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DEPARTMENT OF FORESTRY AND WILDLIFE MANAGEMENT
HOLDSWORTH HALL
AMHERST, MASSACHUSETTS 01003

November 17, 1982

Mr. C. Mack Shaver, Superintendent
Northwest Alaska Areas - NPS
P.O. Box 287
Kotzebue, AK 99752

Dear Mack:

Enclosed is a copy of my field report to Earthwatch. It gives an overview of our field activities. A complete analysis of our results will be included in the MAB report, which we hope to complete next spring. Hope all is well in Alaska.

Sincerely,

WAP

William A. Patterson III
Assistant Professor of Forestry

WAP/dap

Enclosure

Northwest Areas National Park Service	
DEC 09 '82	
	Date
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FIELD REPORT

The Ecological Role of Fire in Tundra Ecosystems of the Noatak River Biosphere Reserve

Earthwatch Expedition

July 4 - August 1, 1982

Participants

Staff: William A. Patterson III, Principal Investigator

Anne Marie Hine

John F. O'Keefe

*John G. Dennis

*Charles H. Racine

*Stephen Simoes

*Brice Stearns

Volunteers: Team I

Ann D. Cavanaugh

Richard W. Goodman

Robert Bloemer

Edward R. Renwick

Jennifer L. Whistler

Team II

Kurt L. Butefish

John E. J. Erdtmann

Catherine W. Fisk

Todd N. Fisk

Walter M. Medwid

*Associated Scientists and staff funded through a Man and the Biosphere
Grant (C.H. Racine, Principal Investigator).

Prologue

I had held in my heart the wanderlust till it swept me away, and sent me afar on the back trail of the northwind; I have lived in the mighty boreal forest, with its Red-men, its Buffalo, its Moose, and its Wolves; I have seen the Great Lone Land with its endless plains and prairies that do not know the face of man or the crack of a rifle; I have been with its countless lakes that re-echo nothing but the wail and yodel of the loons or the mournful music of the Arctic Wolf. I have wandered on the plains of the Musk-ox, the home of the Snowbird and the Caribou. These were the things I had burned to do. 1/

1/ Ernest Thompson Seton. The Arctic Prairies (New York: Harper & Row Publishers, Inc. 1911), p. 308.

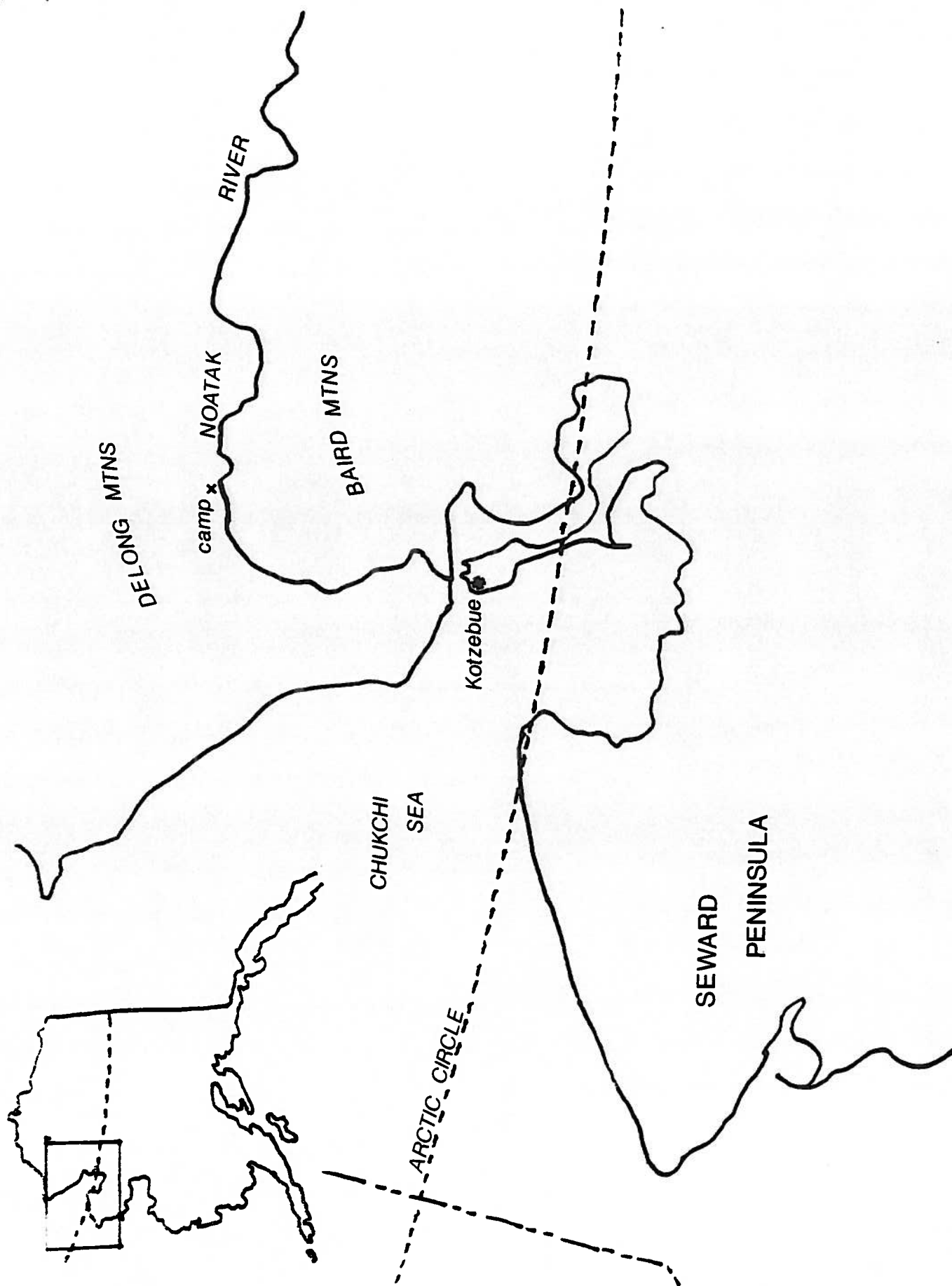
Introduction and Objectives

The following represents a preliminary report of activities for the Earthwatch Expedition "Fire on the Tundra" conducted in northwest Alaska between July 4 and August 1, 1982. We undertook the expedition in conjunction with a Man and the Biosphere (MAB) - funded project that involved the participation of scientists and staff from the U.S. National Park Service (NPS), Washington, D.C. and Johnson State College, Johnson, Vermont. Field activities centered on the Noatak Canyon region of the NPS - administered Noatak National Preserve (Figure 1), which has been designated a National Biosphere Reserve by UNESCO. The areas, which are essentially overlapping, occupy much of the 6.5-million acre Noatak River watershed, which is the largest undisturbed mountain-ringed watershed in North America. Lying between the Baird Mountains to the south and the DeLong to the north, the Noatak River drains much of the west-central region of the Brooks Range. Our base camp was located at the western end of the Noatak Canyon (67° N. Lat., 162° W. Long.), approximately 100 miles upstream from where the Noatak empties into Kotzebue Sound. The campsite was approximately 100 miles north of the Arctic Circle, 200 miles east of the International Dateline and 250 miles northeast of the Siberian coast.

Natural fires are an important component of the moist tundra and taiga ecosystems of the Noatak drainage basin. The objectives of our study as stated in the proposal for MAB funding^{2/}, are:

^{2/} "The Ecological Role of Fire in Tundra Ecosystems of the Noatak River Biosphere Reserve, Alaska"--Research Proposal Submitted to the Consortium for the Study of Man's Relationship with the Global Environment.

Figure 1. Map of northwest Alaska showing the location of Kotzebue an our 1982 field camp.



1) to determine the extent and frequency of past fires in the Noatak watershed; 2) to determine the short term or immediate effects of fire in terms of the pattern and severity of burning, changes in soil thaw depths, organic layers, nutrients and frost action; 3) to determine the longer term rates and directions of post-fire revegetation or succession for different vegetation types and burning severities in relation to successional processes in the Noatak tundras; 4) to measure the functional changes in tundra ecosystems which result from fire in terms of biomass and primary productivity and relate these to succession and grazing herbivores; 5) to determine how certain plant species respond to fire particularly with regard to their post-fire establishment.

More specifically, Earthwatch volunteers were utilized for the following activities: 1) monitor diurnal weather patterns, especially as they relate to fire weather conditions; 2) assist in the recovery of lake sediment cores, which are being analyzed to determine long-term fire frequencies and effects on vegetation; 3) assist in monitoring post-burn vegetation response both with respect to biomass recovery and successional sequences; 4) determine the effects of fire on soil thawing in burned areas formerly occupied by spruce forests and taiga; 5) obtain basal sections from spruce trees killed by fires occurring during the 1970's to determine stand ages and growth patterns as they relate to the possible occurrence of earlier fires; 6) sample spruce seedlings in and near fire-killed stands to determine post-fire regeneration patterns and 7) sample fire-killed alder stands to determine the effects of fire on alder bushes and the way in which alder regenerates

following fire. Much of the field sampling centered on alder and spruce stands because: 1) these are the two largest woody plant species (in terms of biomass production) in the area; 2) the species are at or near their northwestern range limit in North America and 3) preliminary observations made in 1981 suggested that the timing and severity of tundra fires may directly affect the success of post fire spruce and alder reproduction.

Most of the samples and data collected during the one-month field season are still being analyzed in Washington, D.C., Amherst, Massachusetts and Johnson, Vermont. Our MAB grant calls for the submission of a final report in May, 1983. A copy will be forwarded to Earthwatch when it is completed.

Weather

Weather conditions are the overriding factor governing the pace and extent of field activities in the Arctic. Living conditions are primitive with facilities limited to the small tents, stoves, etc. that can be transported by light planes and small boats. The environment provides ample water and (at times) abundant sunshine. Under the best of conditions the efficiency of research activities approaches that which we could expect in the "lower 48". By contrast, poor weather dictates that all of one's energies be directed towards keeping warm and dry. This past summer we had weather that varied from the rain, sleet, high winds and near freezing temperatures of July 23-24 to the clear, sunny first two weeks of July that saw temperatures consistently in the 70's and 80's. A high temperature of 88°F. was recorded on July 11th, when calm winds and "the worst mosquito crop since the 1940's"^{3/} made field sampling challenging to say the least. (The entire camp welcomed the opportunity to swim north of the Arctic Circle that day). Less than two weeks later (on July 24th) the surrounding mountains were capped with snow (above ~2500' elevation) and we recorded a low temperature of 35°F. Temperatures during the last 10 days of July rarely climbed above 55°F. Weather was generally favorable, however, on days that we had scheduled for transit between Kotzebue and Kelly Bar (the make-shift landing strip on a gravel bar 15 miles west (downstream) of camp). As a result we were able to stick to our schedule and both teams returned to Kotzebue in time to catch scheduled departure flights.

^{3/} Several subjective observations by residents of Kotzebue.

Chronology of Field Activities

Anne Hine and John O'Keefe arrived in Kotzebue on June 29th and began preparations to set up camp at the Noatak Canyon site. A major activity involved the making seaworthy of the 18' aluminum boat purchased jointly with funds from NPS, Earthwatch and the MAB grant. I arrived in Kotzebue on July 1 after first stopping in Anchorage to pick up maps at the U.S. Geological Survey Office and freeze dried food, which had been shipped from a factory in Oregon. We made final preparations on July 2nd and spent much of the 3rd attending "4th of July" activities including a parade, Eskimoe beauty contest, etc. (but no fire works in an area where the sun never sets!). A major task that we faced involved the transport of fuel for the outboard motor to the field camp--a problem that plagued us through much of the field season. Initial plans to transport fuel in an NPS jet boat were frustrated by unusually low water levels and Noatak River channels that were difficult to navigate.

Team I arrived on July 4th and the next two days were spent orienting volunteers to the Arctic environment and conditions that they could expect in the field. In the meantime Anne H. and John O. made an initial attempt to navigate the Noatak River. After 13 hours they managed to reach the Eskimoe village of Noatak, approximately 45 miles upstream from the mouth of the river. They left a load of supplies (which was later ferried by small plane to the Kelly Bar) and returned to Kotzebue on the 5th. On July 6th John O. and volunteers Ed Renwick and Dick Goodman headed upriver once again in the boat after first making arrangements with an Eskimoe (70-year old Ned Haworth) for guide services from Noatak to Kelly Bar. MAB participants arrived the same day, and we made final plans to enter the field on the 7th.

Five flights in a Cessna 206 (800 lbs carrying capacity) were required to move the bulk of the equipment and field crew to Kelly Bar on the 7th. The last flight arrived ~7:30 PM, about an hour before the boat arrived from Nôatak. On the trip upriver John O. saw the only grizzly bear that we encountered during the summer.

Four crew members and a boatload of gear (including 60 gallons of fuel) were moved to the base camp during the evening of the 7th. John D. returned to Kelly Bar about 1:00 AM after a five-hour boat trip. A highlight of the evening was the catching of an ~8 lb char by Dick G. This was the first of many char and grayling that Dick caught. He proved to be by far the best fisherman in camp and kept us well supplied with fresh fish. (Walt M. was the champion fisherman for Team II.)

The move upriver was completed during the 8th and the rest of that day and much of the 9th was spent settling camp which, for some, would be home for more than a month. Our base camp was located a few hundred yards from our 1981 site, and was within short walking distance of four study plots established in 1981 on tundra burned in a large 1977 burn. Camp included two cook tents, a work tent and seven sleeping tents. A fire weather station was located nearby and we began recording weather parameters (temperature, wind speed and direction and relative humidity every ~ 2 hours between early morning and late evening, and maximum and minimum 24-hour temperature, daily precipitation amount, kind and duration and fuel moisture content).

Staff conducted an orientation of field activities on the evening of the 9th and field sampling began in earnest on the 10th. Anne C., with her undergraduate background in biology and interest in wildflowers,

found a niche helping John D. and Chuck R. sample permanent plots on the 1977 burn. She spent much of the rest of the 10-day period clipping and sorting regenerating plant biomass. The remainder of the crew began sampling a series of sites in areas occupied by spruce killed by fires in 1977 and 1972. Transects comprised of adjacent 1-m² quadrates were established and tundra grasses and sedges were (literally) combed for the presence of 1-2 inch tall spruce seedlings. For each seedling we recorded location within the quadrate, age, length of current years growth, and whether the seedlings appeared on burned or unburned substrate. For each quadrate we determined the thaw depth in the center of the square and estimated the percent of the quadrate burned by the fire. For the site as a whole (usually 100-300 m²) we mapped the location of living and dead "overstory" spruce (those that occupied the area prior to the most recent burn) and noted the presence of cones either on the ground or in the trees. Fire often kills spruce in tundra environments by burning out root systems while leaving above-ground parts of the trees intact. We cut basal disks from many of these trees for subsequent age determinations. Our sampling this past summer suggests that spruce reseed burned areas one to about seven years after a burn, that seedlings grow better on burned compared to unburned substrates and that most seedlings will date to one good seed year. Thus, if our ring counts of disks we collected this summer show that most trees on a given site were the same age when killed, the date of origin of these stems probably reflects the occurrence of a fire in the preceeding 1-10 years.

We sampled a site approximately 2 miles west of camp during July 10-12. On the 13th some of the group began sampling two additional sites in this

area while the remainder traveled downstream by boat to sample a spruce stand killed by a 1972 burn that spread to the west bank of the Kugururock River. Sampling of these sites (No's II-IV) continued through the 16th. On July 15th a thunderstorm passed through the area setting off an impressive lightning display. We later learned that this and associated storms started several fires 40-150 miles upstream from our camp. We also saw a large bull moose near site III on the 15th. The passage of the storm brought a bright sunny but windy and cool day on the 16th. The change in weather stimulated balsam poplar to shed its cotton-like seeds and brought welcome relief from the hordes of mosquitoes that plagued us during the prior week ("Ten billion dollars would be all too small reward, a trifle totally inadequate to compensate, mere nominal recognition of the man who shall invent and realise a scheme to save this earthly paradise from this its damming pest and malediction.")^{4/}

On Saturday July 17th Team I broke camp and travelled the 15 miles downstream to the Kelly Bar where two flights in Shellabarger's 206 returned us to Kotzebue and "civilization".

Team I departed from Kotzebue on July 18th with Team II arriving on many of the same flights (Kotzebue is the "end of the line" for commercial flights--there is nowhere to go but back to Anchorage!). With our camp and boat in place we spent little time in Kotzebue. Mac Shaver, Superintendent of the NPS Northwest Alaska Areas ferried food and fuel to a landing strip at the mouth of the Kugururock River during the morning of the 19th and Team II was flown to Kelly Bar in the afternoon. Accompanying us were Bill Collins and John Brooks, U. of Alaska reindeer specialists who

^{4/} Ibid., pp. 123, 124.

visited with us for two days. A highlight of the first flight was our overpass of a flock of Dahl sheep in the Maiyemurack Mountains south of camp.

On July 20th Team II received an orientation to the study sites and participated in one of P.I. Patterson's now infamous "death marches" through wet tundra north and west of camp. Warmer weather provided Team II with its only real opportunity to experience mosquitoes in numbers that approached those we encountered during the first two weeks.

On July 21st we began hauling several hundred pounds of coring equipment across the two miles of tundra between camp and Pond J. Shifting weather systems brought cool, cloudy weather that actually made the task somewhat easier. We also began sampling spruce and balsam poplar stands, some of which were burned in 1977, on the west bank of the pond. Bill Collins and John Brooks left camp with Johnny Walker, an Eskimoe bush pilot who landed his Cessna 185 on the "gravel bar" in front of camp.

On the 22nd we assembled our coring platform and anchored it in 4.5 m of water. A 47-cm long "short" core was recovered with a piston-equipped plastic tube taped to tubular steel drive rods. Five drives with a modified "Livingston" corer supplied by Dr. Thompson Webb III of Brown University recovered a 2.64-m long "long" core. Penetration of the base of the core was stopped by a 5-10 cm thick layer of dense pebbly sand.

July 23rd was characterized by cold, windy and rainy weather that made field work all but impossible. We returned to Pond J in the evening, moved the coring platform and attempted to raise a second "long" core but raw weather kept us from staying on the lake for more than about an hour. We returned to camp about 9:30 PM to await better weather.

Sampling of vegetation on the shores of Pond J continued at a slow but steady pace.

We arose on the morning of the 24th to find ourselves surrounded by snow-capped peaks in the Baird and DeLong Mountains. The weather improved somewhat but we stayed near camp and, among other things, extruded the short core into 80, .5-cm long sections. We also began sampling the first of two areas to determine the effects of fire on alder bushes. Our camp, which was on the edge of the bank of the Noatak River, occupied an area with alder bushes and an occasional spruce scattered among the cotton grass tussocks of a moist tundra area. The riverbank itself, which served as a break for the 1977 fire, was occupied by a dense thicket of alder and willow. We mapped all of the alder bushes in a 130 m x 30 m transect that bisected our camp area. Most bushes had been killed by the 1977 fire, and we recorded the degree to which each clump had been damaged by the fire, the number of old stems, new shoots and maximum height and width of the clump. We recorded the direction and distance to all seedlings occurring within a 4-m radius of each clump. On separate 1-m radius plots sampled at 10-m intervals along the center line of the transect we recorded numbers of alder seedlings and extent of burning evident on the soil surface.

On July 25 we finished coring Pond J., continued sampling vegetation along its banks and, at the end of the day, began hauling the coring equipment back to camp.

On the 26th Mac Shaver stopped by the Kugururok River gravel bar on his way upriver to deliver supplies to ranger Walt Shipley. He picked up John O. and Chuck R. and flew them to a gravel bar near one of the fires that burned 10 days earlier so they could quickly sample a fresh burn.

Work at Pond J was completed on the 26th and 27th as was the sampling of the "camp" alder stand. On the 27th Walter M. and I hiked to a small pond (later named Winslow Pond after the Fisk's dog) and recovered a short (36-cm long) core from 2.3 m of water. Winslow Pond is surrounded by relatively dense spruce "forest" that did not burn in the 1977 fire and surface samples should provide an interesting contrast with Pond J which is larger, deeper and has proportionately less spruce in its watershed, which for the most part burned in 1977.

On July 28th we returned to Site I (spruce) and began sampling a 100-m long alder transect. John D, with the help of Katie F, sampled species composition and biomass on small plots in an adjacent area that was left unburned by the 1977 fire but which contained old, charred spruce stems that were apparently killed by a much earlier fire. We sampled stems of living and dead spruce in this area to determine stand history. If we can determine when the earlier fire burned we should be able to use the vegetation data to learn something about long-term recovery following fire.

Kurt B. and Walt M. sectioned fire-killed spruce stems on Sites II and IV. Chuck R. returned to camp from Kotzebue (he left Monday with Mac Shaver who had taken a load of equipment in his 185). Doug Anderson, an archeologist from Brown University, and two associates arrived to spend two days in camp and investigate archeological sites in the Noatak Canyon. Our evening meal was interrupted about 10:30 by a Civil Air Patrol Beaver (airplane) that flew low overhead and tried (unsuccessfully) to speak to us over his loudspeaker. The Beaver returned later (about 12:30 AM) and again the next morning. We never were able to understand the message that he tried to pass to us, but we eventually learned that he was looking

for Mac Shaver who was forced by bad weather to stay upstream overnight.

We returned to Site III on the 29th and completed our sampling of that area. (The Fisks finished sampling alder at Site I.) The motor on our boat began acting up on Wednesday and by Thursday it was very bad. As a result we decided at 6:30 PM to break camp and head downstream for Kelly Bar. We had made previous arrangements for Snellabarger's pilot (Mark) to pick us up at 11:00 on the 30th, and we figured that if the motor quit completely we could spend Thursday night floating downstream and at least make Kelly Bar in time to catch our flight. As it turned out the motor (more or less) survived the trip, and we arrived about 11:00 PM, in time enough to cook a salmon that Walt M. had caught earlier in the day. We met Ray Hodges and his wife June who had flown into the bar earlier in the day in their (respectively) 185 on floats and super cub. They planned to spend two weeks fishing in the area and were accompanied by their two small children and June's sister. Ray is a jet pilot for Wein Airlines and June an Eskimoe who grew up in Kotzebue.

Shellabarger's plane arrived on schedule Friday morning, and we made it back to Kotzebue in two flights. Before leaving Kelly Bar I had a chance to break out my fishing gear for the first time and managed to catch 3 grayling and a salmon between seeing team members off on the 1st flight and repairing the motor on the boat (with sparkplugs sent on the incoming flight by John D. who left camp on Wednesday with a load of equipment). The warm showers of the NPS Quonset hut were especially welcome after two rather chilly weeks on the Noatak. Anne H, who had been in the field for nearly 4 weeks, was given a 1st class ticket on flight #1!

We spent the morning of the 31st repacking gear for the return flight to Amherst. John E., Walt M. and Kurt B. were able to get early flights out of Kotzebue. Anne H., the Fisks and I finished packing and stopped by to visit Richard Schmidt and Kathy Devereaux, former students at the University of Massachusetts and Hampshire College respectively. They work in Kotzebue; Kathy managing a large vegetable gardening project for Mnelik--the non-profit native corporation for northwest Alaska--and Richard conducting energy audits for Eskimoe families in villages near Kotzebue. We broiled a char that Kurt B. had kindly left with us and made a quick stop at the Dairy Queen before descending upon Alaska Airlines with our 15+ pieces of luggage.

We arrived in Anchorage on schedule at approximately 8:30 PM.

Summary of Results and Preliminary Observations

As stated earlier, a detailed analysis and discussion of results of the summers field work will be presented in the final report for the MAB grant late next spring. I have, for that reason, made no attempt to present preliminary results in this report. A brief summary of our activities and a subjective assessment of what the data may mean is appropriate, however.

During the six-week stay on the Noatak (Steve S. and Brice S. continued to record weather observations after our departure), we collected the most extensive weather data ever recorded for this remote area of Alaska. We made 179 different sets of weather observations that should tell us much about conditions that influence fire ignition and spread factors in the area. In general, winds appear to blow from the east and northeast during

periods of fair (and generally warm) weather and from the west to southwest (out of the Chukchi Sea) when weather is foul. Even during sunny days, humidities appear to be higher when winds are out of the SW. The thunderstorms that brought lightning on July 13-15 followed a period of prolonged fair weather and low humidity and appeared for the most part to move from NE to SW. Thus weather conditions that promote the increased likelihood of fires occurring in the area seem to occur when continental rather than maritime influences are dominant.

We sampled fire effects in six spruce stands. I had originally hypothesized (based on 1981 observations) that spruce regenerated following fire from seeds shed from cones remaining in trees that had been killed when their root systems (as opposed to crowns) were damaged by the low-burning, smoldering type fires that characterize tundra burns. Our 1982 observations suggest, however, that this could only be true when fires coincide with good seed years, which occur only every 5-10 years. In other years (e.g. 1982) there appears to be almost no seed produced on spruce trees. I searched the crowns of scores of spruce and found no evidence of flowering in either 1981 or 1982. Abundant cones in some stands appeared to date to seed years in 1978 and 1973 or 1974. We have identified two major fire seasons in the Noatak drainage--mid to late June and late July-early August, and I had theorized that early fires that kill spruce before seeds can mature could be more damaging to post-fire regeneration than later burns. This does not appear to be a problem, however. The likelihood that fires will coincide with good seed years is low (< 15-20% of the potential fire years are also good seed years), and, in any event, we found instances where seed from surviving trees had been blown several hundred yards to regenerate stands in which all pre-fire stems had been killed.

Data from our two alder transects may, on the other hand, lend support to the theory that alder regenerates primarily from seed stored in the canopy of root-killed bushes. Unlike willow, resprouting of alder following fire is limited, and fire-killed bushes are often surrounded by large numbers of seedlings. The fact that similar substrates away from bushes in these sparsely populated alder stands have few seedlings suggests the seeding from distant sources is less likely. We collected seed from alder stems cut at various times during the summer and hope to determine when seeds reach maturity. It is quite possible that in this instance early fires can reduce the likelihood of post-fire alder regeneration.

The observations of Chuck R. and John D. will document immediate post-fire vegetation changes and biomass recovery. They have sampled areas burned in 1972, 1977, and 1982 (June and July fires) as well as small plots that they burned in 1981. Analyses of sediment cores for pollen and charcoal content are part of Anne H.'s masters project at the University of Massachusetts. Preliminary results show clear evidence of earlier fires (abundant charcoal) and we hope that pollen analysis will tell us something about the effects of the fires on vegetation.

Publication of Results and Future Research

In addition to the final MAB Report, we are beginning to develop manuscripts in which we detail specific findings of our study. We (Racine, Dennis and Patterson) have completed a paper that summarizes the results of our analysis of historically recorded fires. The paper should be ready for submission to the journal Arctic early in the coming year. We have also prepared an abstract (Appendix) dealing with results of

our studies of the effects of tundra fires on soil thawing phenomena. The abstract has been accepted as the basis for a presentation at the Fourth International Conference on Permafrost to be held in Fairbanks late next summer.

Our research not only answers basic questions about the role of fires in tundra ecosystems, it also provides information needed by the Natural Park Service as it prepares fire management plans for units in northwest Alaska. The Northwest Alaska Areas office intends to develop these plans in the next 18 months, and they have invited us to return to the Noatak in 1983 to continue our work and provide specific information on fire effects, history, weather and fuels. Their offer includes provisions for all of our local field transportation. This would represent a major contribution to our work, because local transportation for our 1982 work cost an estimated \$7-8000.

Acknowledgements

The 1982 field season was the most productive and enjoyable of the four I have spent in northwest Alaska and that was due, in large part, to the support of many people. Chief among these are the 10 Earthwatch volunteers and Earthwatch staffers Pam Burch and Karen O'Neill who contributed their time and energies so that we could accomplish our goals. I especially appreciate the cooperation of the Chuck Racine and John Dennis who as "volunteer" co-principal investigators went out of their way to ensure that we made the most of the talents and time of Earthwatch volunteers. As Principal Investigator of the MAB grant, Chuck ensured a fair division of funds between the two projects. He, for example, covered all of my field expenses and split evenly transportation costs despite the fact that Earthwatch staff and volunteers comprised two thirds of the field crew. Anne Hine, John O'Keefe, Brice Stearns and Steve Simoes were able and uncomplaining assistants for whatever task was at hand. The continued collection of weather data by Steve and Brice after most of the group had departed provided us with a valuable addition to our weather observations. The expedition could not have succeeded without the support of Mac Shaver and his National Park Service staff who provided a boat for our use on the Noatak, free room in Kotzebue and assistance in transporting supplies to and from the field. Kathy Devereaux and Richard Schmidt provided valuable advice, warm hospitality and good friendship and I wish them well in the future. Bill Collins and John Brooks graciously volunteered to help defray the cost of our transportation when they visited our camp in late July. In addition to these I would be remiss if I did not acknowledge the friendly helpfulness of many residents of Kotzebue.

APPENDIX

ABSTRACT

Paper Submitted for Presentation at the Fourth International Conference
on Permafrost: July 18-22, 1983; Fairbanks, Alaska

Title: Permafrost Thaw Associated with Tundra Fires in Northwest Alaska

Authors: Charles H. Racine: Div. of Env. Studies; Johnson State College;
Johnson, VT. U.S.A.

William A. Patterson III: Dept. of Forestry; University of Mass-
achusetts: Amherst, MA.

John G. Dennis: Natural Science Div.: National Park Service;
Washington, D.C.

Abstract: During the last decade, wildfires have burned a total of almost 4000 Km² (1 million acres) of Low Arctic tundra in the Seward Peninsula and Noatak River watershed and Biosphere Reserve in northwest Alaska. The authors have been investigating the effects of these fires on the vegetation and associated permafrost over the past five years (1978-1982). Active layer thickness, seasonal thaw rates, soil temperatures, water table depths, organic layer thickness and frost features have been measured at a broad range of sites representing different physiographic-topographic situations, time since fire and severity of burning in both the Seward Peninsula and Noatak River areas. Documented effects of fire on the soils include: a) subsidence of the ground surface, b) changes in soil temperatures, active layer thickness and thaw rates, c) increased water content of the active layer, d) changes in the relationship between surface microtopography and the frost table, and e) the condition of frost features. Additional fire effects on the permafrost are associated with the construction of firebreaks and attempts to revegetate them as well as with off-road vehicle travel over burned tundra. A model is developed relating microtopographic and vegetational changes following fires to changes in the active layer, soil temperatures, frost action and soil moisture levels.