31N	163.46W	10	162	Bendleben
1205-21595	February 13, 1973	0	64.10N	165.08W	11	161	Nome - Soloman
1205-22001	February 13, 1973	5	62.49N	166.23W	12	160	Black
1205-22004	February 13, 1973	5	61.27N	167.32W	13	159	Hooper Bay
1211-20501	February 19, 1973	0	66.50N	145.05W	11	164	Fort Yukon
1211-20504	February 19, 1973	50	65.29N	146.35W	12	162	Livengood-Circle, Top half of scene clear
1216-21181	February 24, 1973	0	69.27N	148.47W	10	167	Sagavanirktok - Philip Smith Mtns
1216-21183	February 24, 1973	0	68.08N	150.37W	11	165	Chandler Lake, Philip Smith Mtns.
1216-21190	February 24, 1973	0	66.49N	152.11W	13	164	Bettles
1216-21192	February 24, 1973	0	65.29N	153.46W	14	162	Melozitna - Tanana
1216-21195	February 24, 1973	0	64.08N	155.07W	15	161	Ruby
1216-21201	February 24, 1973	0	62.47N	156.21W	16	159	Iditarod, McGrath
1216-21204	February 24, 1973	0	61.25N	157.30W	17	158	Sleetmute
1216-21210	February 24, 1973	0	60.03N	158.33W	18	157	Taylor Mtns
1217-21235	February 25, 1973	0	59.26N	150.13W	11	167	Umiat, Sagavanirktok
1217-21242	February 25, 1973	0	68.08N	152.04W	12	165	Chandler Lake
1217-21244	February 25, 1973	0	66.48N	153.44W	13	164	Hughes, Bettles
1217-21251	February 25, 1973	0	65.28N	155.14W	14	162	Melozitna
1217-21253	February 25, 1973	0	64.07N	156.36W	15	161	Nulato - Ophir
1217-21260	February 25, 1973	0	62.45N	157.58W	16	159	Iditarod
1217-21262	February 25, 1973	0	61.24N	158.58W	17	158	Russian Mission - Sleetmute
1217-21265	February 25, 1973	0	60.01N	160.02W	19	157	Bethel - Taylor Mts.
1217-21271	February 25, 1973	5	58.39N	161.01W	20	156	Hagemeister Island
1218-21300	February 26, 1973	0	68.07N	153.33W	12	165	Chandler Lake
1218-21303	February 26, 1973	15	66.47N	155.13W	13	163	Hughes
1218-21305	February 26, 1973	0	65.28N	156.42W	14	162	Ka teel River, Melozitna
1218-21312	February 26, 1973	0	64.07N	158.03W	16	161	Nulato
1218-21314	February 26, 1973	0	62.45N	159.17W	17	159	Holy Cross, Iditarod
1218-21321	February 26, 1973	0	61.23N	160.25W	19	158	Russian Mission
1219-21343	February 27, 1973	5	71.58N	148.47W	09	171	N. of Beechey Point
1219-21361	February 27, 1973	0	66.47N	156.39W	14	163	Shungnak - Hughes
1219-21364	February 27, 1973	0	65.26N	158.08W	15	162	Kateel River
1219-21370	February 27, 1973	0	64.05N	159.29W	16	161	Norton Bay, Nulato
1219-21373	February 27, 1973	0	62.44N	160.44W	17	159	Holy Cross
1219-21375	February 27, 1973	0	61.22N	161.52W	18	158	Russian Mission
1219-21382	February 27, 1973	0	59.59N	162.55W	19	157	Baird Inlet
1219-21384	February 27, 1973	0	58.36N	163.54W	20	156	Bristol Bay - mostly ice
1219-21391	February 27, 1973	0	57.14N	164.50W	21	155	Bristol Bay, shows edge of ice
1220-21413	February 28, 1973	20	68.05N	156.27W	13	165	Howard Pass, Ambler River
1220-21420	February 28, 1973	0	66.46N	158.05W	14	163	Shungnak
1220-21422	February 28, 1973	0	65.26N	159.34W	15	162	Candle, Kateel River
1220-21425	February 28, 1973	0	64.05N	160.55W	16	161	Norton Bay
1220-21431	February 28, 1973	20	62.44N	162.10W	18	159	Kwiguk
1220-21434	February 28, 1973	15	61.22N	163.18W	19	158	Marshall
1220-21440	February 28, 1973	5	59.59N	164.21W	20	157	Baird Inlet, Nunivak Island
1220-21443	February 28, 1973	25	58.36N	165.20W	21	156	Bristol Bay, sea ice
1220-21445	February 28, 1973	05	57.13N	166.15W	22	155	Bristol Bay, edge of ice
1226-20322	March 6, 1973	0	69.29N	137.30W	14	167	Herschel Island
1226-20324	March 6, 1973	0	68.10N	139.10W	15	165	East of Table Mountains
1226-20331	March 6, 1973	5	66.50N	140.48W	16	164	East of Black River
1226-20340	March 6, 1973	5	64.09N	143.39W	19	161	Eagle
1226-22153	March 6, 1973	0	69.27N	163.11W	14	167	Chukchi Sea off Point Lay
1226-22160	March 6, 1973	0	68.09N	165.00W	15	165	Point Hope
1226-22162	March 6, 1973	0	66.50N	166.39W	16	164	Shishmaref
1226-22165	March 6, 1973	0	65.30N	168 08W	18	162	Seward Peninsula
1226-22171	March 6, 1973	0	64.09N	169.30W	19	161	St. Lawrence Island
1226-22174	March 6, 1973	0	62 48N	170 45W	20	159	St. Lawrence Island
1227-20394	March 7, 1973	10	64.07N	145.10W	19	161	Big Delta, very bottom of image cloudy
1227-22203	March 7, 1973	0	72.00N	160.17W	12	172	N. of Wainwright
1227-22212	March 7, 1973	0	69.27N	164.40W	15	167	Point Lay
1227-22214	March 7, 1973	0	68.08N	166.31W	16	165	Point Hope
1227-22221	March 7, 1973	0	66.49N	168.10W	17	164	Bering Straits, Chukchi Sea
1227-22223	March 7, 1973	0	65.29N	169.39W	18	162	Bering Straits
1227-22230	March 7, 1973	0	64.08N	171.00W	19	161	St. Lawrence Island
1227-22232	March 7, 1973	10	62.46N	172.14W	20	159	Bering Sea - Ice

1228-20435	March 8, 1973	0	69.28N	140.17W	15	167	Herschel Island
1228-22270	March 8, 1973	0	69.27N	166.02W	15	167	Point Hope
1228-22273	March 8, 1973	0	68.08N	167.53W	16	165	Point Hope
1228-22275	March 8, 1973	0	66.49N	169.32W	17	164	Siberia, Chukchi Sea
1231-21012	March 11, 1973	10	68.07N	146.15W	17	165	Arctic
1234-21175	March 14, 1973	0	70.38N	146.59W	16	169	Flaxman Island
1234-21181	March 14, 1973	15	69.21N	149.01W	17	167	Sagavanirktok
1234-21204	March 14, 1973	2	61.19N	157.39W	24	158	Sleetmute
1234-21211	March 14, 1973	0	59.57N	158.42W	25	157	Dillingham
1234-21213	March 14, 1973	10	58.34N	159.40W	26	155	Nushagak Bay
1235-21233	March 15, 1973	0	70.39N	148.22W	17	169	Beechey Point
1235-21240	March 15, 1973	0	69.22N	150.25W	18	167	Umiat, Sagavanirktok
1235-21242	March 15, 1973	2	68.04N	152.14W	19	165	Chandler Lake
1235-21263	March 15, 1973	20	61.21N	129.04W	25	158	Russian Mission, Sleetmute
1235-21265	March 15, 1973	3	59.58N	160.06W	26	157	Goodnews
1235-21272	March 15, 1973	5	58.35N	161.04W	27	155	Hagemeister Island
1235-21274	March 15, 1973	10	57.12N	161.58W	28	154	Bristol Bay
1236-21292	March 16, 1973	0	70.39N	149.53W	17	169	Beechey Point
1236-21294	March 16, 1973	0	69.21N	151.55W	18	167	Umiat
1236-21301	March 16, 1973	0	68.03N	153.44W	19	165	Killik River, Chandler Lake
1236-21303	March 16, 1973	0	66.44N	155.23W	20	164	Hughes
1236-21310	March 16, 1973	0	65.23N	156.52W	22	162	Kateel River
1236-21312	March 16, 1973	0	64.02N	158.12W	23	161	Nulato
1236-21324	March 16, 1973	0	59.56N	161.36W	26	157	Goodnews
1236-21330	March 16, 1973	0	58.33N	162.34W	27	155	Hagemeister Island
1236-21333	March 16, 1973	0	57.11N	163.29W	28	154	Bristol Bay
1237-19551	March 17, 1973	5	59.59N	137.13W	26	157	Skagway
1237-19553	March 17, 1973	20	58.36N	138.12W	27	155	Mt. Fairweather
1237-21344	March 17, 1973	0	71.56N	148.58W	16	172	N. of Beechey Point
1237-21350	March 17, 1973	0	70.39N	151.15W	17	170	Harrison Bay, Beechey Point
1237-21353	March 17, 1973	0	69.22N	153.17W	19	167	Ikpikpuk River , Umiat
1237-21355	March 17, 1973	0	68.04N	155.05W	20	166	Killik River, Survey Pass
1237-21362	March 17, 1973	5	66.45N	156.43W	21	164	Shungnak
1237-21373	March 17, 1973	0	62.42N	160.47W	24	159	Holy Cross
1237-21385	March 17, 1973	0	58.36N	163.57W	27	155	Bristol Bay--ice
1237-21391	March 17, 1973	0	57.13N	164.51W	29	154	Bristol Bay, edge of ice
1238-21402	March 18, 1973	0	71.54N	150.26W	17	172	Arctic Ocean, n. of Harrison Bay
1238-21405	March 18, 1973	0	70.38N	152.45W	18	170	Harrison Bay
1238-21411	March 18, 1973	0	69.21N	154.48W	19	167	Ikpikpuk River
1238-21414	March 18, 1973	0	68.02N	156.37W	20	166	Howard Pass, Killik River
1238-21420	March 18, 1973	0	66.44N	158.18W	21	164	Shungnak
1238-21423	March 18, 1973	0	65.24N	159.47W	22	162	Candle, Kateel
1238-21425	March 18, 1973	0	64.02N	161.08W	24	161	Norton Bay
1238-21432	March 18, 1973	0	62.40N	162.21W	25	159	Kwiguk, Holy Cross
1238-21434	March 18, 1973	0	61.18N	163.28W	26	158	Marshall
1238-21441	March 18, 1973	0	59.57N	164.29W	27	156	Nunivak Island
1238-21443	March 18, 1973	0	58.34N	165.28W	28	155	Bristol Bay
1239-20061	March 19, 1973	0	61.21N	129.03W	26	158	East of McCarthy
1239-21461	March 19, 1973	0	71.55N	151.53W	17	172	N. of Teshekpuk
1239-21463	March 19, 1973	0	70.40N	154.11W	18	170	Teshekpuk
1239-21470	March 19, 1973	0	69.23N	156.13W	19	168	Lookout Ridge, Ikpikpuk River
1239-21472	March 19, 1973	0	68.05N	158.03W	21	166	Howard Pass, Ambler River
1239-21475	March 19, 1973	0	66.45N	159.41W	22	164	Selawik, Shungnak
1239-21481	March 19, 1973	0	65.25N	161.09W	23	162	Candle
1239-21484	March 19, 1973	0	64.04N	162.30W	24	161	Solomon, Norton Bay
1239-21490	March 19, 1973	0	62.43N	163.44W	25	159	Kwiguk
1239-21493	March 19, 1973	0	61.21N	164.51W	26	158	Marshall
1239-21495	March 19, 1973	0	59.59N	165.53W	27	157	Cape Mendenhall
1239-21502	March 19, 1973	0	58.36N	166.51W	28	155	Bristol Bay
1240-20115	March 20, 1973	0	61.23N	140.27W	26	159	E. of McCarthy
1240-21515	March 20, 1973	0	71.56N	153.12W	18	172	N. of Teshekpuk
1240-21531	March 20, 1973	0	68.06N	159.25W	21	166	Misheguk Mtns, Howard Pass
1240-21533	March 20, 1973	0	66.47N	161.04W	22	164	Selawik
1240-21540	March 20, 1973	0	65.26N	162.33W	23	162	Bendleben, Candle
1240-21542	March 20, 1973	0	64.06N	163.53W	24	161	Solomon
1240-21545	March 20, 1973	0	62.45N	165.07W	25	159	Black, Kwiguk
1240-21551	March 20,1973	0	61.22N	166.15W	27	158	dHooper Bay
1240-21554	March 20, 1973	0	60.00N	167.18W	28	157	Nunivak Island
1241-20165	March 21, 1973	1	64.06N	139.29W	25	161	E. of Eagle
1241-20171	March 21, 1973	0	62.45N	140.43W	26	159	E. of Nabesna
1241-21573	March 21, 1973	0	71.58N	154.38W	18	172	Barrow
1241-21580	March 21, 1973	0	70.42N	156.57W	19	170	Meade River
1241-21582	March 21, 1973	0	69 25N	159.00W	20	168	Lookout Ridge, Utukok River

1241-21585	March 21, 1973	0	68.07N	160.49W	21	166	Misheguk Mtn
1241-21591	March 21, 1973	0	66.48N	162.28W	22	164	Kotzebue, Selawik
1241-21594	March 21, 1973	0	65.28N	163.51W	24	162	Bendleben
1241-22000	March 21, 1973	0	64.07N	165.18W	25	161	Norton Sound, Nome
1241-22003	March 21, 1973	0	62.46N	166.31W	26	159	Black, Bering Sea
1241-22005	March 21, 1973	0	61.24N	167.39W	27	158	Bering Sea, Hooper Bay
1241-22012	March 21, 1973	10	60.02N	168.43W	28	157	Bering Sea, Nunivak Island
1242-20221	March 22, 1973	0	65.25N	139.38W	24	162	E. of Charley River
1242-22032	March 22, 1973	0	71.55N	156.08W	18	172	Barrow
1242-22034	March 22, 1973	0	70.39N	158.26W	19	170	Meade River
1242-22041	March 22, 1973	0	69.22N	160.28W	21	168	Utukok River
1242-22043	March 22, 1973	20	68.04N	162.17W	22	166	Delong Mtns, Misheguk
1243-22090	March 23, 1973	0	71.56N	157.35W	19	172	N. of Barrow
1243-22093	March 23, 1973	0	70.40N	159.52W	20	170	Wainwright, Meade River
1243-22095	March 23, 1973	0	69.24N	161.55W	21	168	Point Lay
1243-22113	March 23, 1973	5	64.66N	168.16W	26	161	Nome
1243-22120	March 23, 1973	10	62.44N	169.30W	27	159	St. Lawrence Island
1243-22125	March 23, 1973	0	60.01N	171.41W	29	157	Bering Sea, ice
1243-22131	March 23, 1973	10	58.38N	172.40W	30	155	Bering Sea, ice
1247-20491	March 27, 1973	5	70.41N	139.47W	21	170	E. of Barter Island
1247-20493	March 27, 1973	0	69.23N	141.50W	23	168	Demarcation Point
1247-20505	March 27, 1973	15	65.26N	146.49W	26	162	Circle
1247-20511	March 27, 1973	25	64.05N	148.09W	27	161	Fairbanks
1251-21130	March 31, 1973	0	68.09N	149.21W	25	166	Philip Smith Mountains
1251-21132	March 31, 1973	10	66.50N	151.00W	26	164	Bettles
1251-21135	March 31, 1973	0	65.30N	152.30W	28	163	Tanana
1251-21141	March 31, 1973	0	64.10N	153.52W	29	161	Ruby, Kantishna
1252-21175	April 1, 1973	0	70.43N	146.57W	23	170	Flaxman Island
1252-21182	April 1, 1973	0	69.26N	149.01W	25	168	Sagavanirktok
1252-21184	April 1, 1973	20	68.08N	150.51W	26	166	Chandler Lake, Philip Smith Mtns
1252-21191	April 1, 1973	2	66.49N	152.29W	27	164	Bettles
1252-21193	April 1, 1973	2	65.28N	153.59W	28	163	Melozitna, Tanana
1253-21233	April 2, 1973	20	70.43N	148.19W	24	171	Beechey Point
1253-21240	April 2, 1973	20	69.27N	150.21W	25	168	Umiat, Sagavanirktok
1253-21242	April 2, 1973	0	68.09N	152.11W	26	166	Chandler Lake
1253-21245	April 2, 1973	25	66.49N	153.51W	27	164	Hughes, Bettles
1253-21265	April 2, 1973	0	60.04N	160.07W	33	157	Bethel, Goodnews
1253-21272	April 2, 1973	5	58.41N	161.06W	34	155	Hagemeister Island
1253-21274	April 2, 1973	0	57.18N	162.00W	35	154	Bristol Bay
1253-21281	April 2, 1973	10	55.54N	162.52W	36	152	Cold Bay, Port Moller
1253-21283	April 2, 1973	15	54.30N	163.40W	37	151	False Pass
1254-21303	April 3, 1973	0	66.48N	155.25W	28	164	Hughes
1254-21310	April 3, 1973	0	65.28N	156.54W	29	163	Kateel River, Melozitna
1254-21312	April 3, 1973	0	64.07N	158.15W	30	161	Nulato
1254-21315	April 3, 1973	0	62.46N	159.29W	31	159	Holy Cross, Iditarod
1254-21321	April 3, 1973	0	61.24N	160.36W	32	158	Russian Mission
1254-21324	April 3, 1973	0	60.02N	161.39W	33	156	Baird Inlet, Bethel
1255-19551	April 4, 1973	5	60.01N	137.13W	33	156	N. of Skagway.
1255-21355	April 4, 1973	0	68.07N	155.12W	27	166	Killik River
1255-21364	April 4, 1973	0	65.28N	158.18W	29	163	Kateel River
1255-21371	April 4, 1973	0	64.08N	159.39W	30	161	Norton Bay, Nulato
1256-21402	April 5, 1973	0	72.00N	150.23W	24	173	N. of Harrison Bay
1256-21405	April 5, 1973	0	70.44N	152.44W	25	171	Harrison Bay
1256-21411	April 5, 1973	0	69.27N	154.48W	26	168	Ikpikpuk River
1256-21414	April 5, 1973	0	68.09N	156.37W	27	166	Howard Pass
1257-21461	April 6, 1973	0	72.01N	151.50W	24	173	N. of Harrison Bay
1258-21515	April 7, 1973	0	72.01N	153.14W	25	173	N. of Teshekpuk
1258-21540	April 7, 1973	10	65.30N	162.35W	30	163	Bendleben, Candle.
1258-21542	April 7, 1973	0	64.09N	163.56W	31	161	Solomon
1258-21545	April 7, 1973	0	62.47N	164.59W	32	160	Black, Kwiguk
1258-21551	April 7, 1973	0	61.26N	166.17W	34	158	Hooper Bay
1258-21563	April 7, 1973	60	57.17N	169.14W	37	154	Top cloudy but Pribilof Islands seem clear
1258-21565	April 7, 1973	20	55.54N	170.05W	38	152	Pribilof Islands
1259-21580	April 8, 1973	5	70.45N	156.57W	26	171	Barrow
1259-21582	April 8, 1973	10	69.28N	159.01W	27	169	Utukok River - Lookout Ridge
1259-21585	April 8, 1973	0	68.09N	160.51W	28	167	Misheguk Mtn.
1259-21591	April 8, 1973	2	66.50N	162.30W	29	165	Kotzebue - Selawik
1259-21594	April 8, 1973	0	65.30N	163.59W	31	163	Bendleben
1259-22000	April 8, 1973	5	64.09N	165.20W	32	161	Nome - Soloman
1259-22003	April 8, 1973	20	62.48N	166.35W	33	160	Black
1260-22032	April 9, 1973	0	72.01N	156.04W	25	174	Barrow
1261-20284	April 10, 1973	0	62.48N	143.38W	34	160	Nabesna
1261-22090	April 10, 1973	0	72.01N	157.30W	26	174	N. Of Barrow
1261-22093	April 10, 1973	10	70.45N	159.45W	27	171	Wainwright, Meade River
1261-22102	April 10, 1973	15	68.09N	163.43W	29	167	Delong Mountains

1261-22120	April 10, 1973	10	62.48N	169.25W	34	160	Bering Sea - ice
1262-20331	April 11, 1973	0	66.51N	140.59W	31	165	Black River
1262-20334	April 11, 1973	0	65.31N	142.28W	32	163	Charley River
1262-20340	April 11, 1973	10	64.10N	143.50W	33	161	Eagle
1262-22145	April 11, 1973	5	72.02N	159.00W	26	174	N. of Wainwright
1262-22151	April 11, 1973	5	70.46N	161.19W	27	171	Wainwright
1262-22154	April 11, 1973	10	69.29N	163.21W	28	169	Point Lay
1262-22160	April 11, 1973	3	68.11N	165.12W	29	167	DeLong Mountains
1262-22163	April 11, 1973	5	66.52N	166.51W	31	165	Shishmaref
1263-20383	April 12, 1973	0	68.10N	140.51W	30	167	Table Mtn
1263-20385	April 12, 1973	0	66.50N	142.29W	31	165	Black River
1263-20392	April 12, 1973	0	65.30N	143.58W	32	163	Charley River
1263-20394	April 12, 1973	5	64.09N	145.19W	33	161	Big Delta
1263-22203	April 12, 1973	0	72.02N	160.23W	26	174	N. of Wainwright
1263-22210	April 12, 1973	0	70.46N	162.43W	28	171	Wainwright
1263-22212	April 12, 1973	0	69.29N	164.46W	29	169	Point Lay
1264-19051	April 13, 1973	0	54.31N	129.49W	41	151	Canada, SE of Prince Rupert
1264-20435	April 13, 1973	20	69.28N	140.21W	29	169	Herschel Is.
1264-20441	April 13, 1973	10	68.11N	142.11S	30	167	Table Mountains.
1264-20444	April 13, 1973	0	66.51N	143.50W	31	165	Black River
1265-20500	April 14, 1973	0	68.13N	143.38W	30	167	Table Mts.
1266-20554	April 15, 1973	10	68.13N	145.03W	31	167	Arctic
1266-20561	April 15, 1973	20	66.54N	146.42W	32	165	Fort Yukon
1266-20572	April 16, 1973	0	62.52N	150.47W	35	160	Talkeetna Mtn
1267-21012	April 16, 1973	5	68.13N	146.27W	31	167	Arctic
1267-21051	April 16, 1973	10	55.57N	157.10W	41	152	Sutwik Island
1268-21064	April 17, 1973	5	69.29N	146.10W	30	169	Mt. Michelson
1268-21071	April 17, 1973	0	68.11N	147.59W	32	167	Philip Smith Mtns
1268-21073	April 17, 1973	20	66.51N	149.37W	33	165	Beaver
1269-21123	April 18, 1973	10	69.29N	147.34W	31	169	Sagavanirktok - Mt. Michelson
1269-21125	April 18, 1973	0	68.10N	149.24W	32	167	Philip Smith Mtns.
1269-21132	April 18, 1973	20	66.51N	151.03W	33	165	Bettles
1269-21155	April 18, 1973	20	58.42N	158.16W	40	155	Nushagak Bay
1270-21181	April 19, 1973	5	69.29N	149.00W	31	169	Sagavanirktok
1271-21240	April 20, 1973	10	69.30N	150.25W	31	169	Umiat - Sagavanirktok
1271-21242	April 20, 1973	0	68.12N	152.15W	33	167	Chandler Lake
1271-21245	April 20, 1973	0	66.52N	153.54W	34	165	Hughes - Bettles
1271-21251	April 20, 1973	0	65.32N	155.23W	35	163	Melozitna
1271-21254	April 20, 1973	0	64.11N	156.44W	36	161	Nulato, Ruby
1271-21263	April 20, 1973	5	61.28N	159.07W	38	158	Russian Mission - Sleetmute
1271-21272	April 20, 1973	15	58.42N	161.09W	40	155	Hagemeister Island
1272-21294	April 21, 1973	15	69.33N	151.47W	32	169	Umiat
1272-21300	April 21, 1973	5	68.14N	153.38W	33	167	Killik River, Chandler Lake
1272-21303	April 21, 1973	0	66.55N	155.18W	34	165	Hughes
1272-21305	April 21, 1973	0	65.35N	156.47W	35	163	Kateel River, Melozitna
1272-21312	April 21, 1973	0	64.14N	158.09W	36	161	Nulato
1272-21314	April 21, 1973	0	62.53N	159.24W	37	160	Holy Cross, Iditarod
1272-21321	April 21, 1973	0	61.31N	160.33W	39	158	Russian Mission
1272-21323	April 21, 1973	0	60.08N	161.37W	40	156	Bethel
1272-21330	April 21, 1973	0	58.46N	162.36W	41	155	Kuskokwim Bay - Hagemeister Is.
1272-21332	April 21, 1973	0	57.22N	163.31W	42	153	Bristol Bay & Ice
1273-21361	April 22, 1973	10	66.55N	156.44W	34	165	Shungnak - Hughes
1273=21364	April 22, 1973	0	65.35N	158.14W	36	163	Kateel River
1273-21370	April 22, 1973	0	64.15N	159.36W	37	161	Norton Bay, Nulato
1274-20002	April 23, 1973	0	61.31N	137.34W	39	158	N. of Skagway
1274-20005	April 23, 1973	15	60 09N	138.37W	40	156	Yakutat
1274-21402	April 23, 1973	5	72.06N	150.16W	30	174	N. of Harrison Bay
1274-21420	April 23, 1973	10	66.56N	158.10W	35	165	Shungnak
1274-21422	April 23, 1973	0	65.36N	159.40W	36	163	Candle, Kateel R.
1274-21425	April 23, 1973	0	64.15N	161.02W	37	161	Norton Bay
1275-20061	April 24, 1973	0	61.31N	139.01W	40	158	North of Mt. St. Elias
1275-20063	April 24, 1973	20	60.09N	140.04W	41	156	Mt. St. Elias
1275-21483	April 24, 1973	0	64.14N	162.28W	37	161	Norton Bay
1276-21542	April 25, 1973	0	64.14N	163.53W	38	161	Soloman
1276-21544	April 25, 1973	0	62.53N	165.08W	39	160	Black - Kwiguk
1276-21551	April 25, 1973	0	61.30N	166.16W	40	158	Hooper Bay
1276-21553	April 25, 1973	10	60.08N	167.20W	41	156	Nunivak Island
1277-21584	April 26, 1973	0	68.18N	160.48W	35	167	Misheguk Mtns
1277-22000	April 26, 1973	0	64.18N	165.19W	38	161	Nome, Soloman
1277-22002	April 26, 1973	0	62.56N	166.34W	39	160	Black
1277-22005	April 26, 1973	10	61.34N	167.42W	40	158	Hooper Bay
1277-22011	April 26, 1973	0	60.11N	168.45W	41	156	Bering Sea
1279-20265	April 28, 1973	5	68.19N	137.46W	35	167	East of Table Mts
1279-20272	April 28, 1973	15	67.00N	139.26W	36	165	East of Coleen
1279-20274	April 28, 1973	15	65.40N	140.56W	37	163	Charley River
1279-20281	April 28, 1973	0	64.19N	142.18W	39	161	Eagle

1279-22090	April 28, 1973	0	72.11N	157.18W	32	175	Barrow
1279-22092	April 28, 1973	5	70.55N	159.39W	33	172	Wainwright, Meade River
1279-22113	April 28, 1973	5	64.19N	168.10W	39	161	Bering Sea - Ice
1279-22115	April 28, 1973	10	62.58N	169.25W	40	160	St. Lawrence Island - Ice
1280-20330	April 29, 1973	20	66.59N	140.51W	37	165	East of Black River
1280-20333	April 29, 1973	0	65.39N	142.21W	38	163	Charlie River
1280-20335	April 29, 1973	0	64.18N	143.43W	39	161	Delta - Eagle
1283-20495	May 2, 1973	0	68.16N	143.35W	36	167	Table Mtn
1283-20502	May 2, 1973	0	66.58N	145.14W	28	165	Ft. Yukon
1283-20504	May 2, 1973	5	65.37N	146.44W	39	163	Circle
1283-20513	May 2, 1973	15	62.55N	149.22W	41	159	Talkeetna Mtns
1284-20551	May 3, 1973	10	69.34N	143.12W	36	170	Demarcation Point
1284-20553	May 3, 1973	0	68.15N	145.02W	37	167	Arctic
1284-20560	May 3, 1973	0	66.56N	156.41W	38	165	Ft. Yukon
1284=20562	May 3, 1973	0	65.35N	148.11W	39	163	Livengood
1284-20565	May 3, 1973	0	64.15N	159.33W	40	161	McKinley
1284-20571	May 3, 1973	25	62.53N	150.47W	41.	159	Talkeetna
1285-21014	May 4, 1973	20	66.59N	148.02W	38	165	Beaver
1285-21021	May 4, 1973	5	65.39N	149.32W	39	163	Livengood
1285-21023	May 4, 1973	3	64.18N	150.54W	40	161	Kantishna River
1288-21210	May 7, 1973	3	60.12N	158.42W	45	156	Taylor Mtns
1288-21212	May 7, 1973	1	58.49N	159.41W	46	154	Hagemeister Island, Nushagak Bay
1291-21363	May 10,1973	5	65.35N	158.15W	41	163	Kateel River
1291-21370	May 10, 1973	5	64.14N	159.38W	42	161	Norton Bay, Nulato
1291-21372	May 10, 1973	5	62.52N	160.53W	43	159	Kwiguk, Holy Cross
1291-21375	May 10, 1973	5	61.30N	162.02W	44	157	Marshall, Russian Mission
1291-21381	May 10, 1973	10	60.07N	163.05W	45	155	Kuskokwim
1293-21482	May 12, 1973	15	64.15N	162.27W	43	161	Norton Bay
1293-21491	May 12, 1973	10	61.32N	164.50W	45	157	Marshall
1293-21494	May 12, 1973	10	60.10N	165.53W	46	155	Nunivak Island
1293-21500	May 12, 1973	10	58.47N	166.51W	47	153	Bering Sea
1294-20121	May 13, 1973	10	60.08N	141.31W	46	155	Icy Bay
1294-21541	May 13, 1973	0	64.14N	163.56W	43	161	Soloman
1294-21543	May 13, 1973	10	62.53N	165.10W	44	159	Black
1294-21550	May 13, 1973	0	61.31N	166.18W	45	157	Hooper Bay
1294-21552	May 13, 1973	0	60.08N	167.21W	46	155	Nunivak Island

1295-20161	May 14, 1973	0	65.38N	138.11W	42	163	East of Charley River
1295-20163	May 14, 1973	0	64.17N	139.33W	43	161	East of Eagle
1295-21572	May 14, 1973	0	72.09N	154.34W	36	175	North of Teshekpuk
1295-21575	May 14, 1973	5	70.53N	156.55W	37	172	Meade River
1295-21581	May 14, 1973	5	69.35N	158.59W	38	169	Ututok River, Lookout Ridge
1295-21584	May 14, 1973	15	68.17N	160.50W	40	167	Misheguk Mtn
1298-20323	May 17, 1973	0	68.19N	139.15W	40	167	East of Table Mtn.
1298-20325	May 17, 1973	2	67.00N	140.55W	41	165	Coleen, Black River
1299-22224	May 18, 1973	2	64.18N	171.03W	44	161	Siberia, Bering Straits
1300-20460	May 19, 1973	25	61.35N	149.01W	46	157	Anchorage
1300-22262	May 19, 1973	0	70.56N	164.02W	38	172	Point Lay
1300-22265	May 19, 1973	0	69.39N	166.07W	40	169	Point Hope
1300-22271	May 19, 1973	5	68.28N	167.58W	41	67	Point Hope
1300-22274	May 19, 1973	20	67.01N	169.37W	42	165	Chukchi Sea
1300-22280	May 19, 1973	15	65.41N	171.07W	43	163	Chukotsch Penn.
1304-21063	May 23, 1973	2	69.36N	146.04W	40	169	Mt. Michelson
1305-21115	May 24, 1973	5	70.52N	145.31W	39	172	Flaxman Is.
1305-21121	May 24, 1973	20	69.35N	147.35W	41	169	Sagavanirktok, Mt. Michelson
1305-21133	May 24, 1973	0	65.36N	152.36W	44	162	Tanana
1307-19434	May 26, 1973	0	58.46N	135.17W	50	152	Juneau
1307-21231	May 26, 1973	3	70.53N	148.15W	40	172	Beechey Point
1308-21290	May 27, 1973	0	70.55N	149.37W	40	172	Beechey Point
1308-21292	May 27, 1973	0	69.38N	151.41W	41	169	Umiat
1308-21295	May 27, 1973	5	68.20N	153.32W	42	167	Killik River, Chandler
1308-21301	May 27, 1973	5	67.00N	155.12W	43	164	Survey Pass, Hughes
1308-21310	May 27, 1973	15	64.19N	158.05W	46	160	Nulato
1308-21313	May 27, 1973	20	62.57N	159.21W	47	158	Holy Cross, Iditarod
1311-21472	May 30, 1973	0	66.57N	159.41W	44	164	Selawik, Shungnak
1311-21475	May 30, 1973	20	65.36N	161.10W	45	162	Selawik
1311-21481	May 30, 1973	0	64.15N	162.30W	46	160	Soloman, Norton Bay
1312-20113	May 31, 1973	20	61.32N	140.28W	48	156	McCarthy & East
1312-21524	May 31, 1973	0	68.18N	159.24W	43	166	Misheguk Mtn, Howard Pass
1312-21531	May 31, 1973	0	66.58N	161.04W	44	164	Misheguk Mtn
1312-21533	May 31, 1973	20	65.37N	162.34W	45	162	Bendelben, Candle
1313-21582	June 1, 1973	0	68.16N	160.54W	43	166	Misheguk Mtn
1313-21585	June 1, 1973	5	66.57N	162.33W	44	164	Kotzebue
1314-22041	June 2, 1973	5	68.18N	162.17W	43	166	DeLong Mtn, Misheguk

1314-22043	June 2, 1973	0	66.59N	163.55W	44	164	Kotzebue
1317-20374	June 5, 1973	0	69.38N	138.56W	42	168	Canada, Herschel Island
1317-22203	June 5, 1973	0	70.55N	162.38W	41	171	Wainwright
1318-20432	June 6, 1973	20	69.38N	140.20W	42	168	Herschel Island
1323-19320	June 11, 1973	15	58.49N	132.26W	51	150	Taku River
1326-21284	June 14, 1973	0	70.50N	149.51W	42	170	Beechey Point
1326-21291	June 14, 1973	5	69.32N	151.55W	43	168	Umiat
1326-21305	June 14, 1973	5	64.12N	158.14W	47	158	Nulato
1326-21311	June 14, 1973	5	62.50N	159.28W	48	156	Holy Cross
1328-20004	June 16, 1973	20	58.42N	139.38W	52	150	Yakutat
1328-21413	June 16, 1973	5	66.54N	158.15W	45	163	Shungnak
1328-21415	June 16, 1973	1	65.33N	159.44W	46	160	Candle - Kateel
1328-21422	June 16, 1973	0	64.12N	161.05W	47	158	Norton Bay
1329-21455	June 17, 1973	20	70.51N	154.04W	42	170	Teshekpuk
1329-21462	June 17, 1973	3	69.33N	156.08W	43	167	Lookout Ridge
1329-21464	June 17, 1973	3	68.15N	157.57W	44	165	Howard Pass
1329-21471	June 17, 1973	0	66.55N	159.36W	45	163	Selawik
1329-21473	June 17, 1973	10	65.35N	161.06W	46	160	Candle
1330-21523	June 18, 1973	5	68.13N	159.32W	44	165	Misheguk Mtn, Howard Pass
1330-21525	June 18, 1973	0	66.52N	161.13W	45	162	Selawik
1334-22155	June 22, 1973	5	66.54N	166.52W	45	162	Shishmaref
1334-22161	June 22, 1973	0	65.34N	168.22W	46	160	Teller
1334-22164	June 22, 1973	0	64.13N	169.44W	47	158	St. Lawrence
1335-22201	June 23, 1973	10	70.51N	162.45W	42	170	Wainwright
1335-22215	June 23, 1973	2	65.34N	169.48W	46	160	Teller, Little & Big Diomede
1335-22222	June 23, 1973	2	64.13N	171.09W	47	158	St. Lawrence Island
1335-22224	June 23, 1973	0	62.51N	172.23W	48	155	St. Lawrence Island
1335-22231	June 23, 1973	5	61.30N	173.31W	50	153	St. Matthews
1336-20440	June 24, 1973	10	66.51N	143.56W	45	162	Black River
1336-22262	June 24, 1973	15	69.29N	166.17W	43	187	Point Hope
1336-22274	June 24, 1973	1	65.30N	171.13W	46	160	Siberia
1336-22280	June 24, 1973	0	64.09N	172.34W	47	157	Siberia, St. Lawrence
1337-22330	June 25, 1973	0	66.54N	171.10W	45	162	Siberia
1337-22332	June 25, 1973	0	65.34N	172.40W	46	160	Siberia
1337-22335	June 25, 1973	0	64.12N	174.02W	47	157	Siberia

1339-20595	June 27, 1973	20	70.50N	142.43W	42	169	Barter Island
1339-22424	June 27, 1973	0	72.06N	166.07W	41	172	Chukchi Sea
1339-22431	June 27, 1973	0	70.51N	168.27W	42	169	Chukchi Sea
1339-22433	June 27, 1973	0	69.33N	170.32W	43	167	Chukchi Sea
1339-22440	June 27, 1973	0	68.15N	172.22W	44	164	Chukchi Sea
1339-22442	June 27, 1973	0	66.55N	174.01	45	162	Siberia
1341-21130	June 29, 1973	10	65.33N	152.39W	46	159	Tanana
1341-21135	June 29, 1973	20	62.49N	155.14W	48	155	McGrath
1341-21141	June 29, 1973	5	61.28N	156.23W	49	153	Sleetmute, Lime Hills
1341-21144	June 29, 1973	5	60.03N	157.05W	50	151	Taylor Mts.
1342-21170	June 30, 1973	15	70.49N	147.01W	42	196	Beechey Pt., Flaxman Is.
1342-21173	June 30, 1973	15	69.31N	149.04W	43	166	Sagavanirktok
1342-21191	June 30, 1973	10	64.11N	155.23W	47	157	Ruby
1342-21193	June 30, 1973	20	62.49N	156.37W	48	155	Iditarod, McGrath
1344-21283	July 2, 1973	0	70.49N	149.53W	42	169	Beechey Point
1344-21290	July 2, 1973	2	69.31N	151.57W	43	166	Umiat
1344-21292	July 2, 1973	0	68.12N	153.47W	44	164	Chandler Lake
1345-21342	July 3, 1973	5	70.44N	151.30W	41	169	Harrison Bay
1345-21344	July 3, 1973	20	69.27N	153.33W	43	166	Ikpikpuk River
1345-21351	July 3, 1973	10	68.08N	155.22W	44	164	Killik River
1345-21353	July 3, 1973	10	66.48N	157.00W	45	161	Shungnak
1345-21360	July 3, 1973	15	65.28N	158.28W	46	159	Kateel River
1345-21362	July 3, 1973	10	64.07N	159.48W	47	157	Norton Bay, Nulato
1346-21420	July 4, 1973	20	64.07N	161.10W	47	157	Norton Bay
1346-21425	July 4, 1973	20	61.24N	163.31W	49	153	Marshall
1349-21564	July 7, 1973	0	71.59N	154.54W	40	172	Barrow
1350-20223	July 8, 1973	2	61.24N	143.26W	48	153	McCarthy
1351-20275	July 9, 1973	10	62.41N	143.48W	47	155	Nabesna
1351-20282	July 9, 1973	5	61.19N	144.56W	48	152	Valdez, McCarthy
1352-20333	July 10, 1973	5	62.44N	145.14W	47	155	Gulkana
1352-20340	July 10, 1973	10	61.22N	146.21W	48	153	Valdez
1352-20342	July 10, 1973	15	60.00N	147.23W	49	150	Seward, Cordova
1354-22275	July 12, 1973	20	64.08N	172.39W	46	157	Siberia, St. Lawrence Island
1356-20540	July 14, 1973	0	70.44N	141.22W	40	168	Barter Island
1358-19262	July 16, 1973	2	57.14N	131.58W	50	147	East of Sumdum
1358-19264	July 16, 1973	0	55.51N	132.49W	51	145	Craig, Ketchikan
1358-19271	July 16, 1973	0	54.27N	133.37W	52	142	Dixon Entrance
1358-21052	July 16, 1973	20	70.44N	144.16W	40	168	Flaxman Island

APPENDIX D

NATIONAL INTEREST RESOURCE FACT SHEETS

The Resource Planning Team of the Joint Federal-State Land Use Planning Commission prepared a series of descriptive fact sheets of the resources of key areas in the "National Interest" lands category. These fact sheets were in part prepared from interpretation of ERTS images, and were widely distributed in June 1973 by the Commission prior to and as part of the process of holding hearings throughout Alaska, San Francisco, and Washington, D. C., and eliciting recommendations from all segments of the public relating to land use management decisions.

The Commission's resource fact sheet for the Wrangell-Chugach Mountains region is reproduced in this Appendix. Similar resource fact sheets were also prepared for the following National Interest lands in Alaska:

- Upper Yukon
- Yukon Flats
- Central Brooks Range
- Shumagin Island
- Cape Lisburne - Thompson
- Seward Peninsula
- Yukon - Kuskokwim Delta
- Innoko - Nowitna
- Katmai
- Anaiakchak Crater
- Noatak - Kobuk
- Mt. McKinley
- Juneau Icefield
- Eastern Brooks Range
- Koyukuk - Kanuti
- Lake Klar - Iliamna
- Hagemeister Island - Togiak
- Kenai Peninsula

As the final component in Appendix D, there is included the preliminary resource report on the Wrangell Mountains area which was prepared in January 1973. This report by the Resource Planning Team of the Commission outlines the uses of ERTS imagery in the Team's work in Alaska.

A DESCRIPTION

Joint Federal-State
Land Use Planning Commission For Alaska

A Glimpse Of The Area

This summary describes the two "national interest" withdrawals and related lands in the Wrangell-Chugach Mountain area.

The mountainous region contains some of the most vivid and dramatic scenery in the nation. The wildlife of the Wrangell and Chugach Mountains, particularly Dall sheep have an international reputation among trohy hunters. The region also is outstanding because of its high mineral potential, especially for copper, molybdenum, and silver. The coastal lowlands harbor numerous migratory birds, including over half of the trumpeter swans in the world. These and many other attributes of the area must all be carefully considered in the planning process.

Most of this area lies within the AHTNA Native Corporation region. Small portions are within the Sealaska, Chugach, and Doyon Native regions. The area of the Wrangell withdrawal is 3.9 million acres; the Chugach withdrawal is 7.3 million acres. The major land features of the area are the coastal lowlands, the Chugach Mountains, the Chitina Valley, the Wrangell Mountains, and the Mentasta and Nutzotin Mountains. The Chugach and Wrangell Mountains reach elevations between 10,000 and 16,000 feet and contain extensive glacier and icefield systems. From the coast to the Chugach crest the climate is characterized by much cloudiness and heavy precipitation. The annual average temperature is 40 degrees. North of the Chugach Range the climate is transitional with less precipitation and an annual average temperature of 35 degrees.

People

The 1970 census lists 16 communities in the area surrounding the "national interest" lands. Cordova, Valdez, and Glennallen are the larger communities. The total area population in 1970 was 3,800, of which 1,100 were Alaska Natives. However, in the recent enrollment under the Settlement Act, 2,249 Natives claim residence.

Five AHTNA villages in the area have estimated that their total annual subsistence food harvest averages 254,000 pounds. Using enrollment figures for the five villages, subsistence food harvest totals 600 pounds per person. Caribou, moose, and salmon are the most important types of subsistence food. Fourteen species of fur bearers are also harvested.

The Wrangell-Chugach area has a long history of human habitation. Archaeological deposits have been found along the coast and the Copper River, near larger freshwater lakes and the headwaters of the White and Copper Rivers. Cordova was the distribution center for the Kennicott copper mines, located near McCarthy between 1911 and 1938.

Minerals, Energy, and Geology

The area contains four geologic provinces separated by three major east-west faults. The Gulf province is underlain by sedimentary rocks with excellent petroleum and coal potential. Coal in the Bering River field has coking qualities. The southern province has little mineral potential except for small gold veins. Economic mineral potential in the northern province is relatively unknown. The intermediate province, however, is underlain by both volcanic and sedimentary rocks cut by bodies of granite that have high mineral potential. Zones in the northeast and southwest Wrangell Mountain withdrawal are especially favorable for copper, molybdenum, and silver. Several large copper deposits contain about two billion tons of rock averaging 0.3% copper. Deposits of sand, gravel, and limestone are scattered throughout the area.

Parts of the Wrangell Mountains have high geothermal energy potential. Three sites within the area on the Copper River have potential for hydroelectric power development. The Wood Canyon site, based on cost and power potential, is one of the best in Alaska. With a potential installed capacity of up to 3.9 million kilowatts, it is of national significance. Two related

Minerals, Energy, and Geology (cont.)

projects, Cleave and Million Dollar, could add an additional 1.15 million kilowatts of electrical energy.

Fish and Wildlife

A variety of mammals, birds, and fish abound within the area. Many of these animals are important to the local population for subsistence purposes. There are excellent opportunities for sport fishing, hunting, and wildlife observation. Large mammals of the region include Dall sheep, moose, caribou, brown/grizzly bear, black bear (including the rare glacier bear), wolves, wolverines, and mountain goats. There are also two small herds of bison.

The Wrangell-Mentasta-Nutzotin Mountains complex is the outstanding Dall sheep hunting area in Alaska. It annually produces about 28 percent of Alaska's legal sheep harvest. Part of the critical wintering range for the Nelchina caribou herd, the most important in the State from a sport hunting standpoint, is located in the northwestern flank of the Wrangell Mountains. The small Mentasta and Chisana caribou herds remain in the northern portion of the area year-round.

The Copper River Delta, a part of the Chugach National Forest, is the principal nesting ground for the world population of dusky Canada geese and a prime staging and feeding area for all types of migrating fowl. About half of the world's population of trumpeter swans nest in the Copper River Valley and Delta, along the Chitina River, and on the Bering Glacier outwash plain. During migration periods, the Copper River Delta supports some of the largest concentrations of birdlife known. The coastline from Yakutat Bay to Prince William Sound is prime habitat for bald eagles, harbor seals, sea otters, sea lions, and sea birds. The area also supports small populations of the endangered peregrine falcon.

Because of remoteness, rugged terrain, and the nature of glacial streams, there is little commercial, subsistence, or sport fishing within the two withdrawal units. Watersheds within the units contribute significantly to the salmon production of the Copper River system. More than 37,000 salmon were taken for subsistence use from the Copper River in 1971. Grayling are found in almost all of the clear water streams in the area.

Recreation, Natural and Scientific Features

The withdrawal units and adjacent lands comprise a vast, mostly primitive area. They are dominated by the towering peaks of the St. Elias and Wrangell Mountain Ranges; enormous ice-fields and glaciers; and a variety of other scenic, geological, and wildlife attractions. Many of the highest peaks in North America are within these mountain ranges. Descending from the mountains are glaciers of all descriptions and sizes. The Malaspina Glacier, larger than the State of Rhode Island, forms the coastal foreground to Mt. St. Elias. This 18,000-foot mountain and other peaks form the highest coastal mountain range in the world. Mt. Logan, 19,850 feet, the highest peak in Canada, is in the adjacent Kluane National Park of the Yukon Territory. Historical features related to early mining days are also present.

Previous studies have identified the national significance of the area's scenic, scientific, primitive, and recreation values. Seven sites in the area have been nominated for consideration as ecological reserves, because of their scientific values. Vegetational and glacial features and the trumpeter swan are among the primary values.

Present recreational use of the area, limited by access, consists primarily of trophy hunting and sightseeing. Potentials for tourism and recreation lie in a variety of sightseeing features as well as opportunities for hiking, mountain climbing, back-country camping, lake and river boating, wildlife observation, hunting, freshwater fishing, rock collecting, and possibly winter sports. Interpretive and educational opportunities are abundant.

Ecosystems

Land and marine ecosystems range from an 18,000-foot mountain peak to below sea level, and include glaciers and icefields 25%, alpine tundra 40%, upland spruce-hardwood forest 10%, coastal western hemlock-Sitka spruce forest 5%, riverine 600 miles, wave-mixed estuaries 5%, wave-stirred beach 90 miles, wave-beaten rocky coast 10 miles, continental shelf unestimated and other ecosystems 15%.

Forest

Forests of Sitka spruce and hemlock are scattered along the coast. Forests in the interior contain white and black spruce, aspen, birch, and poplar. In the withdrawal units, there are 88,000 acres of forest land containing about 1.8 billion board feet. Most of the area's harvestable timber volume is located on the beaches and river bottoms adjacent to the Copper and Chitina Rivers.

Coastal and Marine

The Gulf of Alaska and associated coast is one of the most picturesque coastal areas on the North American Continent.

The narrow coastline is backed by high glaciated mountain peaks. Precipitation averages 100 to 160 inches per year, and average temperatures range from 20° to 60°F. Governed by winds up to 100 knots, waves average greater than five feet in height from 5 to 30 percent of the time. Tidal differences range between 15 and 18 feet. Shore currents move east to west 0.5 to 1.0 knot. These conditions make the Gulf of Alaska one of the most hazardous for navigation.

Transportation and Utilities

The Alaska, Glenn, and Richardson Highways extend through the northern and western edges of this area. Access from the south is by sea through the ports of Valdez, Cordova, and Yakutat, and by riverboat up the Copper River. There are major airports with daily service at Yakutat and Cordova. The Alaska Ferry System serves Valdez and Cordova from Whittier from May through September.

An abandoned railroad grade extends from Cordova to McCarthy. Parts of this grade are being reconstructed into a highway. Connections from Cordova to Thompson Pass on the Richardson Highway and from Chitina to McCarthy are scheduled for completion in 1977.

Primary access to the withdrawal units is by light aircraft at approximately 12 airports and many other landing strips. Float planes use lakes and rivers, providing access for hunters, recreationists, and prospectors. A primitive trail system, a remnant of the early 1900's mining era, connects the main valleys and passes in the Wrangell Mountain unit.

Land Status

About 11.2 million acres are in the Wrangell and Chugach Mountain withdrawal units. Less than one percent of this land is privately owned or under application for private ownership. Several grazing leases have been issued on the withdrawals and adjoining lands. Oil and gas leases exist in the Oily Lake and Yakutat Bay areas. Federal Land Office records show that public trail access has been reserved in the northern Wrangell Mountains and road access reserved adjacent to the Copper and Tasnuna Rivers. Recreation reserves are located on Tebay and Hanagita Lakes. About 165,000 acres along the Copper and Chitina Rivers are reserved for power project purposes.

Soils and Watersheds

Watersheds of the area are generally steep and rocky. Icefields extending to low elevations cover 45 percent of the withdrawal units. An equal amount is in alpine tundra. The remaining 10 percent is a fringe of steep slopes with coarse soils bordering the mountain ranges. Permafrost is absent on the coast, discontinuous farther inland but continuous in the Copper River lowland.

Stream flow is generally westerly to the Copper River which, in turn, flows southerly to the Gulf of Alaska. Precipitation is 12-14 inches per year in the low elevations; the higher elevations in the southern part of the area may receive over 160 inches per year. The area has one of the highest rates of stream discharge in the State. Most streams begin in large glaciers and carry high concentrations of glacial silt. Ground water is available only near major streams and along the southern portion of the area.

Agriculture and Grazing

Preliminary estimates based on the Soil Conservation Service exploratory soil survey indicate approximately 330,000 acres within the general area have forage production capabilities. Sixty percent of this acreage may have higher agricultural capabilities not yet proven. Carrying capacity for these lands is about 66,000 animal unit months. Presently seven grazing leases for horses are noted in the area.

ANNOUNCING PUBLIC HEARINGS ON 80 MILLION ACRES OF "NATIONAL INTEREST LANDS" IN ALASKA

Before the Joint Federal State Land Use Planning Commission for Alaska

The Commission has broad responsibilities in planning for the use and management of public lands in Alaska. By the Alaska Native Claims Settlement Act, the Commission must develop recommendations about (1) areas of Alaska which should be kept in Federal ownership as National Parks, Forests, Wildlife Refuges, and other public uses; (2) land selections by the State of Alaska and Native corporations; (3) laws, policies, budgets, and programs affecting Federal and State agencies managing lands in Alaska; (4) public easements; and (5) other methods of promoting the economic and social well-being of all the people of Alaska. The Commission is also available to advise and assist in the development of land-use plans for lands selected by Native corporations and by the State.

By law, the Commission is headed by the Governor of Alaska or his full-time State Co-Chairman Designee, and by a Federal Co-Chairman appointed by the President of the United States. Four Commissioners are appointed by the Secretary of the Interior, and four by the Governor of Alaska.

State Co-Chairman: Governor William A. Egan
State Co-Chairman Designee: Joe P. Josephson
Federal Co-Chairman: Jack O. Horton (Acting)
Max Brewer
Harry E. Carter
Richard Cooley
Joseph H. FitzGerald
Charles F. Herbert
Celia M. Hunter
James J. Hurley
One seat vacant

Hearing Schedule - April 23 thru June 3, 1973

April 23	Anchorage, Alaska	9:00 a.m.
April 24	Anchorage, Alaska Sydney Laurence Auditorium	9:00 a.m.
April 25	Seward, Alaska	10:00 a.m.
	Iliamna, Alaska	11:00 a.m. - 8:00 p.m.
April 26	Kenai, Alaska Council Chambers	10:00 a.m. - 8:00 p.m.
	Dillingham, Alaska	10:00 a.m.
April 27	Valdez, Alaska	11:00 a.m. - 8:00 p.m.
	Toksook Bay, Alaska	11:00 a.m. - 6:00 p.m.
April 28	Holy Cross, Alaska	10:00 a.m. - 6:00 p.m.
April 30	Bethel, Alaska	7:00 p.m.
May 1	Bethel, Alaska	8:00 a.m.
	McGrath, Alaska	11:00 a.m.
May 2	Galena, Alaska	10:00 a.m.
	Emmonak, Alaska	11:00 a.m. - 6:00 p.m.
May 3	Togiak, Alaska	10:00 a.m. - 6:00 p.m.
	Ambler, Alaska	10:00 a.m. - 6:00 p.m.
May 4	Ft. Yukon, Alaska	1:00 p.m.
	Naknek, Alaska	9:00 a.m. - 6:00 p.m.
May 5	Allakaket, Alaska	11:00 a.m. - 6:00 p.m.
May 7	Nome, Alaska	1:00 p.m.
May 8	Shishmaref, Alaska	10:00 a.m. - 6:00 p.m.
May 9	Kotzebue, Alaska	9:00 a.m.
	Kodiak, Alaska	11:00 a.m.
May 10	King Cove, Alaska	1:00 p.m.
	Kiana, Alaska	9:00 a.m. - 4:00 p.m.
May 11	Barrow, Alaska	10:00 a.m.
May 12	Anaktuvuk Pass, AK	10:00 a.m. - 4:00 p.m.
May 13	Copper Center, AK	12:00 Noon
May 14	Cordova, Alaska	2:00 p.m.
May 15	Yakutat, Alaska	11:00 a.m. - 4:00 p.m.
May 16	Juneau, Alaska National Guard Armory	10:00 a.m.
	Northway, Alaska	11:00 a.m. - 8:00 p.m.
May 17	Fairbanks, Alaska Alaskaland	10:00 a.m.
	Juneau, Alaska National Guard Armory	9:00 a.m. - 4:30 p.m.
May 18	Fairbanks, Alaska Alaskaland	8:00 a.m. - 4:00 p.m.
May 22	San Francisco, CA	10:00 a.m.
May 23	San Francisco, CA Jack Tarr Hotel	8:00 a.m.
May 25	Denver, Colorado Continental Motor Hotel	10:00 a.m.
	Seattle, Washington	10:00 a.m.
May 26	Seattle, Washington Pacific Science Center, Eames Theater	8:00 a.m.
	Denver, Colorado Continental Motor Hotel	8:00 a.m.
May 29	Washington, D.C.	10:00 a.m.
May 30	Washington, D.C. General Services Adm. Bldg. Auditorium	9:00 a.m.
June 2	Anchorage, Alaska	9:00 a.m.
June 3	Anchorage, Alaska Sydney Laurence Auditorium	10:00 a.m.

Help Us Plan

The Joint Federal-State Land Use Planning Commission for Alaska asks your help in planning for the management of public lands in Alaska. Hearings will be held this spring in numerous communities. The purpose of these hearings is to learn your thoughts about the 80 million acres of public lands which the Secretary of the Interior withdrew from the U.S. public domain in September 1972. By direction of Congress, these lands are being studied for possible inclusion in the National Park, Forest, Wildlife Refuge, and Wild and Scenic Rivers Systems. The 80 million acres have been referred to by Congress as the "d-2" or "national interest lands" because they were withdrawn for study under Section 17(d)(2) of the Alaska Native Claims Settlement Act (P.L. 92-203).

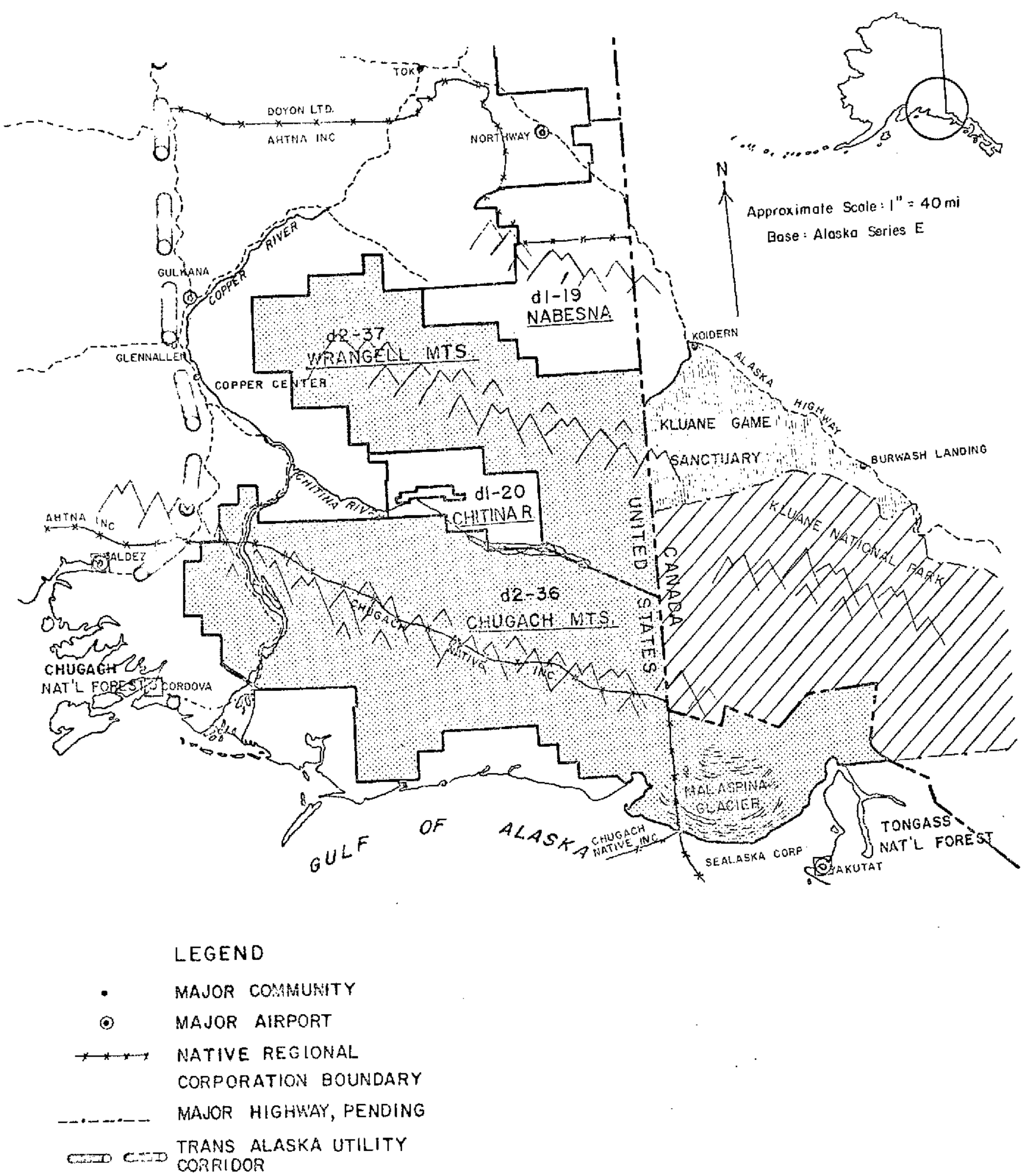
Your Views and Comments. The Commission is holding hearings on how the "d-2 national interest lands" should be used or what uses should be permitted or prohibited before it develops recommendations about land management agencies. This is because the Commission believes that land management agencies should be chosen or designed to fit plans for land use, rather than that land use plans be governed by the choice of agencies to administer the land.

Let Us Know

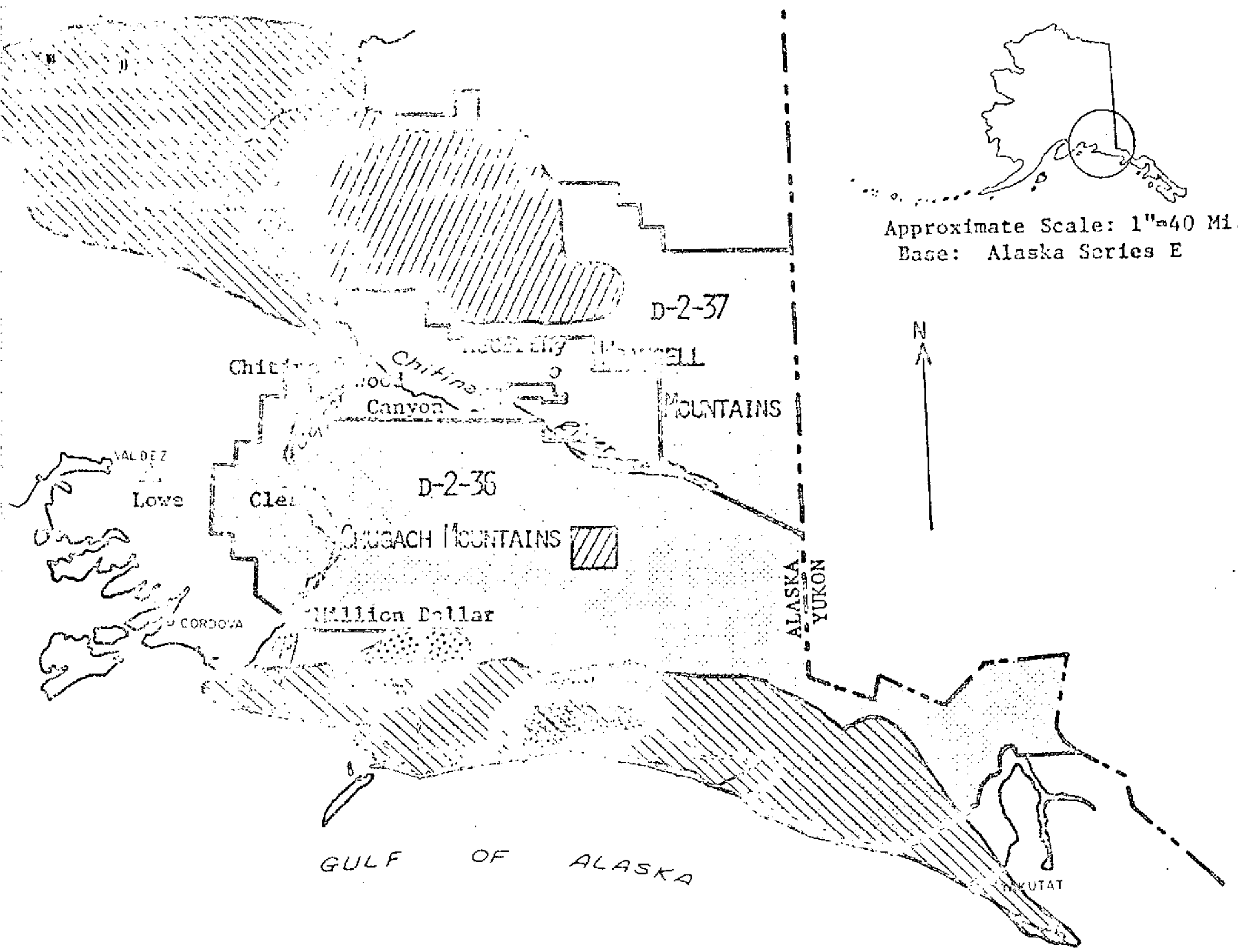
The Commission wants to know what uses, if any, you think should be made of these public lands. What uses should be prohibited? Where do you feel transportation access is needed, if at all? What land management policies would be appropriate? Your comments will be sent directly to the Secretary of the Interior. The Commission will also use your suggestions in making its recommendations for land use and management to the Secretary of the Interior and to Congress.

This brochure contains information on the "d-2 national interest lands" nearest your residence. You are invited to attend any of the hearings and express your views. Written comments should be mailed no later than June 30, 1973, to:

D-2 Hearings
Joint Federal-State Land Use Planning Commission for Alaska
733 West Fourth Avenue, Suite 400
Anchorage, Alaska 99501



DOYON LTD.
AHTNA INC
TOK
NORTHWAY
N
Approximate Scale: 1" = 40 mi
Base: Alaska Series E
COPPER RIVER
GULKANA
d1-19
NABESNA
d2-37
WRANGELL MTS.
GLENNALLEN
COPPER CENTER
KOIDERN
ALASKA HIGHWAY
KLUANE GAME SANCTUARY
BURWASH LANDING
CHITINA RIVER
d1-20
CHITINA R.
AHTNA INC
VALDEZ
UNITED STATES
CANADA
KLUANE NATIONAL PARK
d2-36
CHUGACH MTS.
CHUGACH NATIVE INC
CHUGACH NAT'L FOREST
CORDOVA
MALASPINA GLACIER
GULF OF ALASKA
CHUGACH NATIVE INC
SEALASKA CORP
YAKUTAT
TONGASS NAT'L FOREST
LEGEND
MAJOR COMMUNITY
MAJOR AIRPORT
NATIVE REGIONAL CORPORATION BOUNDARY
MAJOR HIGHWAY, PENDING
TRANS ALASKA UTILITY CORRIDOR



ENERGY RESOURCES

PETROLEUM PROVINCE

GEOTHERMAL AREAS

COAL

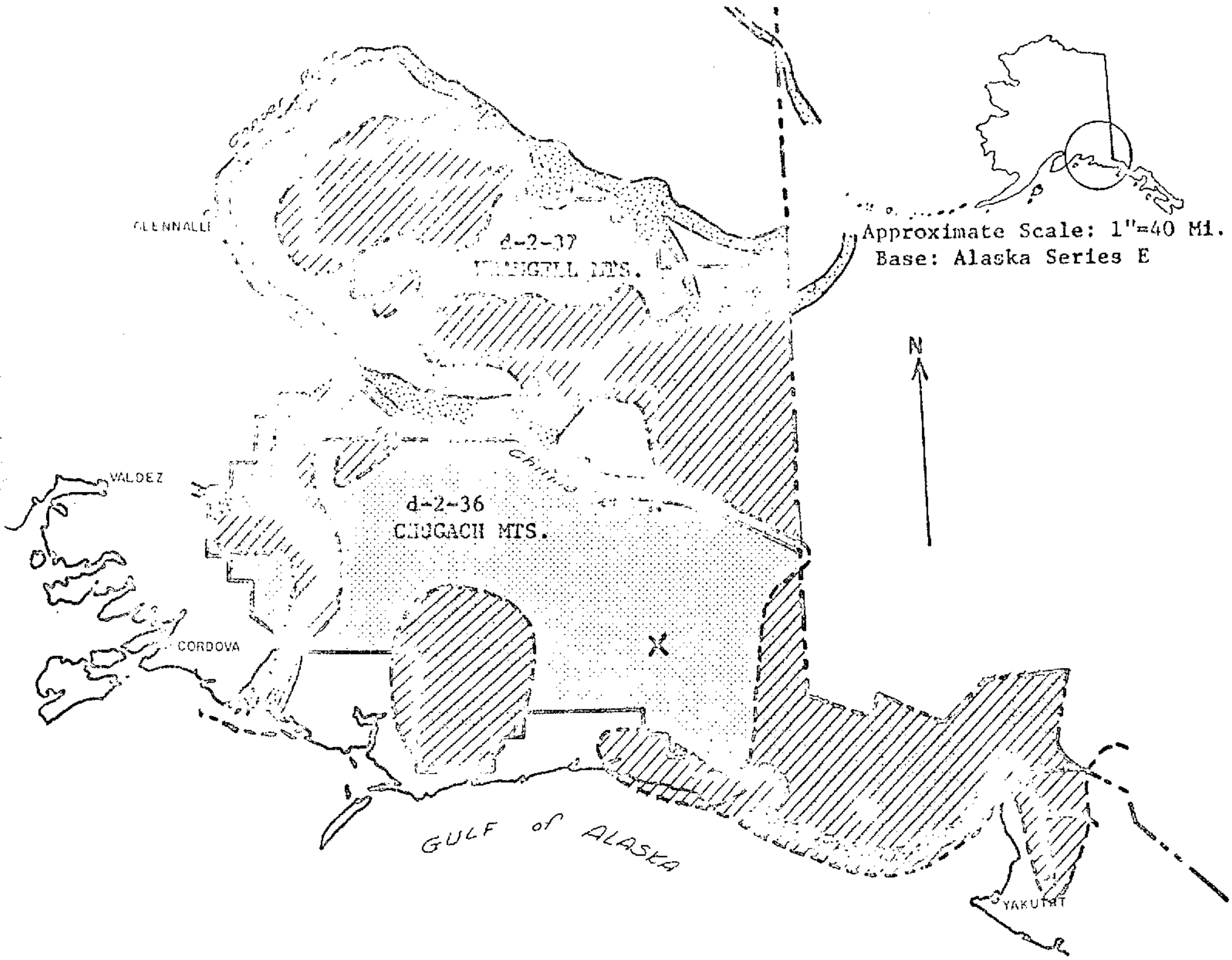
POTENTIAL HYDRO-ELECTRIC POWER SITES

WRANGELL-CHUGACH AREA

RESOURCE PLANNING TEAM

JOINT FEDERAL-STATE LAND USE PLANNING COMMISSION FOR ALASKA

APRIL, 1973



RECREATION MAP

AREAS OF HIGH SIGHTSEEING VALUE

MAJOR TRAVEL AND PEOPLE INFLUENCE ZONES

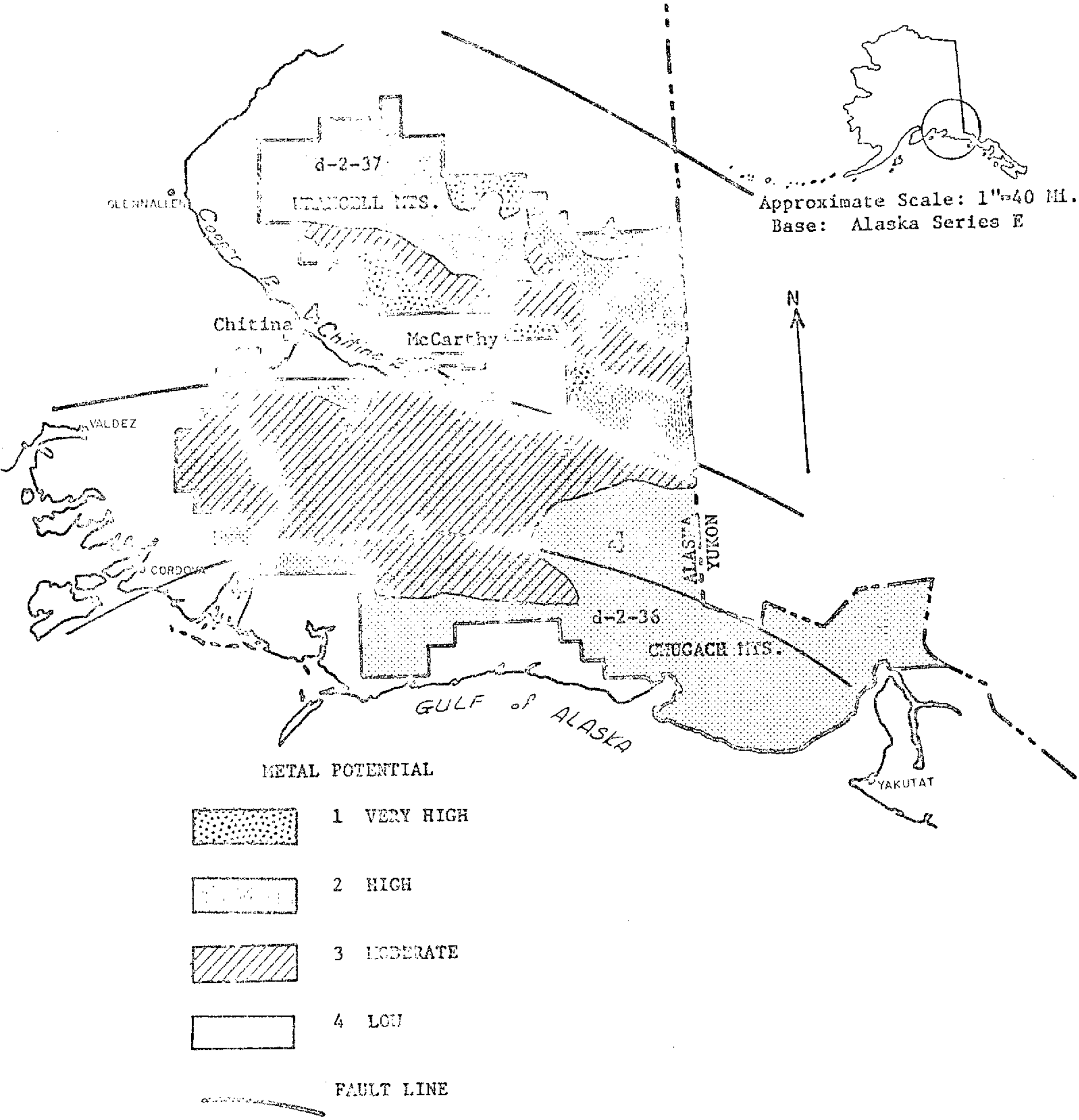
X ECOLOGICAL RESERVE POTENTIAL

WRANGELL-CHUGACH AREA

RESOURCE PLANNING TEAM

JOINT FEDERAL STATE LAND USE PLANNING COMMISSION FOR ALASKA

APRIL, 1973

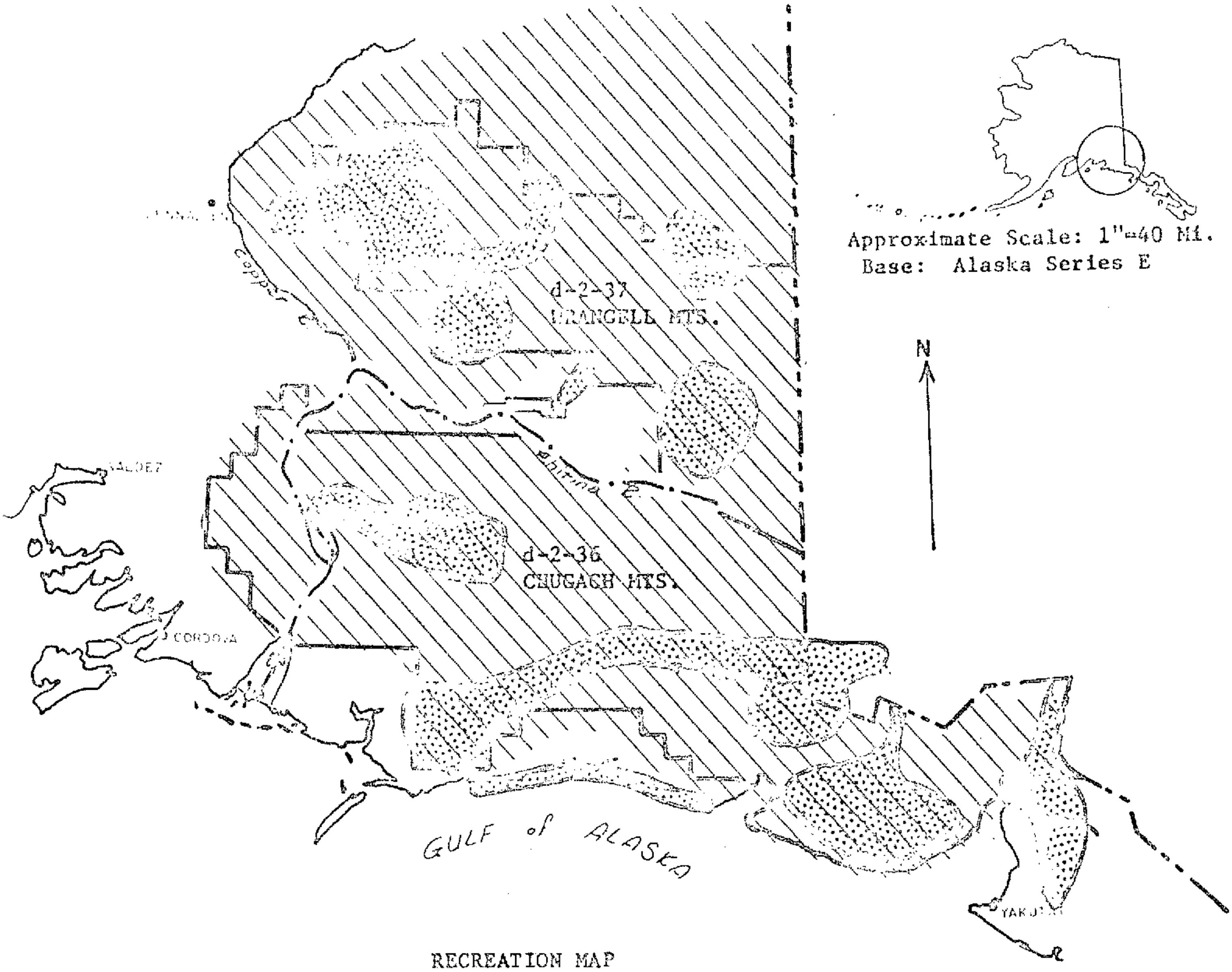


WRANGELL-CHUGACH AREA

RESOURCE PLANNING TEAM

JOINT FEDERAL-STATE LAND USE PLANNING COMMISSION FOR ALASKA

APRIL 1973



RECREATION MAP

GENERAL PRIMITIVE AREA WITH GOOD TO HIGH QUALITY PRIMITIVE VALUES

UNUSUAL, UNIQUE, OR RARE FEATURES OR AREAS

WILD, SCENIC OR RECREATIONAL RIVER POTENTIAL

WRANGELL-CHUGACH AREA

RESOURCE PLANNING TEAM

JOINT FEDERAL-STATE LAND USE PLANNING COMMISSION FOR ALASKA

APRIL, 1973

ALASKA RESOURCE PLANNING TEAM

FEDERAL-STATE LAND USE PLANNING COMMISSION

Report on

WRANGELL MOUNTAINS RESOURCE SURVEY

JANUARY 1973

INTRODUCTION

The Wrangell Mountains are a strategic area in resource management since native land claims and state of Alaska land selections are converging with federal interests for establishment of land use patterns. ERTS-1 image 1026-20220 (18 Aug) and its 60% easterly side lap image 1043-20163 (4 Sept. , 17 days later) were analyzed along with color infrared and thermal infrared aerial imagery obtained from NASA spacecraft and aircraft.

LANDS

The eastern ERTS Photos cover an area in both Canada and Alaska. The area covered in Alaska is almost entirely included in D1 (public interest lands) or D2 (four national systems lands). One small area of State Patent or private lands exists in the McCarthy area north of the Nizina River.

Kluane Park in Canada lies adjacent to the D2 lands in this area.

The westerly photo includes more varied land patterns. The lowlands of the Chitina and headwaters of the Copper Rivers are included in Native Village and deficiency lands. The higher areas are included in D1 and D2 study areas. The State is interested in the mineralized areas but must wait for other actions (Native selections and determination of D1 and D2 areas) before additional selections are made.

Stereoscopic viewing of the 60% sidelap ERTS Photographs delineates the physiography of the region very well. Relief ranges from less than 1,000 feet to more than 16,000 feet at Mt. Bona. The alluviated valleys are distinctive from the adjacent highlands. Glaciers and icefields can be identified. Glow patterns on the glaciers can be defined and braided stream channeling is characteristic of this area.

55<

GEOLOGY

Rock types cannot be identified except with good ground control. There is no contrast between volcanic rocks, sedimentary and metamorphosed rocks or igneous rocks. These were delineated from ground control. Lineations were apparent and may represent faulting. The White River may follow a fault trace where it leaves the Wrangell Mountains. Several lineations which trend northwest-north of the Wrangells, are identified as faults from ground control. A segment of the Denali fault is identified in the northeast part of the photo. The valleys below glaciers are wide and filled with quanternary gravel deposits. Channel deposits can be distinguished from Coluvium and talus deposits flanking the mountains.

RESOURCES

Geothermal:

The Wrangell region is within a geothermal resource area. The extent of the Quanternary volcanic flows and their thickness indications are potentially favorable to environment. The aerial thermal infrared imagery indicates several hotspots on Mt. Wrangell Crater, which is an active volcano. The presence of mud volcanoes in the Copper River lowlands to the west of the Wrangell Mountains may have some bearing on the geothermal potential.

The six possible types determined from the ERTS Image are:

1) Predominately spruce. Seemingly well-stocked-
   1,000 timber possibilities
2) Possible mixed spruce-hardwood-occupies sites
   which appear to be well-drained
3) Mixed brush type - low, mixture of spruce and
   hardwoods occupying poorly drained flood plains
   of all tarov rivers
4) Brush - occupying lower elevations, transition -
   between forests and tundra
5) Tundra - low dwarfed vegetation, lichens etc.
6) Barren
   1) Gravel outwash in riverbeds
   2) High elevations exposed rock, glaciers etc.

The mapping provided by Spetzman showed five types in the area of the overlay. The additional type found on the ERTS was the mixed brush type (no 3) which seemed to be included in a general brush type by the author.

Comparing the 6 ERTS types to those typed on the ground showed fair accuracy in interpretation.

1) White spruce - well stocked - 50-100' high
2) Predominately white spruce, some poplar and
   birch - 40-80' high
3) Combined with 4
4) High brush - 5-20', willow, alder, dwarf birch

5) Moist tundra - 1' x 5' high - cottongrass, dwarf willow and alder

6) Barren and sparse dry tundra

OUTDOOR RECREATION

The major items that would be of assistance to outdoor recreation that are identifiable from the ERTS scene relate primarily to the major physiographic features such as mountains, peaks, glaciers, ice fields, valleys, rivers, streams, lakes, coastline areas, major islands and vegetated areas. The different MSS bands show up the different features either more or less distinct.

In the lake and streams analysis by the use of bands 4 & 7 or 5 & 7 it is possible to identify those water bodies that carry heavy sediment loads.

By the application of techniques such as enlargements, density slices, a better analysis might apply. The ERTS Images provide the "bird's eye view" of the area and as such it is possible to apply a rating system to the scenic value of the landscapes, seascapes and mountainscapes. Outstanding geologic features worthy of interpretation also might be recognized by the trained eye.

The use of the color infrared aircraft images bring out very strongly specific features of the icefields, glaciers and the ability to differentiate vegetative types, stream courses and cultural features increases greatly. The thermal infrared data would have been much more useful if it had been acquired at pre-dawn rather than mid-day.

Solar heating of south slopes tended to make even the highly reflective snow to appear warmer than the background. Also, the geothermally heated bare rocks near the Wrangell caldera tended to be confused with solar heated rocks.

Although ERTS-1 images are extremely valuable for their synoptic information content, the standard products obtained directly from NASA have very limited application - chiefly for estimates of cloud cover and geographic areal coverages. For the purpose of resource surveys it is essential that suitably enhanced photos be processed by a laboratory to the specific requirements of the various disciplines involved, i.e. hydrology, vegetation, geology, etc.

APPENDIX E

Exerpted from "Forest Insect and Disease Conditions in Alaska - 1973"

by U.S. Department of Agriculture, Forest Service, Alaska Region.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.)

This insect remained a focal point in Alaska during 1973. Aerial observations and field data indicated that the infestation of State and Indian lands near Tyonek, while declining in areas of heavy stand depletion, was continuing in stands that contained sufficient host-tree material. The Tyonek infestation covered 103,000 acres in 1973. Heaviest current beetle concentration exists between the McArthur and Chakachatna Rivers. The area immediately north of the Tyonek Indian Reservation and Congahbuna Lake has an increasing accumulation of dead white spruce. The density of trees attacked, however, is closely related to the scattered and dispersed host-type in that area. Increased tree mortality was also recorded along the Beluga River southeast of Beluga Lake. The original portion of the infestation in the vicinity of Stedatna Creek has declined.

The spruce beetle periodically causes heavy damage in Alaska's white spruce stands. In an effort to determine the extent of that damage, the 20-square mile Stedatna Creek area of formerly heavy infestation was sampled. Although the detailed results of that impact study are forthcoming, it was found that 65 percent of white spruce 5 inches d.b.h. and larger was killed. The white birch percentage of the stand became substantially greater following the outbreak.

A limited sample of spruce killed early in the infestation was sent to the Forest Products Laboratory in Madison, Wisconsin. Cooking characteristics of the wood and strength properties of the pulp from dead spruce were good compared to green spruce. If the limited samples evaluated are representative of other beetle-killed trees, little problem is anticipated in the manufacture of high quality kraft or sulphite pulps. Dead trees are not as suitable for lumber because blue staining present in the sapwood is less tolerable in this industry.

In 1973 the State Division of Lands consummated a 10-year salvage sale near Tyonek that covered 223,000 acres and a total of 425 million board feet of mixed species. Spruce sawlogs and utility logs comprised 285 million board feet of the sale and the bid price on spruce was $1.00 per thousand board feet. To facilitate sale layout, the Division of Lands was assisted by the Forest Service, University of Alaska, and others in obtaining full aerial photographic coverage of the sale area. Other efforts in remote sensing of the Tyonek infestation included Earth Resources Technology Satellite (ERTS) imagery coordinated through the University of Alaska's Geophysical Institute. Further cooperation between Institute and Forest Service personnel is planned. Of immediate usefulness in detecting spruce beetle outbreaks in remote areas of the State, is high altitude, small scale, aircraft photography. Although coverage is limited at present, existing color infared photos are capable of revealing outbreaks.

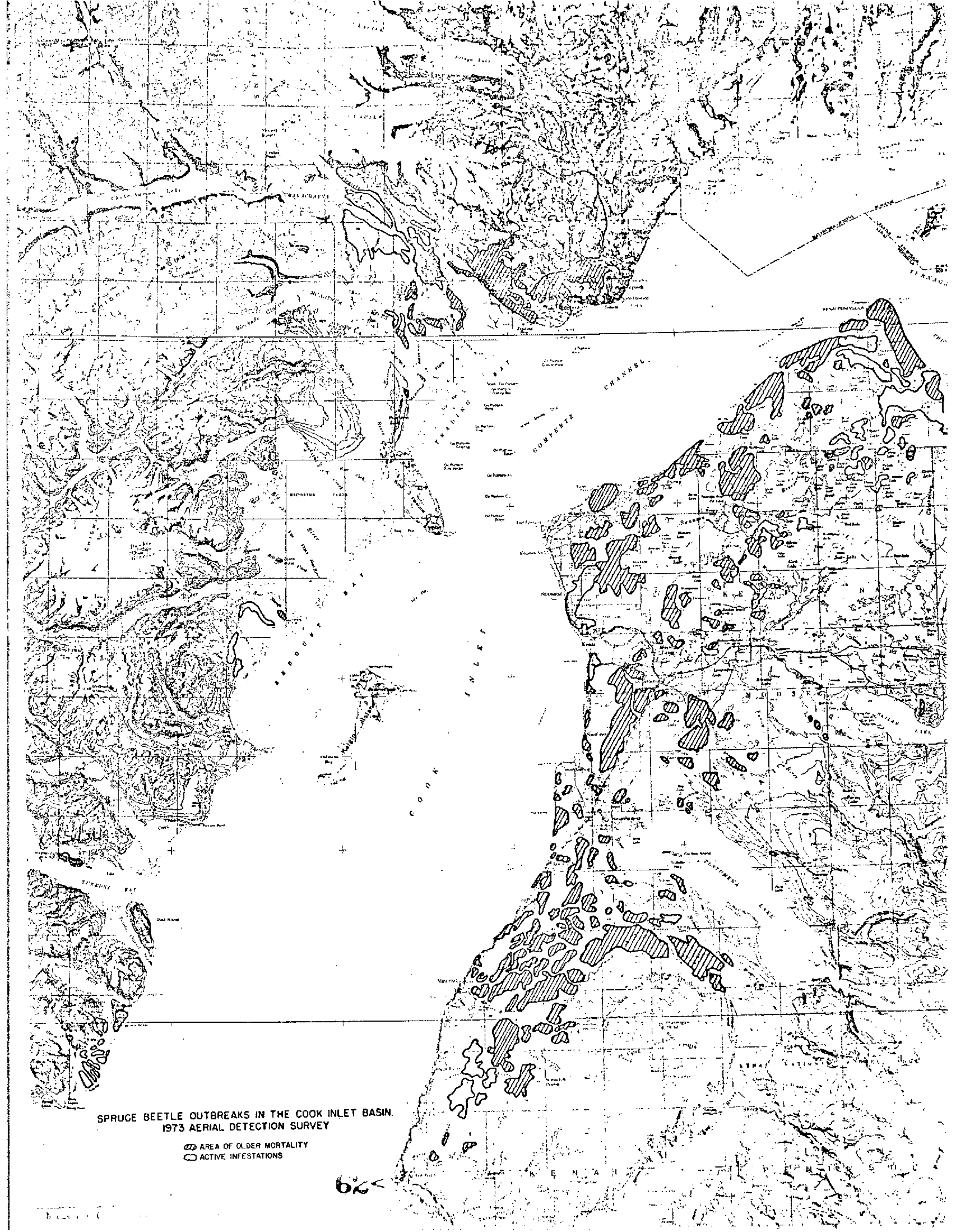
Farther south on the west side of Cook Inlet, spruce beetle activity occurred in Sitka spruce. The outbreak was near Red Glacier on Bureau of Land Management lands. An intensive aerial survey was flown to assist BLM in appraising salvage opportunities. Beetle-infested trees were mapped over 4,190 acres. Additional spruce mortality is expected in both the Tyonek and Red Glacier infestations.

The generally declining beetle populations that were reported on the Kenai Peninsula in 1972 continued to subside. The acreage of active infestation on the Kenai National Moose Range and on State and private lands southwest of Tustumena Lake have declined to approximately 53,000 acres of tree-kill on formerly infested areas. The outbreak is intensifying but is not spreading in area. Remaining activity is concentrated in an area southwest of Turnagain Arm and Chickaloon Bay in the vicinity of Miller Creek, Two-Island Lake, Barbara Lake, and the Swanson Lakes. While some current tree mortality is occurring north of Kenai and west of the highway between Soldotna and Kasilof, damage is relatively light compared to the abundance of previously killed trees in those areas.

A beetle outbreak on Afognak Island in 1933 resulted in the loss of 150 million board feet of Sitka spruce. In anticipation of a 332 million board foot sale on the Chugach National Forest there, a 1973 appraisal of present beetle risk was undertaken. Beetle broods were very low in the few cull logs remaining in a current sale. As an indirect result of the 1964 earthquake, over 700 thousand board feet of spruce felled and bucked the previous year remained in the woods. A 1973 examination of those logs revealed no evidence of abundant beetle galleries. Close monitoring of beetle conditions in any future harvest accompanied by close utilization are considered appropriate preventive practice on Afognak Island.

Ips beetles, *Ips spp.*

An aerial survey was made of Bureau of Land Management lands in an area northwest of Fort Yukon that had historically supported chronic ips beetle populations. The last recorded infestation period in the vicinity



SPRUCE BEETLE OUTBREAKS IN THE COOK INLET BASIN.
1973 AERIAL DETECTION SURVEY

AREA OF OLDER MORTALITY
ACTIVE INFESTATIONS

Appendix F

A MULTIDISCIPLINARY SURVEY FOR THE MANAGEMENT OF ALASKAN RESOURCES UTILIZING ERTS IMAGERY*

John M. Miller and Albert E. Belon

University of Alaska
Fairbanks, Alaska 99701

ABSTRACT

The ERTS program provides an opportunity to narrow an environmental knowledge gap which impedes planning at a critical time in one of the richest, yet most underdeveloped, regions in the United States - Alaska. ERTS-1 data have been applied to a coordinated multidisciplinary survey which has the overriding purpose to provide updated resource inventory data to land use planning groups and government agencies concerned with resource management. Of particular emphasis in this survey are vegetative, hydrological and geological analyses of the proposed trans-Alaska transportation corridor, and lands to be selected by the State of Alaska, the native corporations, and the Department of Interior. Our preliminary analyses are demonstrating that ERTS data are satisfying these objectives on a regional scale.

BACKGROUND

The most crucial problem in Alaska today is a great environmental knowledge gap which impedes planning and adversely affects the decision making process at a critical juncture in the history of Alaska's economic and social development. This problem has been recently and forcefully manifested in several ways:

1) The controversy surrounding the proposed construction of the trans-Alaska pipeline from the arctic coast to the southern port of Valdez, and the recent U.S. Appellate Court decision denying the permit for its construction.

2) The deterioration of fisheries resources in the Alaskan coastal zones and continental shelf. This results partly from a poor environmental knowledge of these regions.

3) The establishment by the Congress and the Alaska State Legislature of the Joint Federal-State Land Use Planning Commission. This Commission has the awesome task of recommending by 1975 a comprehensive land use plan for Alaska's 375 million acres, thereby assisting the State of Alaska, the federal government, and the Alaska native

* This work was supported by National Aeronautics & Space Administration/Goddard Space Flight Center Contract NAS5-21833 and by National Aeronautics & Space Administration Office of University Affairs, Grant NGL 02-001-092

corporations with the selection of 220 million acres of public domain lands.

The basic data for informed land use research and planning in Alaska is sparse and often outdated. Therefore, even the first task of planning on a broad regional basis labors under severe handicaps. Alaska is so vast, and the arctic environment is so varied, that this environmental knowledge gap will not be bridged soon by conventional means with normal dollar resources. Thus, the ERTS program with its demonstrated capability for economical large-scale surveys afford a unique opportunity to narrow this knowledge gap.

Alaska's land mass, Figure 1, covers 586,000 square miles, encompasses 20° of north latitude, and includes four distinct climatic zones. The northern zone experiences extremely cold winters and cool summers with low precipitation. The western climatic zones have very cold winters and cool summers with moderate precipitation. The southern zone enjoys milder winters and summers with heavy precipitation, while the large climatic zone in the interior experiences extremely cold winters and hot summers with low precipitation. Seasonal temperature differences as great as 85°C are possible in the interior.

Four basic ecosystems prevail throughout Alaska:

1) Tree-dominant types cover about 40% of the southern and interior climatic zones. These include the high hemlock/spruce forests of the southern coastal regions and the mixed spruce and hardwoods of the interior flood plains, hills and valleys.

2) The shrub-dominant vegetation primarily forms transition zones north and west of the tree line, between forests and tundra.

3) Grass-dominant systems include upland moist tundra and wet coastal tundra types in the northern and western climatic zones.

4) Barren and sparse dry tundra consists chiefly of low, scattered plants in the higher elevations of central and northern Alaska.

Cultural activities are dispersed along the major river drainages as small villages and concentrations of populations occur chiefly in the southcentral Anchorage-Matanuska Valley and the Fairbanks-Tanana Valley in the interior. These two urban regions account for about half of Alaska's total population. Surface transportation includes a modern railroad from the southern coast to the interior, and a skeleton network of paved roads from the interior to various ice free ports in the south coastal region. A prime objective of Alaskan planners is a transportation corridor from the interior rail and highway head at Fairbanks to the resource-rich northern region including, but not limited to, service to the Prudhoe Bay oil fields of the North Slope. This corridor could include a secondary highway and/or railroad and, of course, the 48-inch pipeline for shipping crude oil from Prudhoe Bay on the Arctic Coast to the southern port of Valdez.

UPDATING THE ENVIRONMENTAL DATA BASE

How to survey the environmental impact of such a transportation corridor, and particularly of the pipeline, is a matter of intense debate and controversy at the present time. It is clear that no single approach to environmental surveys will be acceptable to groups with highly divergent viewpoints upon the subject of Alaskan oil and what to do with it. In this context, ERTS-1 data forms a politically neutral base from which resource surveys can be made without necessarily arousing suspicions from groups which have mutually conflicting goals. The University of Alaska is performing multidisplicinary surveys of a north-south transect centered on the 148th meridian. Twelve ERTS projects in ten disciplines are closely coordinated with cooperating federal, state and borough government agencies to deal with an extremely wide range of environmental problems.

One area of environmental concern is the northeast Alaska caribou population with special reference to oil pipeline facilities and other natural factors that are not clearly understood. These animals may number 150,000 at present, but there have been large fluctuations in herd sizes over the past 50 years which apparently are unrelated to human activity. Migration routes and winter dispersal patterns are not well enough known to significantly improve management of the caribou resource at the present time. Snow cover has long been recognized as a major factor influencing the biology of caribou, but aerial surveys to obtain data over the vast area are prohibitively costly.

ERTS-1 images are being used in two ways to monitor herd activity. One is to map habitat favorable to caribou and the other is to locate and map environmental features that arise from large caribou aggregations. Typical winter grazing habitat includes mixed patterns of open spruce stands and treeless bogs, such as those near Anvil Lake on the low oblique aerial view of Figure 2. The caribou tend to bed down in open spruce stands for wind protection and to use the nearby treeless regions for feeding. The multiform pattern of spruce and bogs is detectable on ERTS images even by visual analysis, but digital computer techniques are being used to identify and map these habitat landforms.

Animals may winter in loose aggregations of several hundred to a thousand, and such aggregations typically remain in a drainage area and feed intensively before moving on. These feeding areas and the extensive network of trails should be identifiable on ERTS imagery acquired in April, when there is maximum snow accumulation and insignificant melt. There also is some evidence that caribou wintering areas thus disturbed melt off much sooner than other areas. Trampling activities of the herds cause early snow melt by a premature exposure of vegetation, a decrease in spectral reflectance, and a disturbance of the natural nival characteristics.

Available snow data generally do not allow sufficiently detailed mapping for many applications in research, planning and construction of civil structures and roads. The climatic differences are very pronounced along any north-south transect, and these differences are reflected in the amount, the physical characteristics, and the duration of seasonal snow cover. Snow has a great many adverse effects on man's activities in the arctic and sub-arctic because it remains on the ground for long periods. It also thermally insulates the soil-atmosphere interface and affords protection to plants and animals. From ERTS imagery, we are producing maps of snow lines across Alaska during the initiation and decay of the seasonal snow cover, cloud cover permitting.

A resource survey has been prepared from an ERTS scene of the Anaktuvuk Pass region of the Brooks Range for purposes of land use planning. Color and black and white prints were visually analyzed in cooperation with the Resource Planning Team of the Federal-State Land Use Planning Commission for Alaska. A multidisciplinary team spent only about 30 man hours in preparing a regional resource survey of a remote and undeveloped area of Alaska. The output included maps of the three predominant types of vegetation (moist tundra, low brush and high brush), Figure 3; ten watershed drainages, Figure 4; geologic features indirectly relatable to economic minerals, Figure 5. Such regional resource surveys applied to 19 regions of critical interest are primary data base objectives of the Planning Commission. These objectives can be achieved as timely inputs to the deliberation process of the Commission only by direct use of ERTS imagery. Comprehensive vegetation maps are also being prepared for much of the north-south transect of Alaska to aid the formulation of land use plans for this region which is subject to imminent development.

In particular, the Matanuska and Susitna Valleys, adjacent to metropolitan Anchorage, are presently bearing high developmental pressures because of the needs of the population heartland of Alaska. The Matanuska Valley contains the most valuable agricultural land in the state, and along with the Susitna Valley has considerable undeveloped lands. However, speculative pressures force sales of these lands at prices that prohibit fulfillment of any agricultural potential. The limited amount of land that is suited to agriculture must be quickly identified and integrated into a long range planning structure if agriculture is to continue both its material and intangible benefits to Alaskan society. The coupling of ERTS data as a resource survey tool in these large, undeveloped areas with difficult access problems is particularly welcomed by planning agencies.

In the southern part of the transect, the type mapping has outlined the broad features of mixed woods, coniferous forest, mixed herb-shrub and sedge associations, tidal flats, subalpine shrub-grass, alpine tundra, low elevation grasslands, and agricultural croplands. Use of computer processing has also delineated silty water from clear water lakes, shallow waters from deeper waters, tidal flat vegetation from muskegs, and stands of birch-aspen.

In a joint effort with the U. S. Forest Service and the State Department of Natural Resources, we have just recently applied multispectral ERTS data to the surveillance of a 200,000 acre spruce beetle infestation near the Tyonek Indian Reservation and on the Kenai Peninsula in the Cook Inlet Basin. An estimated two billion broad feet of white spruce has been killed or damaged by the spruce beetle, but the large areal extent of the spreading infestation presents a difficult task in maintaining surveillance of the extent of the affected trees. Techniques are being implemented using ERTS data to stratify damage to white spruce into three levels - healthy stands, new killed and old kill stands.

Geologic applications of ERTS imagery also are aiding the planning for the development of Alaska. The synoptic view is particularly beneficial in mapping new tectonic features such as reported by Gedney at this symposium.

The University of Alaska is also using ERTS images to study circulation patterns and sediment transport in key estuarine environments in Alaska. The Cook Inlet has been especially well documented from ERTS, and these results are useful for designs of off-shore oil production and marine terminal facilities. The Cook Inlet study results are reported also at this symposium by Wright. Another key marine environment study involving ERTS is located in Prince William Sound and the port of Valdez, which is subject to possible intense oil terminal and shipping activities. Here the application is toward sound ecological management in the face of heavy traffic with the potential for contamination. Valdez is a deep water port, neither tide dominated nor bearing a heavy silt burden as does Cook Inlet. The continuing protection of important fisheries resources in this region is the primary goal of this University project.

SUMMARY

Broadly structured, multidisciplinary environmental surveys of Alaskan resources are underway using ERTS data as a primary input. These results are coupled to a maximum extent to various public agencies for operational applications, such as the Bureau of Land Management, Forest Service, Corps of Engineers, Bureau of Sports Fisheries and Wildlife, and the Geological Survey. Also using ERTS Alaskan data are many other agencies, including the Alaska Department of Highways, Department of Fish and Game, Department of Economic Development, Department of Natural Resources, the Joint Federal-State Land Use Planning Commission, and various borough governments. Applications of ERTS data are playing an extremely vital and timely role in planning for the imminent, and hopefully, the orderly development of Alaska.

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