PLANNING A FOREST INVENTORY:

GUIDELINES FOR MANAGERS OF ALASKA NATIVE LANDS

RONALD K. MILLER
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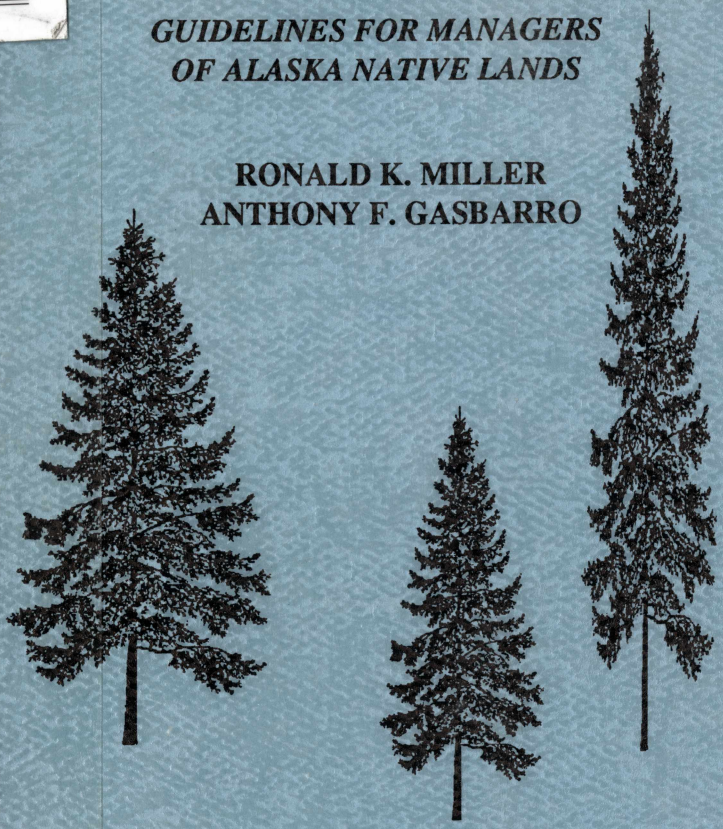

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School of Agriculture and Land Resources Management
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by

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PREFACE

This handbook is designed for land managers of the Native regional and village corporations in Alaska. These corporations, authorized by the Alaska Native Claims Settlement Act (ANCSA) in 1971, now own and manage millions of acres of land throughout the state. Collectively, the corporations are the third largest landholder in Alaska next to state and federal governments. The ultimate land entitlement to Native corporations will be 44 million acres. This figure represents about 95% of the private ownership of Alaska or about 12% of the state. Non-corporate land under Native ownership (Native allotments and the Annette Island Indian Reservation) further increases the total Native land acreage.

The purpose of this handbook is to provide guidelines for corporate land managers who make decisions about forest inventory needs on their lands. These lands are significant because of their combined size and because of their unique ownership. As Native lands, they are owned by the Eskimo, Indian or Aleut people who live on them. These lands are not included in state or federal land use plans. Native corporation land managers, therefore, have the opportunity to devise their own plans recognizing the cultural needs and desires of the corporation stockholders.

One of the first steps in considering what to do with a corporation's forest resources is to inventory those resources. It is difficult to determine the best use of forested lands without knowing what they contain. This handbook is about forest inventories—what they are, what purpose they serve, inventory planning and implementation and, how to decide if one is needed.

Chapter 1 provides background material on Alaska's Native lands which is the land base that is the focus of these guidelines. The chapter also provides an overview of Alaska's forests and introduces the subject of forest inventories.

Chapter 2 explores the question of whether an inventory is needed. The primary purpose of this chapter is to encourage the reader to check for existing forest inventory information before investing in another inventory. Perhaps the manager will not need to gather additional information. Or perhaps an inventory can be tailored to fit around existing information to save on costs and fill in the gaps.

Chapter 3 examines planning a forest inventory. Assuming a manager decides to go ahead with an inventory, planning is the next step. A primary benefit of planning is that it forces managers to consider the many aspects of a field inventory before investing time and money in the effort. Forest inventories need to be planned to ensure efficient implementation and the attainment of project goals. A manager may decide that, instead of doing the work in-house, it would be best to contract the inventory.

Chapter 4 covers some of the methods of conducting a forest inventory. It is not intended to be a specific how-to manual but covers such aspects of a forest inventory as boundary determination, statistical considerations and different methods of timber cruising. This chapter also provides an overview of field activities.

Chapter 5 considers the question of what to do when the inventory is complete. This section focuses on the inventory results and gives ideas to determine where to go from there.

Much useful information is also contained in the bibliography and appendices. The bibliography is divided on a chapter-by-chapter basis to aid in locating pertinent information. All listed references are available in Alaska and have been selected because they provide the most useful and up-to-date

information possible. Books written before 1970 are generally not included in the bibliography unless nothing more recent has been published on the particular subject. For some subjects, such as Alaskan land status, the age of the reference is even more critical. Anything written before 1980 is most likely out-of-date due to land exchanges resulting from the Alaska Native Claims Settlement (1971) and the Alaska National Interest Lands Conservation Act (1980). The appendices contain information too lengthy to describe in the text. Each appendix stands on its own and provides detailed information or background material for subjects covered in this handbook.

This handbook was written recognizing the uniqueness of both the Alaskan situation and Native land holdings. It recognizes that Native values and goals for their lands may be somewhat different than those of mainstream society. The handbook is designed to assist corporate land managers in making decisions about the forest inventory needs on their lands given the unique social and cultural values of the land owners.

CHAPTER 1

BACKGROUND & OVERVIEW

> ***"It is very clear to me that land is the basis of Native cultures, and we need to do everything we can to ensure that the land base is kept in Alaska Native ownership, not just until 1991, but forever."***
>
> **Governor Steve Cowper**
> **1988 AFN Conference**

This introductory chapter discusses the Alaska Native land base which is the focus of this circular. It also provides background information about the extent and nature of Alaska's forests. Following this is a brief introduction to forest inventories.

Alaska's Native Lands

A discussion concerning the application of forest inventories to Native land, requires that some background be given on the land base. Alaskan Native land entitlements are not all the same. They have resulted from a number of important pieces of legislation and are, therefore, governed by a variety of rules and regulations. Most Native land is under corporate control, but there are many scattered parcels belonging to individuals. There is also one Native reserve, the Annette Island Indian Reservation. The Bureau of Indian Affairs has a trust responsibility over a small portion of the Native-owned land. In many cases, the subsurface estate of Native land belongs to a different entity than the surface estate. The following sections will attempt to explain the Native land

ownership pattern and give approximate acreage figures for each of the different components.

Alaska Native Claims Settlement Act Lands (ANCSA)

The Alaska Native Claims Settlement Act (P.L. 92-203) was enacted on December 18, 1971. This act was created to settle all aboriginal land claims in Alaska. Under this act, Alaska Natives are to receive title to approximately 44 million acres of land and a $962.5 million cash settlement. This historic legislation gives Alaska Natives fee simple title to more land than is presently held in trust for all other Native Americans.

ANCSA stipulated that land benefits were to be distributed to Natives through regional and village corporations rather than through clans, tribes or other traditional groupings. Twelve regional corporations and over 200 village corporations were created. A thirteenth regional corporation, having no land entitlement, was established in 1975 for Alaska Natives living outside the state.

Regional Corporations —The 12 regional corporations were formed from 12 regional associations of Alaskan Natives that were already in existence when ANCSA was enacted. It is through the regional corporations that nearly all of the benefits flow to enrolled Natives. Non-profit associations in each region serve in the areas of health and social service programs. The regional corporations and respective non-profit associations are:

1. Ahtna, Incorporated—Copper River Native Association
2. Aleut Corporation—Aleutian Pribilof Island Association
3. Arctic Slope Regional Corp.—Inupiat Community of the Arctic Slope
4. Bering Straits Native Corporation—Kawerak, Incorporated
5. Bristol Bay Native Corporation—Bristol Bay Native Association
6. Calista Corporation—Association of Village Council Presidents
7. Chugach Alaska Corporation—The North Pacific Rim
8. Cook Inlet Region, Incorporated—Cook Inlet Tribal Council
9. Doyon, Limited—Tanana Chiefs Conference, Incorporated
10. Koniag, Incorporated—Kodiak Area Native Association
11. NANA Regional Corporation—Maniilaq Association
12. Sealaska Corp.—Central Council of Tlingit and Haida Indians of Alaska.

A map of corporate boundaries is shown in Figure 1. Although the 12 regional corporations cover the entire state of Alaska, they do not own all the land within their boundaries. ANCSA identified approximately 16 million acres for regional corporations. Acreage entitlement for each region was based on the total land area within the region.

Regional corporations hold both surface and subsurface rights to these lands and subsurface title to all village corporation lands within their boundaries. Calista Corporation, with over 25 percent of all the village corporations within its boundaries, has the largest subsurface entitlement; Chugach Alaska Corporation, with only five village corporations has the least.

Village Corporations—Village Corporations under ANCSA are entitled to about 22 million acres of land. The amount of land that an individual village could select was based on its enrolled Native population. A Native census, completed December 18, 1973, was conducted for this purpose. If a community had a Native population of 25 or more, it qualified to receive a land allocation. The larger the population, the more land the village corporation could select (Table 1).

Table 1—ANCSA Village Acreage Entitlements *

Native Population	Acreage granted	Townships
25 to 99	69,120	3
100 to 199	92,160	4
200 to 399	115,200	5
400 to 599	138,240	6
600 or more	161,280	7

* Note: This acreage formula did not apply to villages in southeast Alaska because of a prior cash settlement between the U.S. Government and the Tlingit and Haida Indians. Instead, village corporations in southeast Alaska were limited to a single township of land (23,040 acres) regardless of their population. (Source: ANCSA)

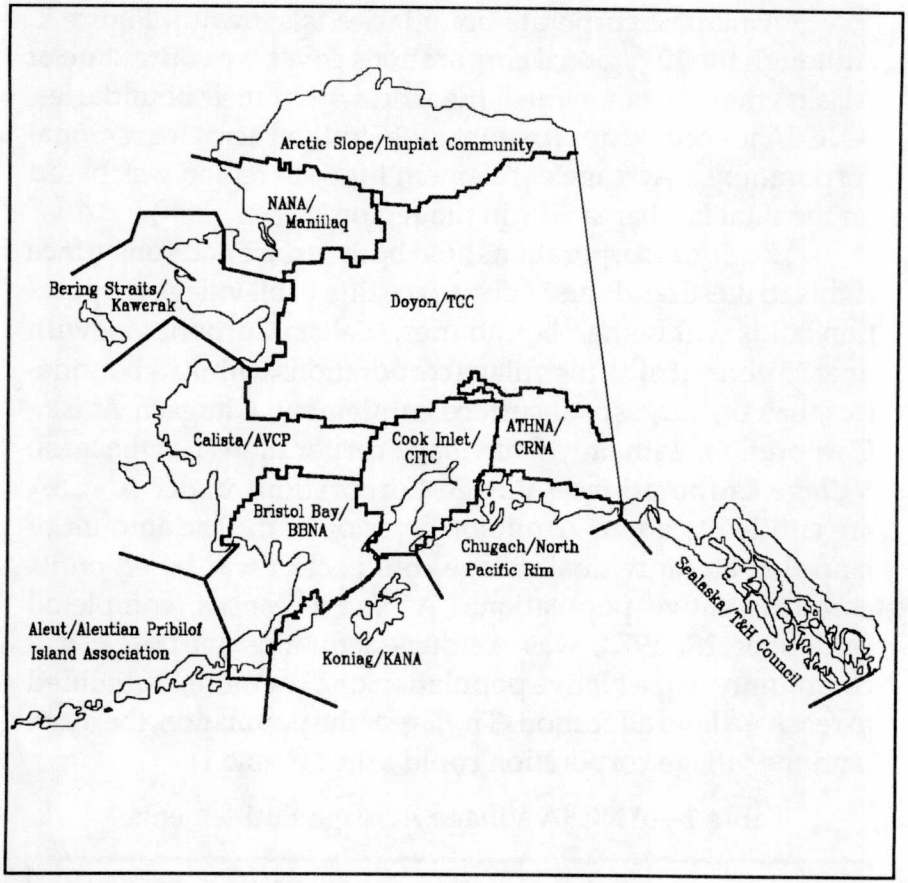

Figure 1 — Native Regional Corporations

While more than 200 villages are listed in the Alaska Native Claims Settlement Act, some of them were found to be ineligible, while others not on the list were later found to be eligible.

Since the passage of ANCSA, some corporate mergers have taken place. Some villages have merged with their regional corporations, while other villages have merged to form conglomerate village corporations. In the NANA region, for example, all village corporations except the one in Kotzebue

have merged with the regional corporation. On the Kuskokwim River, 10 villages joined to form The Kuskokwim Corporation (TKC). Similar mergers have taken place throughout Alaska. After these corporate mergers, there were 173 village corporations by the end of 1988.

ANCSA requires village corporations to reconvey some of their land to individuals and municipalities. This provision was included because ANCSA also required village corporations to select virtually all unreserved land in and around each village. In most villages, individual homes, businesses and other structures occupied this unreserved land. Therefore, a small percentage of village corporation land will be given to those with prior claims.

Additional ANCSA Land Entitlements—In addition to the 16 million acres awarded to regional corporations and the 22 million acres awarded to village corporations, ANCSA designated two million acres of other land entitlement provisions. These entitlements are often referred to as 14h lands because that is the section in ANCSA that describes them.

Former Native Reserve Lands—With the exception of the Annette Island Indian Reservation, all Native reserves and reservations in Alaska were revoked by ANCSA. However, village corporations within the boundaries of the revoked reserves were allowed to obtain fee simple title to their former reserve land, if they voted to give up other benefits provided by ANCSA. Villages on five former reserves originally chose to do so. This added four million acres to the original 40 million acre ANCSA entitlement. Later, one of the villages, Klukwan, changed its mind and elected to join the non-reserve villages. The former reserves now under village control are Venetie, St. Lawrence Island, Tetlin, and Elim.

Table 2—Section 14h Land Entitlements

1. Existing Cemeteries and Historical Places—These parcels are to be surveyed and given to the appropriate regional corporations (986).*

2. Group Entitlements—Native groups that didn't qualify as a Native village in 1973 could still receive up to one township of land if they qualify as a special group. To date, 12,970 acres have been granted under this clause (12,970).*

3. City Entitlements—Natives in Juneau, Sitka, Kodiak and Kenai could incorporate and receive one township of land for each of these four cities (92,160).**

4. Homesteads—Within two years from the date of enactment of ANCSA, Natives could claim up to 160 acres as a primary place of residence (homestead) and receive title (426).**

5. Native Allotments—Acreage of Native allotments that were approved during the four years following the enactment of ANCSA was to be charged against this two million acre provision (184,663).**

6. Remaining Entitlement—Whatever portion of the two million acres is not used for the special purposes outlined above is to be divided among the regional corporations on the basis of population (505,080).*

Note:
* The numbers in parenthesis are acreages that have been patented or allotted to date through interim conveyance under each clause.
** These acreage figures also represent the ultimate entitlement under each respective clause. Over one million acres of 14h entitlements have not yet been conveyed and are, therefore, not accounted for in the above figures. Most of this remaining entitlement will revert to the regional corporations.
Source for acreages: BLM computer files—April, 1988.

These lands have unique status. The local village corporations have both surface and subsurface rights to their land. These corporations are independent and do not share in money distributed under ANCSA. Nor are they stockholders in their respective regional corporation.

Other Native Lands

In addition to ANCSA land entitlements, there is other Native owned land in Alaska. This other land, which includes Native allotments and the Annette Island Indian Reservation, was identified prior to ANCSA. Except for that portion of the Native allotment acreage deducted from ANCSA entitlements (number 5 in Table 2), these lands add to the total acreage figures of Native land holdings.

Native Allotments—Native Allotments are private land holdings. They are not under regional or village corporation control. Once certified, Native allotments are held in restricted status by the U.S. Government. Restricted means that although legal title for these lands is held by the allottee, the federal government retains certain obligations to the land. (Trust land is similar to restricted land except that on trust land the federal government, rather than the individual or tribe, retains legal title to the land.) The Secretary of the Interior has the responsibility to administer these lands for the benefit of the allottee through the Bureau of Indian Affairs. Allotments are exempt from taxation or alienation, however, an allottee has the right to sell the allotment if he or she chooses to, subject to BIA regulations and approval. Allotments carry all subsurface rights not reserved in the certificate of allotment.

Native allotments stem from the Alaska Native Allotment Act of May 17, 1906 (43 USC 270-1). This act authorized the Secretary of the Interior to allot up to 160 acres of land to any Alaska Indian or Eskimo who was the head of a family or 21 years old. (Later court cases dropped the age and head of household requirements.) These allotments were considered a

homestead to the allottees and were deemed to be for the allottee and his or her heirs in perpetuity. In 1956, an amendment gave Aleuts the same rights to apply for an allotment.

Although the Native Allotment Act was in effect since the turn of the century, few people applied for land until the late 1960s. This was primarily because most Natives did not know about the act. During the period 1970-1971, after a recruitment push by the BIA and Alaska Legal Services, about 8500 applications were filed. The Alaska Native Claims Settlement Act repealed the Allotment Act on Dec. 18, 1971, ANCSA's effective date, but recognized those applications that were still pending. Allotments range in size from less than an acre to 160 acres. The majority are 40, 80, or 160 acres. An allotment may consist of several separate parcels of land as long as the total acreage of all parcels does not exceed 160 acres. Allotments are certified once they have been approved, surveyed, and conveyed to the Native applicant. Depending on court cases and federal decisions, the ultimate entitlement for Native allotments may exceed one million acres (Table 3).

Annette Island Reservation—The Annette Island Indian Reservation, a southeast Alaska island containing 86,741 acres of land, is the only Native reservation in Alaska. Tsimshian Indians were granted the island reservation in 1891 after emigrating from Canada. This Native group did not take part in the ANCSA settlement. The Bureau of Indian Affairs Portland Area Office, through the tribe, administers this tribal land.

Native Land Status

Figure 2 provides a graphic summary of the foregoing discussion on Native lands. Currently, there are approximately 44.8 million acres of Native landholdings in Alaska. A map showing the location of Native lands in Alaska as of 1986 is shown in Figure 3. The level of detail, depicted to the township level, provides a general overview of Native land distribution in Alaska.

Table 3—Current Native Allotment Acreage By Region*

Region	Application Acreage**	Certified Acreage
1. Ahtna	17,061	14,515
2. Aleut	3,970	2,094
3. Arctic Slope	56,191	839
4. Bering Straits	60,348	20,194
5. Bristol Bay	112,001	30,164
6. Calista	352,627	32,651
7. Chugach	6,223	3,518
8. Cook Inlet	19,105	8,338
9. Doyon	173,924	73,512
10. Koniag	24,353	1,567
11. NANA	119,234	36,468
12. Sealaska	16,890	5,359
TOTAL	961,927	229,219

* Source: BLM computer files—February, 1988. Note: The certified acreage figures are in addition to application acreage figures. Once certified, an allotment's acreage is moved from the application acreage column to the certified acreage column.

**Awaiting approval or land survey.

As of April, 1988, 35.3 million acres of the 44 million acre entitlement had been transferred to Native Corporations and 230,000 acres of Native allotments had been certified. Much work still remains before all lands are transferred. On Native allotments alone, 7,116 parcels were still awaiting survey and

certification in April, 1988.[1] The Bureau of Land Management (BLM), which has primary responsibility for surveying these lands, estimates that the survey work will cost about $600 million annually and take more than 40 years to complete.[2]

Alaskan Forests

A recently completed U.S. Forest Service assessment found about 129 million acres of forest land in Alaska.[3] These forests are divided into two primary zones: interior and coastal. Interior forests cover about 115 million acres and consist primarily of white spruce, paper birch, quaking aspen, balsam poplar, and black spruce. Coastal forests cover about 14 million acres and are primarily Sitka spruce and western hemlock. (A list of Alaska's principal tree species is included in Appendix II.) Coastal forests contain significantly more volume per acre than do interior forests. Figure 4 details Alaska's forest resources.

For both interior and coastal forest land, the more productive sites are classified as "timberland." Timberland, as defined by the USFS is land capable of producing at least 20 cubic feet of usable wood per acre per year. Approximately 13.5 million acres of the interior forests are classified as timberland while coastal forests contain about 7.6 million acres of timberland.[4] In older publications, timberland is reported as

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[1] Bureau of Land Management Computer Printouts (April, 1988).

[2] Leask, Linda. 1985. Alaska: Review of Social and Economic Conditions. University of Alaska, Institute of Social and Economic Research, Anchorage.

[3] van Hees, Willem (U.S. Forest Service—Anchorage). Note to principal author, 30 November 1988.

[4] LaBau, Vernon J., and Willem W.S. van Hees. 1989. An Assessment of the Ownership of Timberland In Alaska. U.S. Forest Service Pacific Northwest Research Station, Portland, OR (In press).

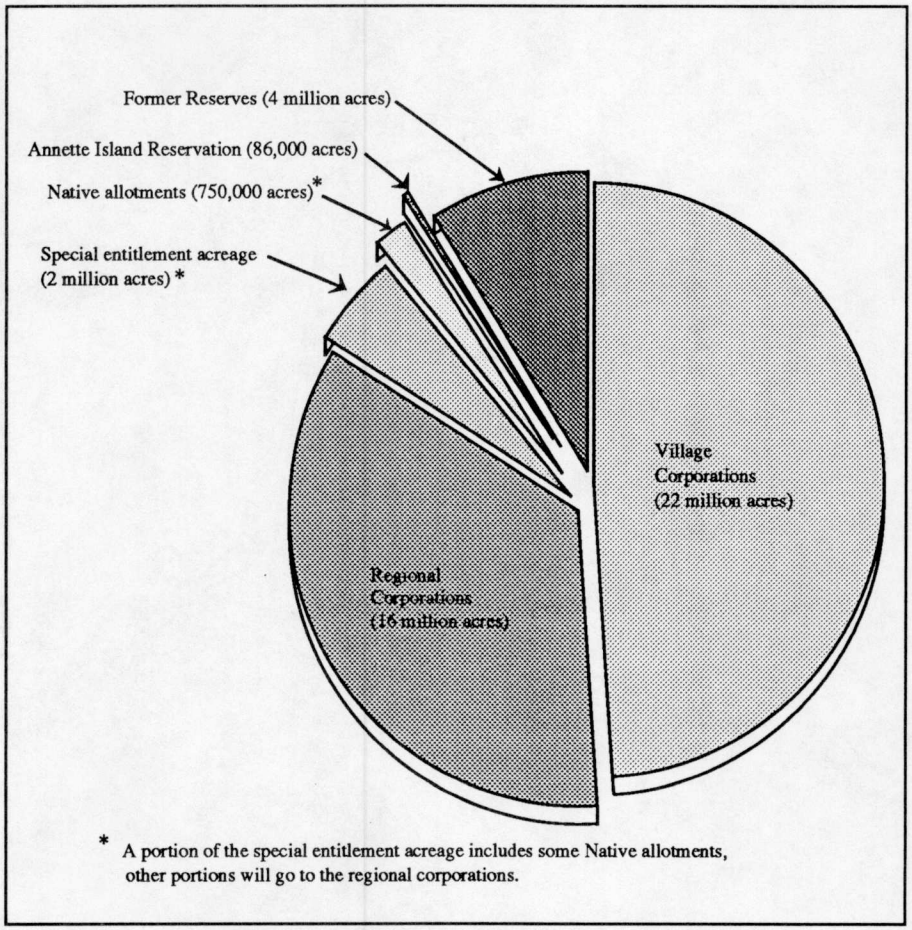

Figure 2 — Native Land Categories by Acreage of Ownership

commercial forest land. The latter term was changed to timberland because of past confusion about the word commercial. Commercial or timberland are simply biological definitions and have nothing to do with the economics of logging.

Data on Native owned forest land is not readily available, partially because of the constantly changing status of these lands. Some estimates, however, have been made. One estimate for Native corporation land is that as much as eight

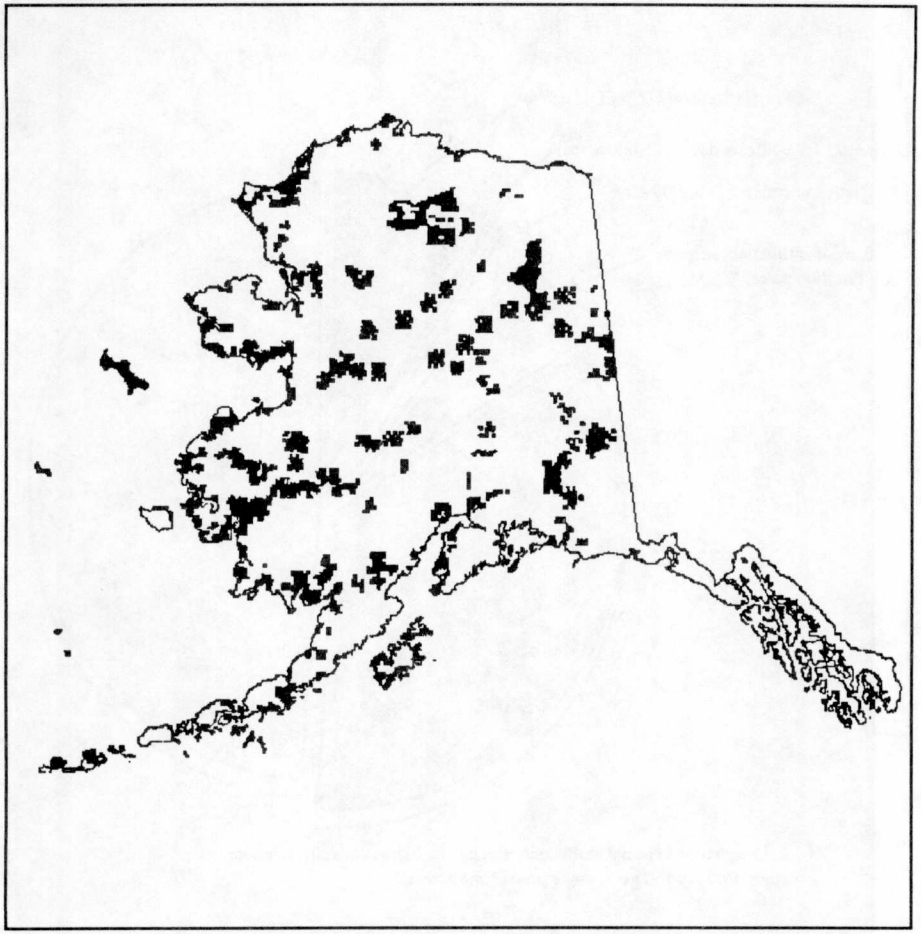

Figure 3 — Native Lands in Alaska

million acres may be forested.[5] The Bureau of Indian Affairs estimates that another 325,000 acres of forest can be found on Native allotments.[6] Finally, about 25 percent (21,595 acres) of

[5] Schiller, Robert. 1985. Alaska's Commercial Forest Resource. Department of Commerce and Economic Development, State of Alaska, Juneau

[6] Stevens, Jim. 1987. Bureau of Indian Affairs Forest Operating Plan: Native Allotments in Alaska. Unpublished report on file at the BIA Anchorage Agency Forestry Department, Anchorage.

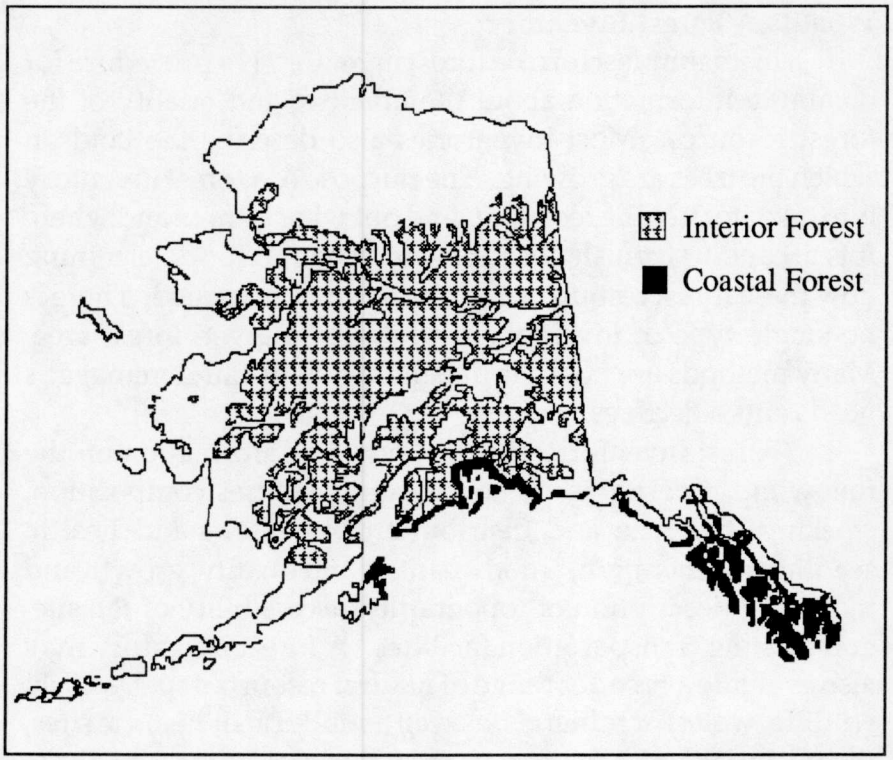

Figure 4 – Alaska's Forests

the Annette Island Indian Reservation is forested.[7] Assuming that each of these three separate estimates is correct, there are approximately 8.3 million acres of Native-owned forest land in Alaska. A separate Forest Service study classifies 5.7 million acres of the Native owned forest land as timberland.[8]

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[7] Bruns, John E. (Annette Island Tribal Forester—Metlakatla). Letter to principal author, 3 August 1988.

[8] LaBau, Vernon J., and Willem W.S. van Hees. 1989. An Assessment of the Ownership of Timberland in Alaska. U.S. Forest Service Pacific Northwest Research Station, Portland, OR (In press).

What Is A Forest Inventory?

In its simplest form, a forest inventory is a procedure for obtaining information about the quantity and quality of the forest resource. Most inventories also describe the land on which the trees are growing. The purpose of a forest inventory is to take stock of the resource (find out what is there and where it is at) and to furnish necessary information for determining how these forest resources can or should be managed. There is no single type of inventory method for a given forest area. Many methods are possible depending on the land manager's needs and objectives.

Forest inventories usually provide information on the following: forest acreage and location, species composition, stocking, tree size and distribution by class, stand health, seedling regeneration, wood quantity and quality, growth and mortality, description of topography, accessibility of the site, and existing transportation facilities. A forest inventory may also evaluate a broader range of natural resources such as fish, wildlife, water, or minerals, as well as cultural or historic sites, the potential for recreation, or the value of the area for subsistence use. The emphasis placed on specific elements will differ with the purpose of the inventory.

Forest inventory information is obtained by using instruments to measure standing trees and their growth and by assessing tree condition and various physical characteristics of the timber stand. If measurements are taken on every tree, the inventory is called a complete or 100 percent inventory. When measurements are taken on only a portion of the forest, it is a sampling inventory. This latter method is generally used unless the inventory site is a small tract containing high value timber. The term "timber cruise" is frequently used for the more intensive timber inventories especially if the work is on a specific site in preparation for a timber sale.

Forest Inventories in Alaska

Forest inventories in Alaska were initiated before statehood. Coordinated efforts began in 1952 when the USFS started to inventory the Tongass National Forest in southeast Alaska. Inventories covering large acreages of the southeast continued in the 1960s and 1970s.

The first complete forest inventory of interior Alaska occurred in the early 1960s when the USFS conducted a large scale reconnaissance inventory of the area. The results of this extensive inventory were published in 1967.

This state-wide inventory was followed by more refined inventories. Timbered portions of Alaska were divided into large units which were subsequently inventoried. These units included areas of the interior from the Koyukuk River to the Susitna Valley as well as units in southeast Alaska.

Additional inventories have been conducted by other agencies and private firms in Alaska as well. These will be discussed in more detail in Chapter 2. These subsequent inventories have looked at smaller areas of land to gather more precise and site specific data. Native land managers can use the published results of large-scale inventories before obtaining site specific information for their own land.

Forest Inventories on Native Lands

Although it will be many years before title to all Native land is received, land managers need to manage the land now. A primary step in this management may be a resource inventory to determine resource management needs. Such an inventory does not necessarily imply future development. Instead, it provides information from which to develop management options. The more a manager knows about the land, the wiser the resulting management decisions will be.

CHAPTER 2

DETERMINING THE NEED FOR AN INVENTORY

"A forest inventory of village or regional corporation lands is an important first step in developing a land management plan and policies for using the forest resources."

Chris Maisch, Director
Tanana Chiefs Conference Forestry Program

The decision of whether or not to inventory a particular area will depend on information needs. Once these needs are clearly identified, the land manager can proceed in determining how to best gather the necessary information. If the objective of a forest inventory is simply to find out the relative abundance of various tree species growing on a piece of property, the information needs will be considerably less than if the objective of the inventory is to prepare for a timber sale. A simple reconnaissance inventory could accomplish the first objective while an intensive timber cruise is needed to accomplish the second. If an inventory is needed, the land manager must decide in advance what is to be inventoried and how detailed the inventory will be.

Existing Forest Inventory Information

Assuming that a village corporation or regional corporation has forests, the first step in determining whether an inventory is needed or not is to check for existing forest

inventory information. Collecting data in the field can be very expensive, therefore, if information that has already been collected is available, use it. Less time and money will be spent doing a little research for existing information than to proceed with an inventory that might not be necessary. A timber inventory of Kodiak's Spruce Island was conducted in 1987 only to later discover that a more intensive timber inventory of the same island occurred a few years previously. The second inventory probably would not have been necessary had the manager who authorized the inventory known about the earlier work.

Agency Inventories

As mentioned in Chapter 1, practically all forested areas in Alaska have been inventoried at some level. A statewide inventory of Alaskan resources was requested in the early 1970s to assist in implementing ANCSA. The Joint Federal-State Land Use Planning Commission determined that the inventory would be a "compilation of existing data from all possible sources." The resulting 619-page document, along with the companion six-volume State Profile Series included inventory information on 17 resource areas including forestry—all compiled from existing data.[9] While the level of detail might not be sufficient to meet the needs of the land manager, the available information can supplement local inventory data and provide a good starting point.

Many state and federal agencies have conducted forest inventories in Alaska including the U. S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, Soil Conservation Service, National Park Service, and the Alaska Department

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[9] Resource Planning Team. 1975. Resources of Alaska: A Regional Summary. (Revised Edition). Joint Federal-State Land Use Planning Commission for Alaska, Anchorage.

of Natural Resources. Private consulting firms have also inventoried portions of Alaska's forests. While most agencies concentrate specifically on land under their own jurisdiction, some agencies such as the Forest Service and the Soil Conservation Service inventory forest land regardless of ownership boundaries throughout Alaska. The Forest Service is required by the law to conduct forest inventories nation-wide to assess the national timber supply.

Forest Service Inventories

The research branch of the Forest Service has inventoried most forested areas in Alaska. In addition to the statewide forest inventory, the Forest Service has conducted more detailed inventories on dozens of smaller units. Results from these smaller units are of more practical value to land managers than statewide statistics because the information is more detailed and more site specific. Forest Service inventory units in interior and coastal Alaska are listed in Tables 4 and 5 respectively.

The inventory units range in size from the 180,000 acre Tuxedni Bay Inventory Unit west of Cook Inlet to the 8.9 million acre Porcupine Inventory Unit in northeast Alaska. Figure 5 shows the areas covered by each inventory. Additional statistics for inventory units in Southcentral Alaska including Afognak, the Kenai peninsula and the Cordova area should be published in 1989.[10] Forest Service land within the Tongass and Chugach National Forests is also covered by dozens of that agency's in-house forest inventories. The primary purpose of these inventories is to determine total forest area, the amount of timberland or commercial forest, timber volume, and the condition, growth and mortality of the forest in each unit.

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[10] van Hees, Willem (U.S. Forest Service—Anchorage). Computer transmittal to principal author, 8 July 1988.

Table 4—U.S. Forest Service Inventory Units for Interior Alaska

Inventory Unit	Year of Inventory
Susitna Valley	1964-65
Kuskokwim River	1967
Copper River	1968
Fairbanks Block*	1970
Koyukuk River	1971
Tuxedni Bay	1971
Kantishna Block*	1973
Upper Tanana Block*	1974
Wood-Salcha Block*	1975
Porcupine	1978
Willow Block**	1978
Talkeetna Block**	1979
Beluga Block**	1980
Upper Susitna Block**	1980
Upper Yukon	1980

Note: (Table 4)
* These four blocks form the Tanana Inventory Unit, however, the data were gathered and published separately.
** These four blocks form the Susitna River Basin Inventory Unit. Data are more current and slightly different than what was collected in the earlier Susitna Valley inventory.

Table 5—U.S. Forest Service Inventory Units for Coastal Alaska

Inventory Unit	Year of Inventory
Haines/Skagway	1965
Juneau	1970
Sitka	1971
Petersburg/Wrangell	1972
Prince of Wales	1973
Ketchikan	1974
Yakatat	1975
Yakataga	1976

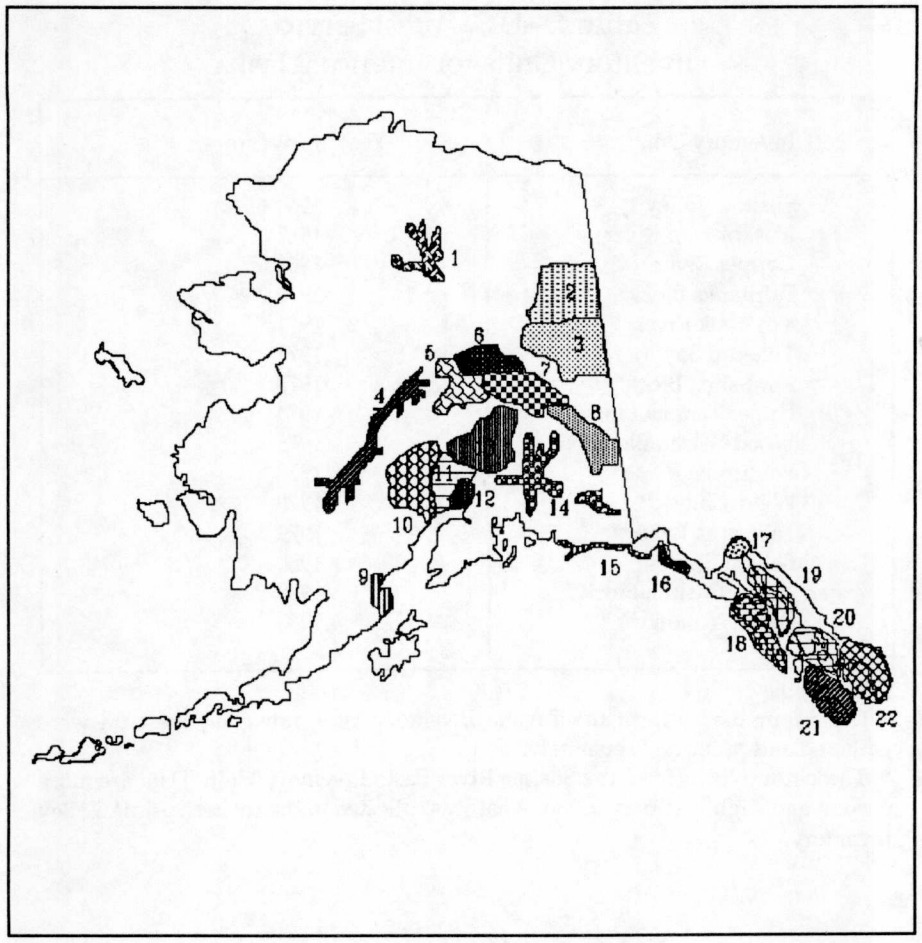

Figure 5 — Forest Service Inventory Units

1. Koyukuk River
2. Porcupine
3. Upper Yukon
4. Kuskokwim River
5. Kantishna Block
6. Fairbanks Block
7. Wood-Salcha Block
8. Upper Tanana Block
9. Tuxedni Bay
10. Beluga Block
11. Talkeetna Block
12. Willow Block
13. Upper Susitna Block
14. Copper River
15. Yakataga
16. Yakutat
17. Haines/Skagway
18. Sitka
19. Juneau
20. Petersburg/Wrangell
21. Prince of Wales
22. Ketchikan

The published inventory reports could provide information that would be very useful to a Native corporation land manager. Data collected by the Forest Service in the Copper River Inventory Unit, for example, could be of interest to Ahtna, Inc., while timber resource statistics for the Porcupine, Upper Yukon, and Tanana Inventory Units would be useful to the Doyon Regional Corporation. Statistics for many inventory units are subdivided into blocks in the published results. The 1970 Juneau Inventory Unit, for instance, contains eight blocks. These smaller unit summaries could be useful to village corporations. While an inventory unit will cover considerably more area than most villages have, an individual block may not. Each block is described with individual statistics so a village land manager could select information from the most pertinent block. A village land manager seeking information that could be useful for an individual village should try to locate inventory data that is as site specific to the region or village as possible. It may not be necessary to start another inventory completely from scratch.

TETLIN EXAMPLE

Suppose a land manager for Tetlin Village Corporation near Tok, is considering undertaking a forest inventory. Tetlin, one of the former reserves that chose to retain full title to its land, has 743,000 acres of land. Once the land area is specifically identified, the search for existing inventory information can begin. Of course, the manager could start with the information gathered during the large scale inventory of interior Alaska. However, more site specific inventory information would be more useful. From the inventory map (Figure 5) the manager sees that the Upper Tanana Block of the Tanana Inventory Unit covers an area in the vicinity of Tetlin's land. Therefore, this inventory (and possibly others around it) is likely to provide information that is most pertinent. By looking at the bibliography for Chapter 2 in this guide, the manager would be able to find out the full title, author and date of the publication(s) needed. (Forest

inventories other than USFS ones are also included in the bibliography.) The USFS inventory was authored by Karl Hegg and was published in 1983. Copies of this report or other Forest Service reports are available at the Anchorage Forestry Sciences Lab or can be ordered from the Forest Service Pacific Northwest Research Station. The address is in Appendix IV.

The publications describe the forest resources of each area as well as climate, soils, topography, general resource use and the inventory methodology used on the unit. A map in each publication shows more detailed boundaries of the inventory unit and any blocks it may contain. Tree species growing in the area are mentioned and forest terminology is defined. The bulk of each publication consists of tables (thirty of them in the example we're using) which define the forest resource in terms of area, number of trees, gross and net volume, net annual growth, and annual tree mortality. Under each of these headings the forest is further divided into categories by species, size class, and commercial vs. noncommercial land. Comments on the effects of fire, permafrost, and drainage on forest growth and location are included.

A word of caution: while the Forest Service inventories contain valuable information when applied to the entire inventory unit or block, they cannot provide site specific information for smaller units within those areas that have not been separated. A village corporation having land ownership of only a portion of an inventory block cannot simply divide the inventory figures to obtain its percentage of the timber base. In that case, however, the publications would still give the manager a good idea of approximate volumes per acre to be expected in similar forest stands. The publication should also be valuable in determining whether the village lands are likely to contain a timber resource valuable enough to consider inventorying on a smaller scale.

Bureau of Indian Affairs Inventories

On the opposite end of the spectrum from the large scale USFS inventories are Bureau of Indian Affairs (BIA) inventories of individual native allotment parcels. Hundreds of timbered allotments throughout Alaska were inventoried by BIA forestry crews, primarily between 1985 and 1988. (In the Doyon region, the BIA contracted with the Tanana Chiefs Conference to do the allotment inventories.) The inventories are, for the most part, now complete. Though not in published form, results can be obtained from BIA offices in Juneau, Anchorage and Fairbanks. Addresses are in Appendix IV. Data was collected on tree abundance, quality, species, height, diameter, and defect. Site characteristics—such as depth to permafrost, understory vegetation, regeneration and other physical characteristics of the stand were also recorded in some of the inventories. Data was compiled by allotment and then summarized by larger management unit groupings.

Individual forest type maps are also being prepared for each of the allotment parcels. Many of these maps have been digitized and entered into a computerized database called ALOT. ALOT will eventually contain data for every native allotment in the state and will provide forestry, realty, and other pertinent information necessary for the management of these lands. In addition to the allotment inventory projects, the BIA has also completed several village corporation inventory projects.

Tanana Chiefs Conference Inventories

In some regions such as Doyon, the corporation itself is conducting forest inventories. Tanana Chiefs Conference Inc. (TCC), the non-profit association in the Doyon region, employs three full-time foresters who are involved in inventorying forested village corporation land within Doyon's boundaries. These projects are funded through the Bureau of Indian Affairs

to provide technical forestry services in the region. By the end of 1988, fifteen forest inventories with corresponding vegetation type maps had been published by TCC on a village by village basis. A list of the TCC inventories is included in the bibliography of Chapter 2.

Level of Inventory

With all the information from large scale inventories that is currently available, it is doubtful that any corporation will have the need for another inventory at this level. The appropriate level of forest inventory for most Native corporations will be at the village level or smaller. Even for conglomerates such as The Kuskokwim Corporation (TKC) with its union of 10 villages, there is little need to do another extensive inventory to encompass all TKC lands. The Forest Service, the BIA, and Reid, Collins Incorporated have all done forest inventories along the Kuskokwim. An additional Kuskokwim River Basin Study is being planned for the early 1990s by the U.S. Soil Conservation Service.[11] The information gathered by these inventories should be more than sufficient for any area-wide needs TKC may have. Any future inventories in this area should concentrate on smaller portions of the forest to obtain more site specific information where it is needed.

Is an inventory needed? Much has to be considered to answer that question. Determine information needs and then do some research to see what information already exists. If all the information does not exist, perhaps a portion of it does. If so, effort can then be concentrated on the missing portion. Before initiating an inventory, however, it is important to focus on the reasons or the goals and objectives of the inventory.

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[11] Ward, Tom (U.S. Soil Conservation Service—Anchorage). Personal Communication, 6 June 1988.

CHAPTER 3

INVENTORY PLANNING

"Forest resources are vital to the economic and social welfare of many Indian Nation and Native Alaskan Corporation. The management of these valuable and renewable resources not only provides income and employment opportunities for our people, but also affects our lives in many other ways. The harmony of man, trees, and other vegetation, soil, water and wildlife, which collectively comprise the forest community, influence our very emotional and spiritual well being..."

—Intertribal Timber Council

The Twelfth Annual National Indian Timber Symposium was held in Fairbanks, Alaska in June, 1988. This symposium was sponsored by the Intertribal Timber Council, an association of 54 member tribes and organizations, including eight from Alaska. Representatives from all over the United States and Canada attended. The symposium's theme was "Indian forests: the land, the people, the future." Over and over again the speakers stressed the need for a "vision for the future" with regards to Indian forestry. Tribes and native corporations were urged to look ahead (plan) in order to determine the direction they wished to proceed. Forest inventory workshops held at this conference emphasized the same point. In order to successfully complete an inventory, a plan describing what the inventory is to accomplish and how it will be implemented must first be developed. Only by knowing what you are aiming at will you be able to hit the target.

Gathering Information

A forest inventory is an information-gathering process. Deciding what information is needed is one of the first steps of forest inventory planning. The collected information should enable the land manager to make sound decisions about the forest resource. If too little information is gathered, faulty decisions about the resource may result. On the other hand, gathering too much data or gathering the wrong type of data can be a waste of time and funds. The kind of information needed depends on the goal of the inventory. With regard to forest inventories, goals give the purpose for conducting the inventory in the first place. They also shape the inventory design. Information from a simple reconnaissance inventory, for example, should tell the manager what tree species are present, their location, and their density. An intensive timber cruise, on the other hand, should be designed to provide enough information to determine the economic feasibility of a timber harvest and possible extraction methods. The goals of these two types of inventories are different. In the first situation, the goals are simply to take stock of the resource, in the latter case development of the resource may take place if economic conditions are favorable. The land manager must determine ahead of time what type of information will be most useful when the inventory is completed and in the foreseeable future. The Intertribal Timber Council formulated overall recommendations for forest inventories on Native lands. Later they discovered their recommendations were unrealistic because of the great diversity among Indian reservations and Native corporations. Every reservation and every corporation is different both in terms of culture and available natural resources. Therefore, standardization doesn't work. Instead, it is important to recognize these differences and determine local needs and wants before planning a forest inventory.

Planning Considerations

Many things have to be considered in preparing for a forest inventory. Any planning effort must consider all aspects of the inventory from beginning to end before proceeding with the actual field work. Questions that need to be addressed include the following:

Why is this inventory needed?
Where will the inventory take place?
What needs to be inventoried and what information is to be collected?
Who is going to do the inventory?
When will the inventory take place?
How is the inventory going to be done and how will the data be processed?
How much is the inventory going to cost?

These questions must be considered carefully and answered fully before forging ahead. Since these questions are basic to a successful inventory, these ideas are expanded in the following pages.

Why is This Inventory Needed?

Why are we interested in inventorying a certain piece of land? It is often helpful to ask a series of why's in order to find out what the underlying reasons or goals really are. The questioning might go as follows:

Why do we want to inventory our land?
To find out what's out there.
Why?
To see how much our trees are worth.
Why?
To see if harvesting timber is worth while.
Why?
To raise some money for the shareholders.
Why?...

The questioning could continue even further. The main purpose is to clearly boil down the intent of the inventory and identify, as precisely as possible, inventory goals.

Where will the Inventory Take Place?

The location of a corporation's boundaries and where within those boundaries the resources of interest are, are important planning considerations. Before an inventory can proceed, the location of the area to be inventoried must be specified. Legal boundaries need to be identified and located on maps and aerial photographs, and on the ground. Once mapping has been completed, a manager can determine if all land holdings need to be inventoried or if certain areas should receive priority. Aerial photographs are invaluable tools in this respect. Priority ratings can be based on many different criteria. For example, the areas to be inventoried could be based on any of the following:

1. Resource location (inventory only forested areas);
2. Proximity to a village of interest (inventory only lands that are within 5 miles of a village); or
3. Accessibility (inventory only areas that are within a one mile wide strip on either side of a major river).

What Needs to be Inventoried and What Information is to be Collected?

The decision of exactly what is going to be inventoried must be considered in the planning process and is dependent on the project goals. Inventories range from single-resource to multi-resource considerations. What are the specific data needs? The natural resources that will be inventoried have to be identified. The inventory could range from strictly a timber inventory to a multi-resource inventory measuring additional resources such as soils, wildlife habitat, water, reindeer forage, or berry patches. A multi-resource inventory will take more planning than a single resource inventory and will involve

more people trained in different disciplines.

Even in single resource inventories, the information of interest must be clearly defined. In a timber inventory for instance, all tree measurements must be specified. Tree height and tree diameter measurements are standard, but there may be many other variables of interest. If, for example, information is needed on tree age or growth, core samples of the trees will have to be taken. Insect and disease problems or other defects in tree quality will probably need to be examined. Some inventories may require additional information on aspects such as bark thickness. Again, the measurements to be gathered are dependent on inventory goals. For example, if the end product is to be pulpwood data there is little need to collect information on the number of eight or sixteen-foot logs per tree or exact diameter measurements. However, if the end product is to be information about lumber or veneer resources, diameters, log heights, log grades, and defect measurements are essential.

Data analysis considerations may also effect the type of information that is collected. If the field information is going to be stored and analyzed on a "canned" computer program, the manager must be sure that all the required inputs are collected in the form that the computer uses. Some computer programs run tree height as total height while others are based on tree height measurements to a six-inch top diameter. Incorrectly gathered information maybe worthless for certain computer programs. The decision of what information is needed in the final reports must be addressed during the planning phase.

Who is Going to do the Inventory?

The question of who will conduct the inventory is very important. Is the work going to be done by staff, by seasonal employees, or by contract? Training needs or legal contract documents may need to be addressed. Inventory crews, if

hired, must be outfitted with all the equipment necessary to complete the inventory. Crews should be familiar with Alaskan forests and must have the skill and stamina to competently perform the task.

It may make more sense to contract a forest inventory than to try to do it from scratch. There are several private forestry firms, including at least one Native corporation (Tanana Chiefs Conference), in Alaska that will conduct forest inventories on a contract basis. A list of forestry consultants with their addresses and phone numbers is included in Appendix III. Additional information can also be obtained from sources listed in the technical assistance directory in Appendix IV. Even if contracting the inventory is the chosen method to accomplish the task, the land manager should still be familiar with what is involved in a forest inventory. The manager, with input from the corporation, should set the goals and be involved in planning the inventory. He must also plan for quality control checks of any contract work.

When will the Inventory Take Place?

The year and season that the inventory is going to take place must be determined. The harsh conditions of Alaska's interior generally restrict the inventory field season to the summer months. In southeast Alaska, the field season extends into the spring and fall, but is still restricted. Although, the field season is short, it is important to allow plenty of time to cover any unforeseen events that may arise. Plenty of lead time is also needed before the field season begins. Acquisition of good aerial photographs of the area, for example, can take several years if the photograph is not currently available. Even existing photographs may take months to arrive after they are ordered.

A time frame for completing the inventory should be set. This is often dictated by budget constraints. It is also

important to realize that forest inventories are not necessarily one-time projects. Good inventory projects provide for future concerns and need to be updated at least occasionally. Many agencies plan updates on regularly scheduled intervals to keep data current and to account for unexpected changes in forest conditions. Reinventory schedules should coincide with resource dynamics. Old-growth stands could be reinventoried every 15 to 20 years, depending on stand conditions and any natural catastrophic impacts that may occur such as fire, insect outbreaks, or large windstorms. Young-growth stands, because of their greater growth potential, should be reinventoried every 5 to 10 years.

How is the Inventory going to be Done and How will the Data be Processed?

The question of how the inventory will actually be conducted requires much forethought. For instance, how are the trees going to be measured? How is the data going to be recorded? Logistically, how will the field crew reach all the areas that need to be inventoried?

The inventory sampling design also has to be taken into account. How is statistical accuracy going to be checked? Which sampling design is going to be used? How is the collected data going to be analyzed? The advantages and disadvantages of the numerous sampling designs need to be understood and considered. This aspect is covered in more depth in Chapter 4.

Finally, the question of how the inventory data is going to be processed must be decided during the planning phase. This decision cannot be put off until after the inventory is complete. More on this subject appears in Chapter 5.

How Much is the Inventory going to Cost?

The land manager must determine how much time and

money is going to be budgeted for the inventory. It is easy, especially in interior Alaska, to spend more money on the inventory than the resource is worth. The value of an inventory must be judged by the value of the information that the inventory provides. How much is the inventory data worth to the corporation once it has all been collected?

Costs for a forest inventory vary. Tanana Chiefs Conference's inventories of village corporation land in interior Alaska ranged from 17 to 65 cents per acre in the 1980s.[12] The price range was primarily due to transportation costs. Village lands near the road systems are considerably less expensive to inventory than village lands far from roads. The amount of land that each village has also varies and is reflected in the cost figures. The total cost for each of the TCC village inventories ranged from $25,000 to $45,000.

Unique Alaskan Constraints

A special topic to consider in planning for an inventory project in Alaska concerns unique problems associated with rural Alaska. These problems affect working conditions in the field and often place constraints on planned activities. A slowdown in productivity often results. Hardships field crews may encounter are important to recognize in order to plan a response. Even so, the best plans may still run afoul. Some constraints inventory crews in Alaska face include the following:

Transportation Logistics—Because rural Alaska has few roads, aircraft and boats provide the most common transportation. Airplanes have limited space for inventory equipment; therefore, logistics can become a major problem. Size and weight of all gear must be considered. BIA forest inventory crews used inflatable boats to get to allotments along major river systems.

[12] Maisch, Chris (Director, TCC Forestry Program-Fairbanks) Note to principal author, 26 October 1988.

It was often a tight squeeze getting boat, motors, and crew into bush aircraft to be flown out to a river. Costs increased dramatically if two flights or larger aircraft had to be used. Scheduling aircraft can also present problems. Charters have to be booked in advance. Even then they may not always be able to get through due to weather or some unforeseen circumstance. Flexibility and plenty of lead time must be included in inventory plans.

- **Adverse Weather**—Working conditions and access to inventory units are both affected by weather conditions. Alaska field seasons are severely restricted by the long, harsh winters. The entire snow-free field season may be as short as 70 days in some regions. Summer is often the rainy season. Interior Alaska is not affected as much by rain as southeast Alaska, but rain is still a factor. Rain gear and waterproof inventory cards always need to be taken to the field regardless of the weather conditions when the inventory begins. Weather also affects take off and pick up times in rural Alaska. Extra food and clothing should always be packed to prepare for foul weather. Adequate survival gear is also a necessity to protect the crew from aircraft of boating accidents.

  Muskeg—Even in good weather, wet tundra and muskeg require rubber boots. Permafrost does not allow good drainage. Rubber boots are necessary inventory equipment all summer long since unforeseen wet areas crop up constantly. Crew members should also be careful crossing muskeg because deep holes covered with water and vegetation are not always apparent.

- **Dangerous Wildlife**—Inventory crews must always be alert for bears and other potentially dangerous wildlife. For safety, crews should carry firearms and remain alert while in the field. Safety precautions include knowing proper bear country conduct. Moose are a formidable adversary when disturbed, especially during rutting season and when cows are with

young calves. Most dangerous encounters can be avoided, but crews must be aware of their surroundings. The wildlife that probably causes the most discomfort, however, are not the large mammals. Rather, it is the small but abundant insects that are often the greatest nuisance. Mosquitoes, white sox, and no-see-ums can become a terrible nuisance. Anyone not preparing for insects with plenty of mosquito repellent is in for misery. Bees and hornets are a dangerous threat to anyone allergic to their stings.

Vegetation Barriers—Thick vegetation creates access problems in Alaskan forests. A serious nuisance, especially in coastal forests, is devil's club, a tall, spindly plant covered with sharp spines that easily become embedded into the hands, arms and legs of inventory crews. Interior forests not covered with devil's club often contain thick patches of prickly rose. Either of these plants can create formidable barriers that reduce field crew productivity. Willow and alder thickets also create obstacles that are hard to pass through. Good inventory systems have failed in the past because managers didn't recognize obstacles created by terrain and vegetation. Costs determined in relatively easy going terrain with open vegetation types were greatly multiplied when ground crews had to work in rough terrain with thick vegetation.

Availability of Supplies and Fuel—Inventory crews need to be self-sufficient. Villages may not have many extra supplies. At certain times of the year, necessities, such as fuel, may be lacking. A fuel barge supplies the villages along the Kuskokwim River, for instance, and between break-up and the barges' first arrival in the spring, fuel is often scarce. Inventory crews should make arrangements for fuel and other supplies before traveling to an area. Extra field equipment is also a must. Replacements will be needed for lost or broken tools.

Advantages of Planning

Successful inventories are the result of careful planning and efficient management. There are many advantages of the planning process. A primary advantage is gained in the time and money saved. Knowing the exact budget and carefully planning each step is better than running out of money in the middle of the inventory and having to abort the entire project. Carefully considered inventory goals ensures that the correct information is collected.

Another advantage of planning is the additional insight gained in working through the plan. Many things not readily apparent at the initial planning stages become apparent as the plan progresses. Each step makes the final picture a little clearer. A sample outline for planning a forest inventory is given in Appendix V.

CHAPTER 4

HOW FOREST INVENTORIES ARE CONDUCTED

"Although the means of transportation have changed, the challenges of inventorying timber in the remote parts of the state are like those faced by Lower 48 foresters 75 years ago. Bush flights delayed by weather, makeshift outboard-motor repairs 20 miles downstream from the nearest village, and bears raiding the camp food cache all play havoc with the best laid schedules."

—Jim Stevens, former BIA Lead Inventory Forester in Alaska

This chapter describes activities that take place during a forest inventory. It explains forest inventory procedures to aid the corporate land manager in planning for an inventory. The chapter is not designed to be a how-to-do-it manual. Detailed information on the procedures discussed can be obtained from references cited in the bibliography.

Maps and Aerial Photographs

An inventory often begins with detailed mapping of the selected area. Both quadrangle maps and aerial photographs are used. These maps and aerial photographs are necessary for defining boundaries and for pinpointing exact locations when in the field. They show where corporation and forest boundaries are, where the natural resources are, and where inventory plots can be placed. Maps are useful for obtaining elevation readings, plotting legal descriptions, and determining orienta-

tion. Aerial photos are used for detecting vegetation patterns, terrain features, and for delineating different forest and non-forest types. They generally are taken so that the photos overlay each other. When two are viewed side-by-side with stereo glasses, the scene appears three-dimensional. Aerial photographs taken at different years or in different seasons also document changes over time.

Using Aerial Photographs in Forest Inventories

The use of aerial photography greatly simplifies forest inventory procedures because the manager knows at a glance which areas are forested and which are not. A village corporation may have 100,000 acres, but perhaps only one-tenth of that is forested. This can be learned by inspecting aerial photographs of an area. Information on stand density and the locations of different tree species can be obtained directly from appropriate scale aerial photographs, thus saving a manager time and money.

Aerial photographs are photographic images of the earth's surface taken from satellites, NASA high-altitude aircraft, small planes, and helicopters. The photographs come in many different sizes, scales, and colors. Satellite digital images are generally too small in scale to be useful for most forest inventory work. Larger scale photographs, which pick up more detail, are needed. The advantages of large scale photographs, however, have to be balanced against the cost of obtaining and handling extra photos. The larger the scale, the more photos required to cover an area. As the scale is doubled, the number of photos needed to cover an area is quadrupled. The scale selected needs to be large enough that the land manager can pick out detail on the photos sufficient to meet the needs of the project.

NASA high-altitude aerial photographs are the smallest scale photograph that has been used for Alaskan forest inven-

tories. These aerial photos are taken from 65,000 feet above the earth. Two cameras mounted on the aircraft simultaneously photograph the terrain. One camera takes black and white photographs while the other camera takes color-infrared photographs. The black and white photographs are taken at a scale of approximately 1:126,720 (1/2 inch to a mile). Each photographic frame covers about 250 square miles. The color-infrared photographs are taken at a scale of 1:63,360 (one-inch to a mile), covering 64 square miles of terrain. For photo interpretation and mapping purposes, only about 50 percent of the total frame will give an accurate rendition of the terrain.

Color-infrared photographs are false-color images that record the infrared reflectivity of objects on the ground. Different species of trees reflect different amounts of infrared radiation and can be identified on the photographs by their different shades of color. Broadleaf trees appear bright red because of their higher infrared reflectivity. Slow-growing conifers generally appear black because of lower reflectivity, while fast-growing conifers appear red on the photographs.

A primary advantage of these high-altitude photographs lies in their uniformity and extensive coverage. About 90 percent of Alaska has been photographed by the high-altitude aircraft, most since 1980.[13] The photographs are also relatively inexpensive and are readily available. The U.S. Geological Survey (USGS) offices in Alaska maintain a complete library of Alaskan high-altitude photography. These aerial photographs may be viewed in some of the local USGS offices. Prints can be ordered from USGS supply depositories. Addresses and phone numbers of the USGS offices in Alaska are listed in Appendix VI. These offices also stock Alaskan quadrangle maps which cover the entire state. Maps are available at a scale of 1:63,360

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[13] Brooks, Paul D. 1988. The Alaska High-Altitude Aerial Photography (AHAP) Program. U.S. Geological Survey, Anchorage.

(one inch to the mile) or 1:250,000 (one inch equals approximately four miles).

Larger scale photography than provided by the high-altitude flights is also available for many portions of the state. Public agencies and private companies have flown missions to obtain good large-scale photography coverage of specific areas of the state. These photographs are not always catalogued in a central location, but some private Alaskan consultants have lists of much of the coverage. Check with these consultants listed in Appendix III to see what photos are available. Photographs with scales between 1:15,000 and 1:30,000 generally provide the best coverage. Forest detail at these scales are sufficient for most inventory work while at the same time they are small enough to be relatively low-cost. When ordering, specify the most current photography available especially if the photography details major rivers or areas of recent development or change.

The final option for obtaining photographs is to have a specific area photographed. This is by far the most expensive option but the manager can then precisely specify the area to be photographed, film type, altitude, season and date. Months, and maybe years of lead time may be needed to get good cloud-free photographic coverage.

Using Aerial Photographs for Timber Typing

After the area to be inventoried has been marked on the aerial photographs, the forested portion shown on the photos is usually divided into subgroups. These subgroups are generally based on tree species, size class, and stand density. These categories can be distinguished on aerial photographs by a person trained in aerial photo interpretation. Different tree stands are then delineated directly on the aerial photo or on a clear overlay. Delineation of tree stands or groupings on aerial photographs is called timber typing.

BUREAU OF INDIAN AFFAIRS EXAMPLE

For BIA timber inventories in interior Alaska, tree stands are grouped by species, stand density and size class. Codes which best describe the tree stands are used to identify them. A WS3S designation, for instance, signifies a dense white spruce stand that is sawtimber size. The WS identifies the species. The number 3 in the code represents the stands' density. Three represents the most dense class (60-100% crown closure in this case) on a scale of one to three. The S in the abbreviated code stands for sawtimber. Sawtimber in interior Alaska was defined further by the BIA to mean trees with diameters larger than 10 inches when measured at a point 4.5 feet above the ground. A BIWS1P designation, on the other hand, would signify a mixed birch and white spruce stand of low density (the number 1 in the code) where most of the trees are pole size or less than 10 inches in diameter. The order of listing the tree species also has significance. The first tree species listed represents the predominant species. Any secondary or tertiary species listed must comprise at least 30% of the stand. Species making up less than 30% of the stand are ignored in the timber type designation.

The BIA method is an example of one way to group tree stands. Many different grouping methods exist. The method of timber typing selected is not as important as making sure that all terms are defined exactly and consistently.

There are several reasons for separating timber types. As shown in Appendix II different species of trees are utilized for different purposes. Knowing that a corporation has 10,000 acres of forest land is not nearly as useful as knowing how many acres of each species type are contained within the forest. If house logs are needed, it is important to know where stands of straight, house log size white spruce trees are located. If firewood cutting sites are desired, it would be important to

differentiate between birch and aspen stands because birch is nearly one and a half times as effective a heat producer as aspen (26.3 million BTU's per cord vs. aspen's 18.1 million BTU's per cord).[14] On the other hand, if the birch and aspen trees are to be used only for pulp then a timber type combining the hardwoods together may be sufficient. Perhaps a future timber buyer in southeast Alaska is only interested in buying Alaskan cedar. A corporation interested in selling that timber would need to know the locations and approximate quantity of that tree species within the corporation's landholdings.

Secondary characteristics of the land can also sometimes be tied to timber type designations. Black spruce stands in Alaska often grow where soil is wet and underlain with shallow permafrost. Aspen, on the other hand, usually grows on the higher, drier sites of the interior forests where shallow permafrost is unlikely. Therefore, timber type maps can be of aid to land managers with other land use decisions as well.

Another important reason for dividing forest stands into timber types or stratifying them is for statistical purposes once the inventory has begun.

Statistical Considerations of a Forest Inventory.

Rarely are all trees measured during a forest inventory. Instead, a sample of the forest stand is measured. The data collected in this sample is used to make an estimate or an inference about the total population. The sample measurements represent the entire population which, because of its size, usually cannot be economically measured in its entirety.

Sampling is usually performed to estimate certain expressions of forest characteristics such as the mean (volume per acre), total (volume per tract), or the variance (the variability of

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[14] Forest Products Laboratory. 1974. Wood Handbook: Wood as an Engineering Material. USDA Forest Service Agriculture Hand book No. 72 (rev.). U.S. Forest Service, Madison, WI.

a specific characteristic). These numerical descriptions of the whole population are called population parameters. Similar numerical descriptions of a sample from the population are referred to as sample statistics. Sample statistics are used to infer population parameters.

Estimates obtained from samples cannot precisely describe the characteristics of the entire forest. Forests are seldom uniform, therefore, forest inventories based on samples will always have what statisticians call sampling error. The sampling error is the probable difference between the estimate obtained from the sample and the unknown true value of the population as a whole. For this reason, statistical estimates are given a corresponding measure of goodness which indicates the acceptable reliability of the estimate. This measurement is called the bound on the error of estimation. This bound describes, at a specified degree of confidence, the range of values within which the true population should lie. For example, a timber cruise may determine that a particular forest stand contains 8,000 board feet of timber per acre plus or minus 500 board feet. This means that subject to the probability level (discussed later), the true value per acre lies between 7,500 and 8,500 board feet. The plus or minus 500 board feet in this case is the bound on the error of estimation (error bounds). The interval (7,500 to 8,500 board feet per acre) is called the confidence interval.

The desired bound on the error of estimation should be set in advance of the inventory. The narrower the bound, the more precise the estimate. However, as the desired bound is decreased, the number of samples necessary to achieve it must increase. For instance, the number of samples recommended to obtain a bound of plus or minus 500 board feet for a certain tree stand is more than the number of samples recommended to meet a bound set at plus or minus 1,000 board feet in that same stand.

Not only must inventory planners specify a desired bound on the sampling error, but they must also specify how confident they want to be that the true population parameter falls within those error bounds. When a confidence level is associated with an error bound, the latter is referred to as the confidence limit or confidence interval. The degree of confidence is expressed as the probability, (ranging from 0 to 1 or 0% to 100%), that the true value falls within the specified bounds. Being 90% confident that the true value falls within a specified error bound is the same as saying the planner is willing to accept a 10% chance that the true value lies outside the error bound. A 90% confidence level is the same as a 10% probability level. An alternative interpretation of a 90% confidence limit or interval is that the value of the sample statistic of 90 out of 100 random samples from a specific population, will fall within the specified error bounds or interval.

The desired error bounds at a specified probability or confidence level are stated prior to sampling as a target and are used as a guideline in determining the sample size likely to achieve that target. However, once sampling has occurred, the actual bounds at a specified confidence level will be dictated by the data and, hopefully, will be close to the target.

Forest inventories usually are designed and the results are usually reported at the 68% or 90% confidence level (i.e., the .32 or .10 probability level). An inventory designed for a 90% probability level requires four times the numbers of samples as one designed at the 68% level.

In general, the larger the sample size, the better the estimate of the population. On a small scale it is easy to see that measuring nine trees in a grove of 10 is sure to give a better estimate of the total volume of those 10 trees than measuring only two of the trees. Since this is true, why not try to measure all the trees during a forest inventory? Because the work takes time and money. Usually it is not economically feasible to

measure all of the trees during an inventory. Basically, sampling is a trade off between wanting perfect information and a willingness to pay for that information. The best information for the least cost is the desired end. Sampling is a means to that end. Rather than measuring all the trees in a forest for an exorbitant price, a sample of those trees can be measured for a fraction of the cost and still give a good estimate of the entire population. How good that final estimate will be is dependent on the bound on the error of estimation and probability level that are set as well as the following:

1. Variability of the samples
2. Number of samples
3. Sampling design

Variability of the Sample

In any natural population, differences among individuals are evident. Variance is the measurement of how much each sample differs from the entire sample's mean. In other words, how much does each individual measurement vary from the group average? The higher the variance of a group, the more samples required to achieve a desired error bound within a specified confidence.

Stratifying stands reduces variability because the population is divided into separate strata where characteristics are more homogeneous. As an example, it is easy to imagine that height and diameter measurements taken in Alaskan black spruce stands will tend to be smaller than tree measurements taken in good white spruce stands. If samples from both types are combined, the variability will be very high since the black spruce will tend to have diameters less than five inches and heights of 25-30 feet while the white spruce might average 10 inches in diameter and 80 feet tall. However, if these two types can be identified and delineated prior to sampling, the variance

could be reduced significantly. Stratification also allows for separate compilation of data.

Number of Samples

Selecting the correct sample size for a forest inventory is an important but sometimes difficult decision. Sampling costs money. If the sample is too large, time and energy are wasted. If the sample is too small, inadequate information is obtained which also results in waste. The number of samples needed for a forest inventory is dependent on the precision desired in the final estimate and the variability found within the sampled population. Expected precision can be varied by setting the required bound on the error of estimation and the desired probability level. Both the bound on the error of estimation and the probability level must be set by someone who understands statistical principles and who is knowledgeable of the particular inventory's requirements. Also the number of sample plots generally increases as the value of the timber increases and the size of the inventory tract increases.

The population variance is never exactly known before the inventory takes place but it can be estimated from data collected in a previous forest inventory. If no inventories have taken place in the area, data collected in similar forest stands may be used to estimate the population variance. Otherwise, sample plots may need to be put in during a forest reconnaissance of the project area to get some idea of the population variance.

Sampling Design

There are several methods by which individual trees are selected for measurement. Forests are normally sampled from within spatially distributed plots or from spatially distributed points. Plots are of a specified size, such as 1/5 of an acre, and individual trees within the plot are measured. Sampling from

points employs special instruments such as prisms, angle gauges, or relaskops which are used to determine which trees about the sample point are tallied and measured. The number of trees actually measured from a point depends upon the characteristic of the instrument, the diameter of the trees, and their distances from the point. This type of point sampling in forestry is also referred to as variable-plot cruising.

In contrast to the sampling method, sample design determines where and how the plots or points are placed. The choice of which sampling design to use is governed by many factors.

These factors include the size and accessibility of the area to be sampled, time, budget allowed for the inventory, precision desired, and the value of the timber.

There are many sampling designs to choose from. These include simple random sampling, stratified random sampling, systematic sampling, cluster sampling, two-stage cluster sampling, multistage sampling, double sampling, 3-P sampling and ratio and regression estimation. A land manager who is constantly involved in forest inventory procedures needs advanced classes in statistics and sampling. It is important to understand statistical concepts to a degree far greater than this handbook can cover in order to properly execute a timber inventory. References provided in the bibliography provide a more in-depth discussion of sampling techniques.

Field Measurements

Once the sampling design and methods have been determined, consideration must be given to on-the-ground measurements of individual trees and a basic site analysis. The purpose of these measurements might be to determine the amount of standing wood available in a particular area, current and past growth rates or lost productivity. For simplicity these measurements can be grouped into five primary categories.

These categories include measurements of:

1. Tree height
2. Tree diameter and taper
3. Tree defect
4. Tree age and growth
5. Site conditions

Methods used to obtain these measurements and instruments involved in taking the measurements will be discussed in this section.

Tree Height

Information on the height of standing trees must be collected during a forest inventory. All trees cannot be cut to obtain height measurements nor can they all be climbed. Instead, tree heights are obtained using trigonometry. A tree is normally viewed from a set distance from its base; this distance is usually measured with either a standard measuring tape or a logger's tape. From the specified distance, the angle formed by sighting from a horizontal at eye level to the top of the tree and to the base of the tree are measured (Figure 6). Any one of several different instruments may be used to take these angle measurements. Clinometers or relaskops are most commonly used. The older abney level provides the same information. Once the angle and the distance from the tree are known, the total height of the tree can be determined. The clinometer and relaskop give direct readings of tree heights when used at prescribed distances from the tree.

For some inventories, measurements of total height are not desired. If a tree is to be cut for lumber, any portion of the tree that is less than six inches in diameter is usually of little value. Therefore, some forest inventories only measure trees up to a six-inch top diameter. The relaskop is equipped with an internal scale which guides the cruiser in determining where

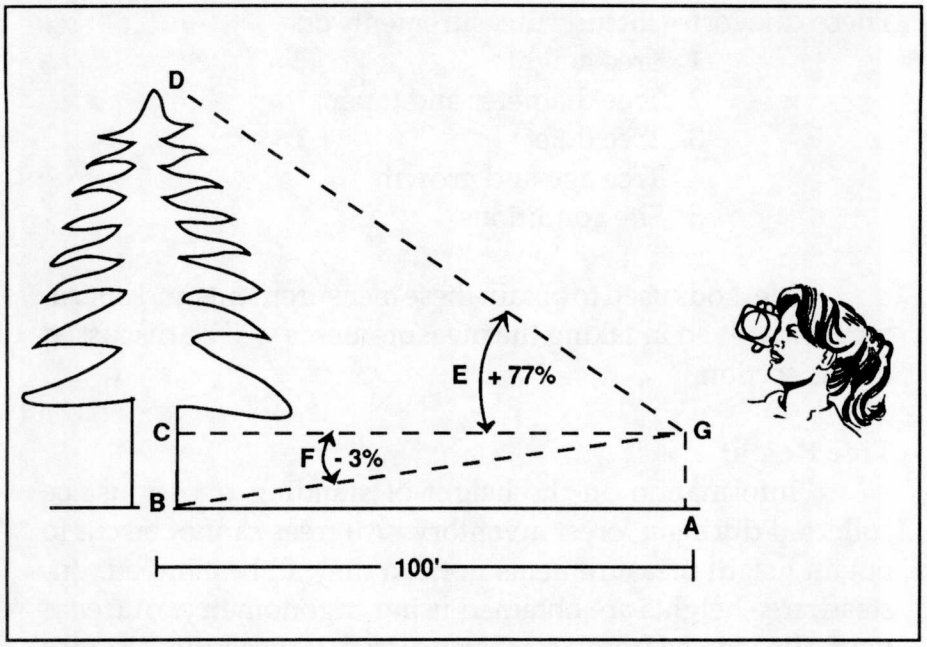

Figure 6 —Measuring Tree Height with a Clinometer

To determine tree height:

a. Measure the horizontal distance A-B in feet.

b. Stand at point A and read the slope percent to base of tree (G-B) which is angle F.

c. Also from point A read the slope percent to tree top (G-D) which is angle E.

d. Combine angles E and F by adding both percents, if one percent is plus (+) and one percent is minus(-). If both percents are plus, subtract angle F percent from angle E percent. If A-B is 100 feet as in figure 6, the total tree height is the combined percent of angles E and F expressed in feet. Thus the total height of the tree is 80 feet.

the six-inch top (or other desired diameter) on the standing tree is. The height of the tree up to that point can then be found using the same procedures required for determining total tree height.

Tree Diameter and Taper

In order to determine board foot or cubic foot volume, the diameter of a tree as well as its height needs to be measured. Conventionally, the diameter of a tree is measured at point 4.5 feet above ground. This point is referred to as the diameter at breast height or dbh. For instance, a white spruce in interior Alaska may be described as 10 inches dbh and 70 feet tall. The most common method of measuring tree diameter is with a steel diameter tape (D-tape). Other methods of measuring tree diameters include various calipers or a straight stick called a Biltmore stick. These latter instruments are sometimes faster to use than the diameter tape but are bulkier to carry in the field. Additionally, since trees are not usually perfectly round, caliper or Biltmore stick readings of the same tree from different sides of the tree may result in different readings.

Tree heights and diameters are measured to give an idea of the size and hence, volume of the log or logs that make up the tree. Other factors may be taken into account as well. Trees of similar dbh and height may have different volumes due to different degrees of taper. The amount of taper can be taken into account when calculating stem volume. Bark volume, which cannot be used for lumber, is deducted from the gross measured volume. The important thing to remember is that the field measurements used to estimate individual tree volumes must be compatible with the specifications of the volume tables that will be used.

Tree Defects

Not all of the wood in a tree is usable. Disease, insects or frost and snow can cause problems which result in a portion

of the tree missing or being rotten and unusable.

Deductions for all of these problems have to be made while in the field. The cruiser visually inspects the tree for indicators which give evidence of volume loss. Indicators include broken or missing tops of trees, frost cracks, evidence of insect damage, and conks. Conks are fungal fruiting bodies which grow on the sides of trees. They indicate that the tree contains rot. Standard deductions are made for all these defects based on their severity, location on the tree, and the nature of the attacking agent. A cruiser must be familiar with the various kinds of tree defects in an area and know how to deduct for them.

Trees can also contain hidden defects that have no indicators and are not apparent until the logs are processed at the mill. Standard deductions, based on average percentages of hidden defects are used to estimate the volume loss due to this problem.

Tree Age and Growth

Tree age and growth measurements give the land manager an idea of how fast a given forest area is accruing wood volume, and what rate of growth can be expected in the near future. Tree age can be determined with an increment borer, a small hand-held auger with a hollow tube that is screwed into the tree to extract a core which shows the annual growth rings. Current annual growth, which will give an indication of what the growth rate will be in the future, is usually obtained by counting the number of the annual rings on the extracted core in the last inch of tree growth. This number, along with the diameter of the tree inside the bark taken at 4.5 feet above the ground is used to calculate the rate of growth. The procedure for doing this calculation can be obtained from forestry texts or handbooks.

Site Conditions

In addition to tree measurements, the site where the trees are growing must be assessed. Each site has unique characteristics. Different combinations of overstory and understory vegetation exist and reveal much about the site. Tree growth is tied to site quality.

If the inventory is a multi-resource inventory, many other measurements and site descriptions will need to be recorded as well. A site may not be suited for good tree growth, but may provide excellent wildlife habitat. Facts such as this should be noted in the site description. A soil profile may need to be gathered as well in order to gain additional knowledge about site characteristics. This is why it is so important to properly plan the inventory before attempting to conduct it.

Forestry Equipment

When planning for field work, decisions will have to be made on the kind of equipment that will be used for each of the required measurements. It is best to select a standard set of instruments and require all crew members to use the same type of instruments. This will help ensure consistent measurements. It would not be a good idea, for example, for one crew to measure tree diameters with a D-tape while another crew uses a Biltmore stick.

No matter what instruments are used, be sure that they are in adjustment and properly calibrated before sending the crew to the field. Compasses must have the correct declination setting for the area of use. All crew members need to know the precision required for each of the measurements. Are diameter measurements to be recorded to the nearest inch or nearest tenth of an inch? Are tree height measurements to be recorded to the nearest foot or in five-foot increments?

Finally, be sure that all crew members are properly trained in the use of any equipment they take to the field. A relaskop shows many black and white lines in its viewfinder that can confuse someone not skilled in its use. Relaskops also come in different scales which have to be read at varying distances from the tree. Any mistakes that occur in reading the instruments will throw off the inventory results. It is often a good idea to have a check-cruiser whose job is to make sure that measurements are gathered correctly. Errors that occur during the collection of field measurements are greatly magnified as the data is processed and expanded into area-wide figures.

CHAPTER 5

AFTER THE FIELD WORK IS DONE

"The development of our village's forest resources has provided economic opportunity for all of our shareholders. Together, we are able to share the benefits of the land as we continue to prepare for the future."

Ramona Hamar, Board member
Kavilco Village Corporation

Compilation of Data

Once field measurements have been gathered, data must be compiled. The exact formulas to use in compiling the data are dependent on the sampling design that was chosen for the inventory. The formulas are used for estimating means, totals and standard errors of the data.

Tree volumes must be calculated. Volume equations mathematically compute tree volumes from simple ground measurements. The principal variables used in these equations are diameter at breast height (dbh), tree height and sometimes, tree form. Some volume equations are based on dbh alone. The choice of which equations to use is dependent on tree species, the area the trees are from, and how volume is expressed. Tree height may be described as total height or merchantable height (to a six-inch top, for example). Volume may be expressed in board feet, cubic feet, cords or even, total weight.

Plans for the calculation and compilation of forest inventory data should be made before starting the inventory.

The formulas selected for data processing influences the data collection method. For instance, if the volume equations that will be used to calculate total volume are based on dbh measurements alone, there is little reason to spend time in the field measuring tree heights. Along the same line, if volume tables list diameters by the full inch, there is no need to collect diameters with a tenth of inch precision. Knowing the data processing procedures ahead of time can save time in the field.

More serious problems can result if the wrong measurements are collected. If the volume table is calibrated to merchantable height measurements but the field crew collects total tree height, the entire inventory could prove worthless. It is best to plan data calculation and compilation at the same time the sampling design is planned.

Computers do much of the manipulation of inventory data. However, this does not invalidate the necessity of knowing beforehand how the data is calculated. If anything, computers make this knowledge even more necessary. Computer programs are based on the same mathematical formulas as longhand methods for determining parameters such as volume. If a computer will be used for the inventory data make sure that the measurements are taken in the field in the form required by the computer program.

When the Inventory is Complete

Suppose that the inventory is now complete and the data are compiled. Now what? Where does a land manager go from there? (There is value in contemplating such a scenario even before an inventory has taken place because the exercise helps define the goals of the inventory.) The results of a forest inventory provide a land manager with information in a usable form. With this information, the manager knows where the resources of value are. An analogy may help answer the questions above.

Warehouse Analogy

An analogy can be made comparing a warehouse foreman with a land manager. A good foreman keeps track of the products in the warehouse. He keeps an inventory of the products, knows where in the warehouse the individual products are and knows how much of each product is on hand. The foreman will constantly strive to improve his stock, learn more about all aspects of it and, of course try to protect his investment from fire or other damaging agent. Finally, a foreman who is really on top of things will also watch market trends relating to his products and know who his potential customers are.

In the same way, a land manager needs to keep track of and know the specific locations of the natural resources. An inventory gives that information. But an inventory is just the first step. Rather than being an end in itself, a forest inventory is just the beginning of good forest management.

Forest inventory results identify the timber resources presently available. Locations of the different forest types will be known, if tree stands were stratified. Acreage figures for each timber type will be computed. Volume per acre by type will also be known. With this information, the resource picture will be much clearer. These facts will be very helpful in guiding land management decisions. Once the supply of available resources is known, the land manager can focus on specifics.

Each land manger must determine the corporation's particular needs and wants consistent with the supply of local resources. A forest inventory describes that supply. There is no reason to dream of a thriving timber industry if the local resource is unsuitable for that purpose. On the other hand, there is no reason to dismiss forestry practices altogether just because a corporation has marginal forest resources. Can the resource be made more productive? Are there alternative uses for the resource? At a minimum, can the resource be main-

tained to provide villagers with their subsistence needs? Consider all options before dismissing any of them. The whole gamut of natural resources management is included. A forest inventory may uncover areas of good wildlife habitat, streams and fisheries needing protection, subsistence resources of use to nearby villages, or areas of high scenic value and possible recreation potential.

A forest inventory is not necessarily a one-time project. Just as a warehouseman must re-inventory periodically to update changes, a forest inventory should be updated periodically. Tree growth and mortality and other changes that occur in a forest should be accounted for. Changes to the forest caused by the building of new roads, houses, or airstrips or catastrophic events (fires, floods, etc.) that cause major changes should be catalogued. The more rapid the change, the more often an inventory update is required.

Some agencies like the Forest Service have permanent inventory plots so that they can record the natural changes that take place in a forest. These plots, called continuous forest inventory (CFI) plots are remeasured at regular intervals to record changes. CFI is very expensive and requires tremendous continuous commitment. It is doubtful that a village corporation needs to go to this extent to update inventory information, but CFI is one possibility.

Inventories on village lands may proceed in a number of ways. A village may want to conduct one inventory of all of its landholdings and later concentrate only on those areas shown in the first inventory as having good forestry potential. In this way, corporate funds are effectively used.

Up to date, automated mapping of village lands can also be very beneficial to land managers. Computerized systems, such as the geographic information systems (GIS), allows data collected during an inventory to be graphically displayed. Maps can be produced in various scales with multiple shading

patterns to highlight information of interest. For example, village lands can be highlighted to show forest types, subsistence areas, or any other designations of interest. Different layers can be displayed on the maps separately or simultaneously.

Maps are usually entered into the computer system through a process called digitizing. This process allows hand-tracing of existing maps with a device called a digitizer. Areas of interest or areas having certain qualities can be delineated and shaded. Two major advantages of GIS are the ability to display information in a map form and the ability to quickly update any changes. New inventory information or on-going management activities can be quickly added to the existing information and mapped.

Looking Toward the Future

Inventory results provide information upon which to base future management activities and plans. With the solid base provided by the data, the land manager can launch a forestry program that looks toward the future. Future activities can lead to forest management practices that protect the forest while providing income and forest products to the villages at the same time. Proper management can provide both. Forest management is not just a euphemism for timber harvesting. Good forest practices ensure that a forest returns where one was cut. This can be accomplished through natural regeneration or planting. As the trees grow, silvicultural practices such as thinning, pruning or fertilization can be employed to improve the stand. (References provided in this chapter's bibliography include books and articles which discuss most of these forest practices in relation to Alaska's latitude and climate.)

Finally, while looking toward the future, village and regional corporations could benefit by encouraging some of their stockholders to study the natural resource disciplines.

An example of the useful information that can be found in the reference materials can be seen in the work on forest resource development for interior Alaska by Hugh Marshall.[15] This document was prepared by Reid, Collins Incorporated, a forestry consulting firm from Anchorage. In the document, 16 interior Alaska village corporations that have what Reid, Collins Inc. considers a high potential for future forest resource development are identified. Reid, Collins Inc. based their findings on three primary criteria:

1). High biological potential in the region for producing wood;
2). Proximity to a population center which could provide labor, management, and back-up services;
3). Proximity to transportation routes and to markets.

The 16 villages that were mentioned in the report, along with the general region that the villages occur in, are listed in Table 6.

Table 6—Interior Villages Having A High Potential for Future Forestry Development

Upper Yukon River Basin	Tanana Valley	Mat Su Valley and Vicinity
Birch Creek	Dot Lake	Alexander Creek
Chalkyitsik	Healy Lake	Chickaloon
Circle	Manley Hot Springs	Knik
Fort Yukon	Nenana	Tyonek
Stevens Village	Tanacross	
Venetie	Tanana	

[15] Marshall, Hugh. 1981. Forest Resource Development For Interior Alaska. Reid, Collins Incorporated, Anchorage.

Each area would benefit if some of its own people were knowledgeable in resource inventory and management techniques. Advanced training is a necessary prerequisite to complete understanding of the many facets of natural resources management. Appendix VII lists the names and addresses of Alaskan schools that offer natural resources subjects. The University of Alaska Fairbanks offers a four-year Bachelor of Science degree in Natural Resources Management with emphasis programs in forestry, land planning, water resources, outdoor recreation and soil science. Sheldon Jackson College in Sitka offers a Bachelor of Science degree in Natural Resource Management and Development and certificates in forest technology or fish husbandry. The Alaska Vocational Technical Center (AVTEC) in Seward offers a 14-month forestry technician training program. Individual classes in forest measurements and inventory techniques are also offered by these institutions. All three schools are actively recruiting Native students.

Another Reid, Collins Inc. study examined the forest development potential for village lands along the middle Kuskokwim River.[16] The conclusion reached in that study was that it was not economically feasible to develop that resource at that time (1981). This was primarily due to the area's remoteness which would be reflected in high transportation costs. The report was optimistic for future prospects in this area, however.

Information such as this is invaluable to these village corporations. The 16 villages listed in the first Reid, Collins Inc. report, in particular, may want to proceed with a forest inventory (if they have not done so already) to confirm earlier indications and to begin to fully realize their potential for future forest resource development.

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[16] Hammons, John. 1981. Forest Development Potential in the Middle Kuskokwim. Reid, Collins Incorporated, Anchorage.

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APPENDIX I

ALASKA'S PRINCIPAL TREE SPECIES

Interior Forests

Common Name	*Scientific Name*
White spruce	Picea glauca
Black spruce	Picea mariana
Tamarack	Larix laricina
Paper birch	Betula papyrifera
Quaking aspen	Populus tremuloides
Balsam poplar	Populus balsamifera
Black cottonwood	Populus trichocarpa

Coastal Forests

Common Name	*Scientific Name*
Sitka spruce	Picea sitchensis
Western hemlock	Tsuga heterophylla
Mountain hemlock	Tsuga mertensiana
Alaska cedar	Chamaecyparis nootkatensis
Western red cedar	Thuja plicata
Lodgepole pine	Pinus contorta
Pacific silver fir	Abies amabilis
Subalpine fir	Abies lasiocarpa
Pacific yew	Taxus brevifolia
Black cottonwood	Populus trichocarpa
Red alder	Alnus rubra

There are also 33 species of willow in Alaska, but most do not reach tree size.

APPENDIX II

USES OF ALASKA'S PRINCIPAL TREE SPECIES

Tree Species	***Principal Uses***
White spruce	Lumber, pulp, log cabins, caches, smokehouses, tent frames, sluice boxes, plywood, bridge timbers, firewood, boats, tea (needles), paddles, drying racks, medicine, snare toggles, chewing gum (pitch), weaving for birch bark baskets (young roots), air freshner, spruce boughbeds for people or sled dogs, Christmas trees.
Black spruce	Firewood, drying racks, tea (needles), caches, pulp, Christmas trees, poles, chips, particleboard, pressed-wood logs.
Tamarack	Ornamental tree, poles, fence posts, fire wood, paneling, flooring, chips.
Birch	Paneling, veneer, cabinets, canoes, firewood, plywood, handles, boxes, crates, furniture, baskets, fire starter (bark), dog sleds, sheeting under sod, toboggans, paddles, caskets, snowshoe frames, birch syrup (sap), toothpicks, clothes pins, spools, bobbins, ornamental.
Quaking aspen	Boxes, crates, smoking meat, pulp, waferboard, particleboard, molding, furniture components.

Tree Species	*Principal Uses*
Balsam poplar	Smoking fish, poles for smokehouses, crates, boxes, speciality items, net floats (bark), carving, pulp.
Black cottonwood	Lumber, smoking fish, carving, pulp, paneling, waferboard, particleboard, shade tree.
Sitka spruce	Lumber, airplane and glider construction, airplane props, ladders, scaffolding, oars, boats, packing boxes for the salmon industry, high grade wood pulp.
Western hemlock	Lumber, flooring and ceiling, marine pilings, railroad ties, mine timbers, plywood, cabinets, boxes, crates, good pulp, coarse bread can be made from the inner bark.
Mountain hemlock	Lumber, flooring and ceiling, marine pilings, railroad ties, mine timbers, plywood, cabinets, boxes, crates, good pulp.
Alaska cedar	Aromatic wood, window frames, exterior doors, boat construction, furniture, cabinet work, novelties, canoe paddles.
Western red cedar	Shingles, totem poles, houses, utility pole, chests, boats, dug-out canoes, fence posts, pilings, fish trap floats, bark: mats, baskets, ropes.

Tree Species	*Principal Uses*
Lodgepole pine	Posts, poles, fuel, pulp, construction, fiberboard, waferboard, paneling.
Pacific silver fir	Christmas trees, lumber, paneling, furniture components, chips, pulp, interior finish, ornamental.
Subalpine fir	Christmas trees, ornamental, paneling, furniture components, pulp, chips, interior finish.
Pacific yew	Cabinet work, ornamental, poles, bows, canoe paddles, speciality items, bird feed ("berries").
Alder	Smoking meat & fish, wood carving, chips, dye (roots), laxative (inner bark).
Willow	Rims for birch bark baskets, fish traps, aspirin (leaves & inner bark), artistic pieces of diamond willow (canes, lamp stands, furniture, etc.)

Sources:

Gasbarro, Anthony, John Zasada, Jack Utton, and Dean Argyle. 1979. Opportunities for the Subsistence Use of Forest Resources in Interior Alaska. In: *Proceedings of The Subsistence Lifestyle in Alaska Now and in the Future.* Fairbanks: School of Agriculture and Land Resources Management, University of Alaska.

Packee, Edmond C. 1984. Forest Management For Interior Alaska: Can Products Justify Costs? *Agroborealis* 16(2):53-58.

Viereck, Leslie A., and Elbert L. Little. 1972. *Alaska Trees and Shrubs*. USDA Forest Service Agriculture Handbook No. 410, Washington D.C.: U.S. Forest Service.

APPENDIX III

FORESTRY CONSULTANTS IN ALASKA

Anchorage and vicinity

Forests North, Ltd,
3842 Wesleyan Drive
Anchorage, AK 99504
Ph: 333-9462

Kerr & Associates
P.O. Box 111293
Anchorage, AK 99511
Ph: 346-3141

Koncor Forest
Management Co.
3501 Denali
Anchorage, AK 99511
Ph: 562-3335

Sanders Forestry Consultant
Hope Highway
Hope, AK 99605
Ph: 782-3591

Taiga Resource Consultants
P.O. Box 750
Girdwood, AK 99587
Ph: 783-2416

Tindall Enterprises
6821 Sherwood Avenue
Anchorage, AK 99504
Ph: 333-1914

Fairbanks

Superior Hardwoods
Jack Utton
600 Old Steese Hwy. North
Fairbanks, AK 99712
Ph: 457-7378

Tanana Chiefs Conference
320 2nd Avenue, Annex Bldg.
Fairbanks, AK 99701
Ph: 452-8251

Juneau

Stephen C. Jacoby
& Associates
Suite B 102
9309 Glacier Highway.
Juneau, AK 99801
Ph: 289-4822

Ketchikan

Alaska Timberland
Management
P.O. Box 5761
Ketchikan, AK 99901
Ph: 225-2320

Sealaska Timber Corporation
400 Mission Street, Suite 205
Ketchikan, AK 99901

Palmer
Arctic Geo Resource Associates
Palmer, AK 99645
Ph: 745-2436

Wasilla
Susitna Forestry
Glen G. Holt III
Forester & Wildlife Biologist
P.O. Box 870674
Wasilla, AK 99687
Ph: 373-6715

APPENDIX IV

TECHNICAL ASSISTANCE DIRECTORY

State of Alaska, Department of Natural Resources

Director's Office.
3601 C Street
P.O. Box 107005
Anchorage, AK 99510-7005
Ph: 762-42501/561-2707 telecopier

Southerncentral Region Office
3601 C Street
P.O. Box 107005
Anchorage, AK 95510-7005
Ph: 762-2117/762-2503 telecopier

Valdez/Copper River Area Office
P.O. Box 185
Glenallen, AK 99588
Ph: 822-5534

Haines Area Office
P.O. Box 263
Haines, AK 99827
Ph: 766-2120

Ketchikan Area Office
P.O. Box 3361
Ketchikan, AK 99901
Ph: 225-3070

Tok Area Office
P.O. Box 10
Tok, AK 99780
Ph: 883-5134

Southwest Area Office
P.O. Box 130
McGrath, AK 99627
Ph: 524-3010

Kenai/Kodiak
Area Office
HC-1, Box 107
Soldotna, AK 99669
Ph: 262-4124

Icy Bay Area Office/
Juneau Area Office
400 Willoughby Ave
Juneau, AK 99801
Ph: 465-2491

Delta Area Office
P.O. Box 1149
Delta Junction, AK 99737
Ph: 895-4225

Mat-Su Area Office
Mile 8,2 Big Lake Raod
P.O. Box 520455
Big Lake, AK 99687
Ph: 892-6027

Southeast Region Office
400 Willoughby Ave. 5th Floor
Juneau, AK 99801
Ph: 465-2491

Northern Region Office
3700 Airport Way
Fairbanks, AK 99709
Ph: 451-2660
451-2690 telecopier

Fairbanks Area Office
3742 Airport Way
Fairbanks, AK 99709
Ph: 451-2700

Icy Bay Field Office
P.O. Box 460
Cordova, AK 99574
Ph: 424-3933

USDA Forest Service

State and Private Forestry
201 E. 9th Ave.
Anchorage, AK 99501
Ph: 271-2575

Institute of Northern Forestry
308 Tanana Drive
Fairbanks, AK 99775-5500
Ph: 474-7443

Pacific Northwest
Research Station
P.O. Box 3890
Portland, OR 97208
Ph: 503-294-7128

Regional Forester
P.O. Box 1628
Juneau, AK 99802
Ph: 586-7263

Forestry Sciences Lab
201 E. 9th Ave.
Anchorage, AK 99501
Ph: 271-2500

Bureau of Indian Affairs

Agency Forester
Anchorage Area Office
1675 "C" Street
Anchorage, AK 99510
Ph: 586-7185

Agency Forester
Juneau Area Office
P.O. Box 3-8000
Juneau, AK 99802

Agency Forester
Fairbanks Area Office
Federal Building
101 12th Ave, Box 16
Fairbanks, AK 99708
Ph: 456-0222

Other

Cooperative Extension Service
University of Alaska Fairbanks
Fairbanks, AK 99775-5200
Ph: 474-6356

Tanana Chiefs Conference
320 2nd Avenue, Annex Bldg.
Fairbanks, AK 99701
Ph: 452-8251

APPENDIX V

SAMPLE OUTLINE FOR DEVELOPING A FOREST INVENTORY PLAN

1. PURPOSE OF THE INVENTORY
   a. Why the inventory in required
   b. What information is needed
   c. How the information will be used

2. ACCESSIBLE INFORMATION
   a. Past inventories
   b. Published reports
   c. Local knowledge

3. AVAILABLE MAPS AND AERIAL PHOTOGRAPHS
   a. Coverage and scale of available maps
   b. Type of aerial photos (size, scale, color) and existing flight lines
   c. Plan and budget for additional coverage if needed

4. DESCRIPTION OF AREA TO BE INVENTORIED
   a. Location, legal boundaries
   b. Acreage
   c. Accessibility
   d. General description of forest

5. INFORMATION REQUIRED FROM THE INVENTORY
   a. Specific resources to be inventoried
   b. Measurements which will be collected
   c. Other information needed such as site description, access information, etc.

6. STATISTICAL CONSIDERATIONS
   a. Sampling design
   b. Required probability level
   c. Acceptable bound on the error of estimation
   d. Estimate of stand variability
   e. Number of plots

7. MEASUREMENT PROCEDURES
   a. Size, shape, and distribution of sampling units
   b. Required field measurements
   c. Exact methods for making primary measurements (equipment and methodology)
   d. Measurement procedures for other parameters of interest
   e. Design of forms for recording observations

8. MANPOWER NEEDS
   a. Size of crew and source of personnel
   b. Training needs
   c. Salaries/budget
   d. Safety precautions (aircraft, boats and animals)

9. LOGISTICS
   a. Travel arrangements (in house vs. commercial)
   b. Equipment needed including vehicles, boats, or planes
   c. Field camp arrangements

10. TIME TABLE
   a. Starting date and estimated duration of the inventory
   b. Budget and time constraints for completing the inventory

11. ANALYSIS AND COMPILATION PROCEDURES
   a. Statistical formulas that will be used
   b. Volume tables that will be used
   c. Calculation procedures ie, computer, calculator

12. FINAL REPORT PREPARATIONS
   a. Outline/format
   b. Estimated time for preparation
   c. Responsibilities for preparation
   d. Distribution of final report

13. FUTURE INVENTORY NEEDS
   a. Time interval
   b. Priority areas
   c. Permanent plot establishment and remeasurement schedule

APPENDIX VI

USGS OFFICES IN ALASKA

(For obtaining Alaskan maps and aerial photographs)

Anchorage

Public Inquiries Office
Earth Science Information
and Sales
U.S. Geological Survey
E-146 Federal Building, Box 53
701 C Street
Anchorage, AK 99513
271-4307

Public Inquiries Office
U.S. Geological Survey
Room 101
4230 University Drive
Anchorage, AK 99508-4664
561-5555

Fairbanks

U.S. Geological Survey
Federal Building-Box 12
101 12th Avenue
Fairbanks, AK 99701
456-0244

GeoData Center
Geophysical Institute
University of Alaskax Fairbanks
903 Koyukuk Drive North
Fairbanks, AK 99775-07800
474-7487

U.S. Geological Survey
Branch of Alaskan Geology
800 Yukon Drive, B-6
P.O. Box 80586
Fairbanks, AK 99708
474-7245

APPENDIX VII

NATURAL RESOURCES SCHOOLS IN ALASKA

Alaska Vocational Technical
Center (AVTEC)
Admissions Office
P.O. Box 889
Seward, AK 99664
Ph: 224-3322

Sheldon Jackson College
Director of Admissions
801 Lincoln Street
Sitka, AK 99835
Ph: 747-3666

University of Alaska Fairbanks
School of Agriculture and Land
Resources Management
Fairbanks, AK 99775
Ph: 474-5550

Agricultural and Forestry Experiment Station
School of Agriculture and Land Resources Management
University of Alaska Fairbanks
James V. Drew, Dean and Director

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