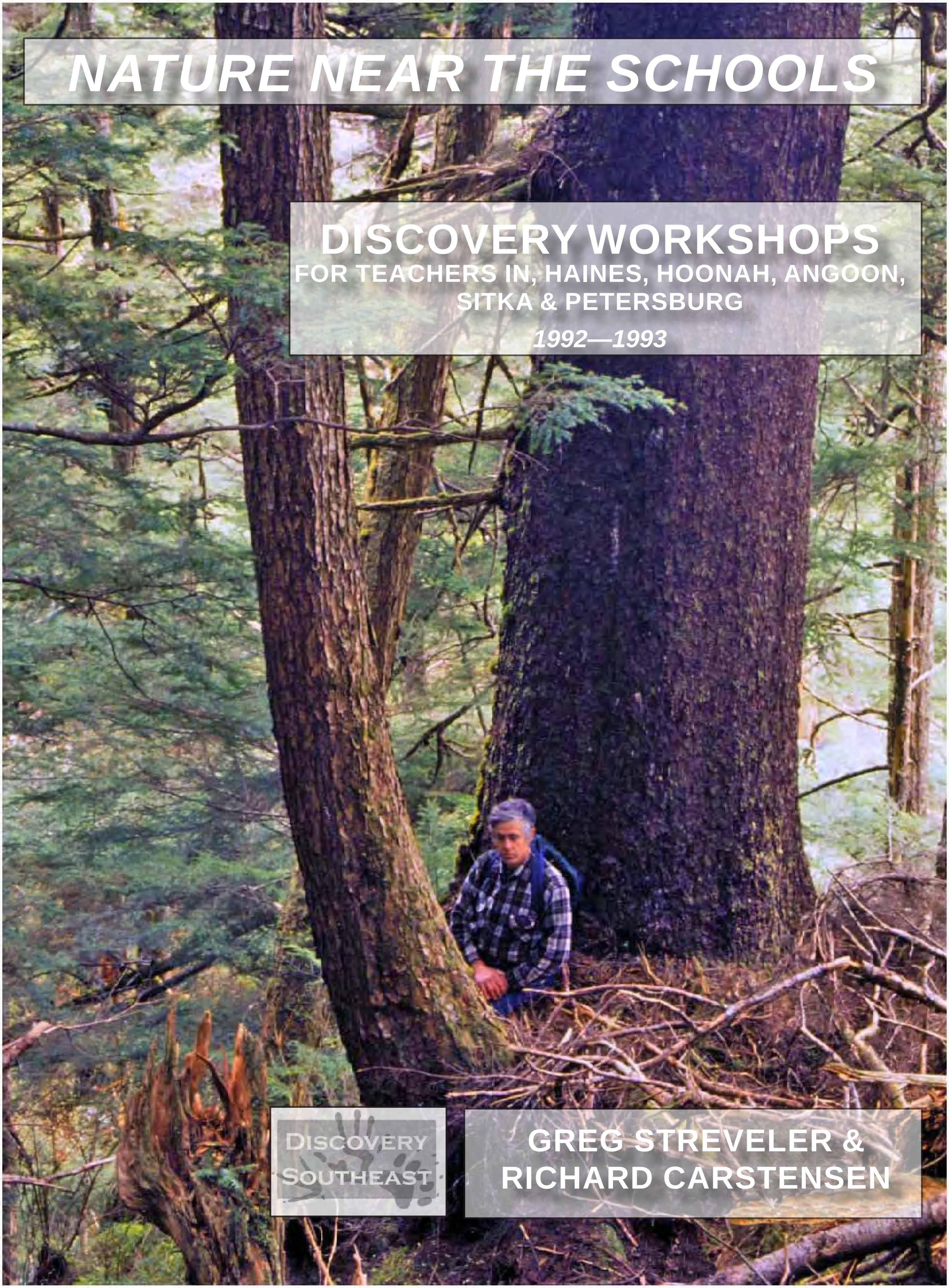


NATURE NEAR THE SCHOOLS

DISCOVERY WORKSHOPS

FOR TEACHERS IN, HAINES, HOONAH, ANGOON, SITKA & PETERSBURG

1992—1993

DISCOVERY SOUTHEAST

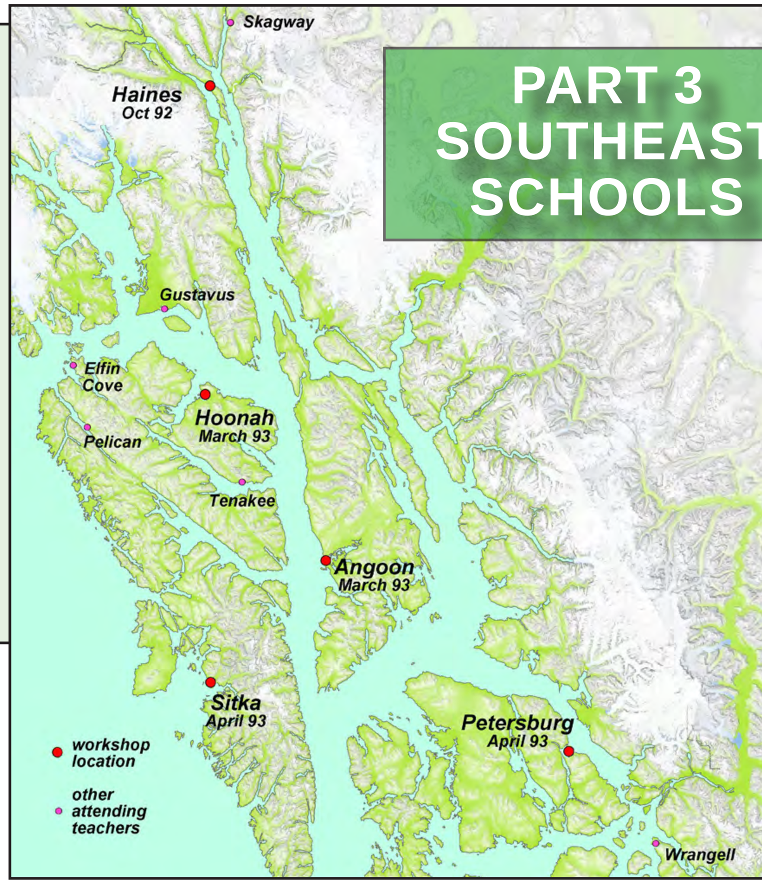
GREG STREVELER & RICHARD CARSTENSEN

PART 3 SOUTHEAST SCHOOLS

Following the Juneau-area workshops—in 1992 and 93—Streveler and I hit the road (marine highway, actually) in the "Naturemobile," a 1969 Ford camper, delivering teacher workshops to Haines, Hoonah, Angoon, Sitka and Petersburg.

At the Haines workshop we also had teachers from Skagway, so we titled this *Northern Lynn Canal Schools*. The *Icy Strait* workshop at Hoonah had teachers from Gustavus, Elfin and Pelican. Tenakee's principal attended the *Chatham Strait* workshop at Angoon, and Wrangell teachers came to the Petersburg workshop. Sitka was too far from other communities for out-of-town teachers, but had the highest local turnout of the series.

The introduction below explained the contents of post-workshop notebooks delivered to most ofl the public schools between Skagway and Wrangell.



TO SOUTHEAST TEACHERS

From: Richard Carstensen & Greg Streveler, workshop instructors

Discovery Foundation[1] is a non-profit environmental education group providing nature studies programs in 3 Juneau District elementary schools,[2] as well as teacher workshops in natural history. In 1992-93, we took these workshops "on the road," to Haines, Hoonah, Angoon, Sitka and Petersburg. At each of these communities we invited all public school teachers and staff from K through 12, and teachers from surrounding smaller towns and logging camps. The workshops provided one ED 593 credit from UAS, and were funded by an Eisenhower grant, administered through the Alaska Department of Education.

Discovery workshops are about PLACES, as site-specific as possible. This notebook, to be housed in your school library, includes maps, site descriptions, species lists, stereograms, slides and script. We hope it lays a secure foundation for your nature studies, enduring long after details of the workshop have faded from memory.

Our modus operandi As teachers of natural history, we prefer to ask questions (and when we get lucky, even to answer some) that can't be looked-up in books, rather than dishing out stuff that persevering readers can discover on their own. To our satisfaction, this was also the consensus from workshop participants. Thus, instead of "How is a mammal different from a bird?" we tended to ask" How is Hoonah different from Gustavus?" or "What landform is this school built on?" This required us to do our homework, or come to think of it, our away-from-homework—many days of scouting, interviewing, photography, map-making, report-reading, air photo cut-&-pasting,[3] and writing for every day of actual workshop.

The result was far more material than we could convey in 3 class days, but with this notebook, you can digest it at your leisure. The first and often the last, step in describing a place is to acquire or make a map. Back in Juneau, before even our first set of reconnaissance visits, we ordered all of the 'topos,'

1 Since re-named Discovery Southeast, as explained in the introduction to Part 1.

2 Shortly after these workshops, our Nature Studies program (grades 3 to 5) expanded into all Juneau elementary schools.

3 PS RC 2012: Back in the dark ages of the early 1990s, I made stereogram pages by ordering 9x9-inch contact prints (at considerable expense) and taking a razor to them to paste-up the sets of 4 paired images, surrounded with coordinates. Afterward, no matter how carefully I taped the razored prints back together, the cut-lines were visible. Projecting 35mm slides of these re-assembled air photos, I constantly had to explain to students and teachers those weird straight lines. Rather than subject you to those same pesky questions, I've since spent many hours with Photoshop's rubber stamp tool, erasing the razor marks.

Greg Streveler and the Naturemobile north of Haines—probing the mysteries of spruce-forest succession.

marine charts, air photos, and geology maps we could think of. In each town, our first stop was the city planning department, for property maps and fine contour intervals of the school vicinity. Our next stop was the Forest Service, for closeup air photos of the schools, and of nearby mountain tops and estuaries.

But the most useful map for you as a teacher is of the area right outside your classroom. Five minutes from the door, you can be kneeling with your students over nature-puzzles that would make a teacher in Ohio green with envy (in Petersburg, for example, the jaw of a baby bear). That map, of a scale appropriate for mapping bear jaws, didn't exist, so we made it. Only when formidably armed with maps did we actually set foot in the wilderness beyond your playground fence. The rest was gravy—scat poking, fossil hunting, expert-hounding, skull-cleaning, rock and feather collecting, and generally admiring the incredible beauty of the place you teach in.

Notebook Contents

• course outline

• lots of maps

• a natural history of your area including bedrock and surficial geology, glacial history, plant communities, and supportive text for various maps.

• table of terrestrial mammals of northern Southeast, with columns and revised totals for all 1992-93 workshop sites.

• stereograms: paired air photos, viewable in 3D with the stereoscope included in the pencil pouch in this notebook.

• supportive materials for stereograms: puzzlers, teacher's tips and answers.

• slide show and script for your school site

• photocopy master for *A naturalist's look at Southeast Alaska*. Generic stuff about Southeast that we couldn't possibly cover in a 3-day workshop

• forest comparison method: a low-tech way to quantify a place (with a piece of paper and a string)

• bibliography: books, papers and maps pertaining especially to your community—for more generic background see *References* in *A naturalist's look*.

GPS
RLC
93

Teaching the Natural History of Southeast Alaska

DISCOVERY FOUNDATION **teaching aids and reference materials for Chatham Strait Area Schools**

NORTHERN LYNN CANAL SCHOOLS

course outline

A teacher's workshop for Haines, Skagway, Klukwan, Mosquito Lake
Instructors: Greg Streveler, Richard Carstensen, Gretchen Bishop

October 25 1992

Friday 6-9PM

Introduction
- the Discovery Foundation
- the cottonwood tree as a symbol of the upper Lynn Canal environment

Rivers
- how rivers work: gradient, velocity, sediments, etc.- the Chilkat System: local rivers and their histories

Sequential reciprocation: a locomotory experience!
The big picture: habitats and history of SE Alaska

Saturday 8:30 AM - 5 PM

Three-ring circus
- who eats who?
- Who is related to whom?
- Who uses what habitats?

Intro. to Sawmill Creek Wetland
Upper Lynn Canal in 3-D
LUNCH 12-1 PM
Afternoon field trip to Sawmill Creek Wetland

Sunday 8:30 AM - 4 PM

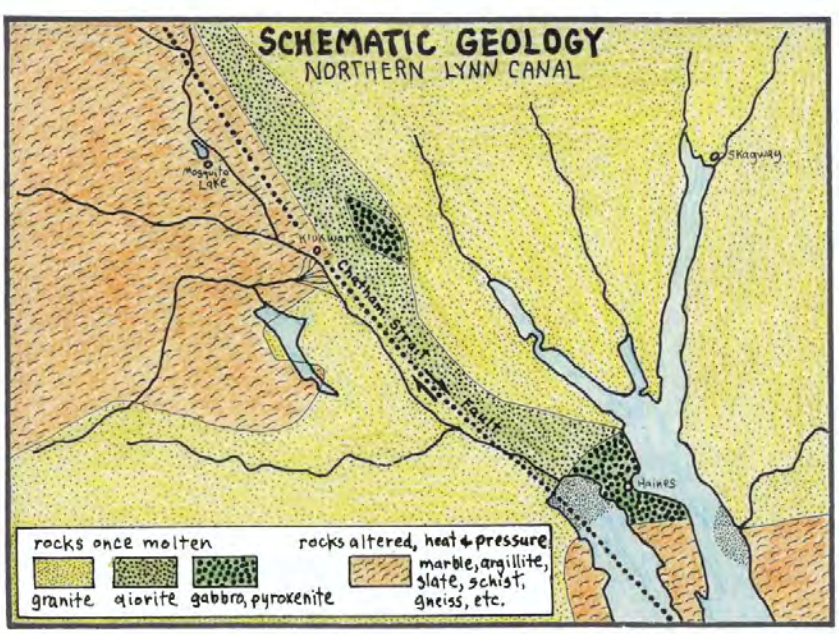
Topics chosen by you: geology, fish ecology
Intro to field trip
Field trip on Dan's Bus (11AM-4PM), Chilkoot Lake to Klehini R.

The northern Lynn Canal area

In the last several million years, ice has repeatedly covered northern North America in a vast blanket extending from what is now New England to SE Alaska Repeatedly these ice blankets flowed through passes in the Coast Range and followed channels to the continental shelf, where they disgorged into the sea. One major outlet followed a linear rift in the bedrock. gouging it ever more deeply in the process. As the ice retreated most recently, about 14,000 years ago, it left behind one of the world's greatest fiords, Lynn Canal-Chatham Strait, that runs for 250 miles due north before branching and coming ashore as valleys fanning through passes and up into the continental interior. The mosaic of valleys, ridges, fiord heads and interior plateaus at the northern extremity of this great ice gutter today constitutes the Haines-Skagway Area.

Today the Haines-Skagway area guards a major portal between the lush maritime fiordlands of SE Alaska and the rest of continental North America Its character is a hybrid of the two. Weather patterns see-saw between the wet, temperate southerlies off the Gulf of Alaska and dry, winter cold and summer-hot spells brought down by continental northerlies.

Plants and animals from both regions intermingle. In the forests, sitka spruce from the coast stands side by side with birch from the interior. Blue grouse and its con.tinental cousin the spruce grouse may be found in the same valley. Interior whitefish and coastal red salmon occupy the same lake.



The combination of marine, freshwater and land resources is especially rich in the Haines area, largely due to the interaction of glaciers and rivers, making a constellation of lakes, flood plains and sloughs that provide important fish & wildlife habitats. The large fish runs, game and furbearer populations are mostly found in these places.

Human populations now as in the past tap both regions, and often serve as middlemen between them. Haines-Skagway history has been dominated by traffic through the passes. Chilkat Tlingits derived much of their wealth and status from trade with Athabascan people; the Gold Rush suddenly brought European settlement; highways and railroads connect to marine transportation at present-day Haines and Skagway.

Geology of northern Lynn Canal

Refer to your schematic geology map. First notice the Chatham Strait Fault, a major rift in the earth's crust. Rocks on its southwest side moved many kilometers northwestward prior to 50 million years ago, while rocks on the other side of the fault were already welded securely to North America. As a result, rocks bounding the fault don't match up well.

All of the area's rocks are metamorphic or igneous, showing that they were once deeply buried. Those northeast of the Chatham Strait Fault show evidence of deepest burial. Metamorphics are highly varied, being derived from many sorts of sedimentary and volcanic rocks mostly laid down 300 to 400 million years ago. These are mainly marble, slate and argillite southwest of the fault, while schist and gneiss are common across the fault to the east. A great belt of igneous rocks spans the middle of the area It includes immense bodies of once molten rock injected into the earth's crust at times when crustal fragments to the westward banged into the edge of North America and arranged themselves into their present configurations. Most of this belt is granite, except for a band of dense, locally highly mineralized diorites and gabbros stretching from Haines into the upper Chilkat Valley.

PS RC 2012: Just prior to the teacher workshop at Haines, with Dan and Gretchen Bishop, I had wrapped up an extended study of Sawmill Wetland as part of an impact study for the proposed airport expansions. Dan's consulting business was called *Environaid*. We included many of the maps, plant lists, etc from that study in our teacher handouts.

Easy proximity of Sawmill Wetland to classes on foot from Haines schools makes this an extraordinary educational resource.

Above right: Haines had the highest mammal diversity of the 5 school districts in our Nature near the schools workshop series.

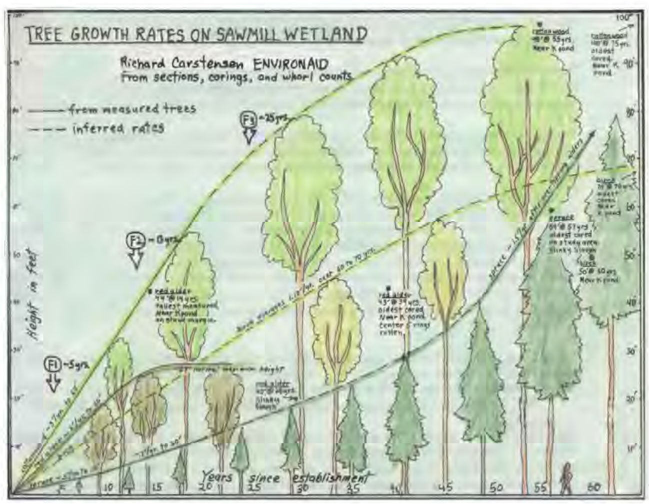
Right center: Differing growth rates for spruce, birch, red alder and cottonwood, measured from tree sections at Sawmill Wetlands in our Environaid study, prior to the workshop visits.

Below: Hypothetical profile through habitat map on the following page. Community classifications correspond to both map and profile.

Land Mammals of Northern Southeast Alaska

prepared by Greg Streveler

Species	Chichagof I	Admiralty I	Glacier Bay	Haines
Insectivores				
masked shrew	X	X	X	X
dusky shrew	X	X	X	X
water shrew	-	-	X	X
Bats				
little brown bat	X	X	X	X
long-legged bat	-	X	-	-
Rabbits				
pika	-	-	-	X
snowshoe hare	-	-	?	X
Rodents				
beaver	X	X	X	X
porcupine	-	-	X	X
hoary marmot	-	-	X	X
northern bog lemming	?	X	?	?
deer mouse	X	X	X	X
long-tailed vole	X	?	X	X
meadow vole	-	-	-	X
red-backed vole	-	-	X	X
tundra vole	X	?	X	X
muskrat	-	-	-	X
bushy-tailed woodrat	-	-	-	?
red squirrel	(	X	X	X
flying squirrel	-	-	X	X
meadow jumping mouse	-	-	-	X
Hoofed Animals				
black-tailed deer	X	X	X	-
moose		-	X	X
mountain goat	-		X	X
Carnivores				
brown bear	X	X	X	X
black bear	-	-	X	X
wolf	-	-	X	X
Coyote	-	-	X	X
red fox	-	-	[X]	X
lynx	-	-	[X]	X
wolverine	-	-	X	X
river otter	X	X	X	X
marten	(	X	X	X
ermine	X	-	X	X



Community classification

A Aquatic Submergents like pondweed, floating leaved plants like pond lily and some emergents like "emergent" horsetail.

As Supratidal aquatic communities. (Subdivisions of **As** correspond to fish stream classifications. See section IIC2.)

As-1 Fast flow, unstable bed, no vascular aquatic plants

As-2 Moderate flow, fairly coarse, shallow substrate, with brooklime (YEAM)

As-3 Slow flow, fine substrate, often with organics

As-3a Shallow, mucky, with plants like marsh marigold (CAPA) and "emergent" horsetail (EQFL)

As-3b Deep channels or ponds, with submergents like pondweed (POspp) and whitewater crowfoot (RATR).

Ai Intertidal slough beds. Occasional salt influence. Tidal scour. Only *Chara sp.* (CHsp) and one pondweed species (POPE) grow.

I Intertidal

I1 Unvegetated sand and mudflat. Eg. river bars. Vasculars go down to about 14 ft. above MLLW on study area.

I2 Low Marsh. From ~15 to ~17 ft above MLLW. Dominated by Lyngbye sedge and other salt tolerant plants (halophytes). These elevations on the study area are now mostly confined to slough margins. Includes also "halophyte pans" at elevations up to 20' where goosetongue still dominates on compacted silt.

I3 High Marsh. Occasional tidal coverage. ~17 to ~20' above MLLW. Grass dominated. Because of Chilkat River's diluting influence, these flood waters have minimal salinity, and succession proceeds directly from high marsh to thickets (F1) on most of the study area, skipping the "meadow" phase.

M Meadow Entirely supratidal communities but without woody vegetation except some low growing species like myrica.

Mw Wet meadows. Groundwater at surface. May never be forested. Eg. spongy meadows below east end of runway with myrica, "pioneer horsetail" and the moss *Drepanocladus aduncus*.

Md Dry meadows. Drainage would permit forestation except for human intervention. All examples on study area are arrested in pre-forest stages by maintenance cutbacks.**F Forest** Usually begins immediately at Extreme High Water Spring (~20'). Exceptionally rapid growth on most sites (cottonwoods ~3'/yr.)

F Forest

F1 Alder/willow thickets. Mostly less than 25 feet high.

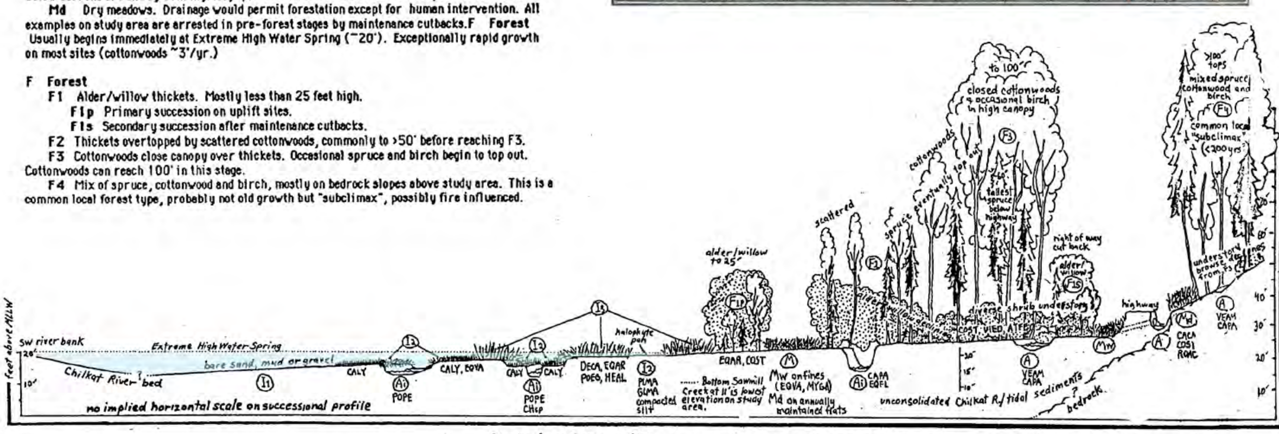
F1p Primary succession on uplift sites.

F1s Secondary succession after maintenance cutbacks.

F2 Thickets overtopped by scattered cottonwoods, commonly to >50' before reaching F3.

F3 Cottonwoods close canopy over thickets. Occasional spruce and birch begin to top out. Cottonwoods can reach 100' in this stage.

F4 Mix of spruce, cottonwood and birch, mostly on bedrock slopes above study area. This is a common local forest type, probably not old growth but "subclimax", possibly fire influenced.



Study Area Communities *Successional sequence on intertidal sediments uplifting at about .9"/yr. Hypothetical section.*


SAWMILL WETLAND
VEGETATION + WILDLIFE NOTES
ENVIRONAID survey by Dan Bishop + Richard Carstensen, 1989, for Alaska Department of Transportation
Revised for DISCOVERY FOUNDATION October 1992
CHILKAT RIVER
Sawmill Slough
Sawmill Creek
Stinky Slough
Third Iron Tributary
Second Iron Tributary

Preface RC 2012: This and other slide shows in our *Nature near the schools* workshop series of course literally were ***slide*** shows in the early 1990s; collections of 35-mm slides were included in the notebooks we placed in all school libraries. For this re-issue of the workshop notes, I've converted the shows to powerpoint format. You can download *lynn.ppt* from *JuneauNature*.

Natural History of northern Lynn Canal

Slide show script

Note to Teachers The natural history workshop for northern Lynn Canal encompassed geology, plant communities, local wildlife, marine ecology, human history and many other topics. These slides are exclusively of maps and air photos, chosen to give the "big picture" of Haines and its environs.

Notes to you as teacher are included in the script in *italics*, and are not intended to be read out loud. You may wish to present some of the technical words, shown in **boldface**, in a separate class before viewing the slides.

If you've never used air photos before, don't be intimidated. We've discovered that students are fascinated (especially when they find their houses or spots they know well). When time permits, we like to have kids come up and point out features on the screen.

The stereogram sheets in this notebook let the kids see selected views around northern Lynn Canal in 3-D. They and the "puzzler" sheet that goes with them makes a companion lesson to the slide show. If you have any questions about photo interpretation, or need suggestions on classroom use, contact Discovery, and someone will be glad to help you.

1) title slide

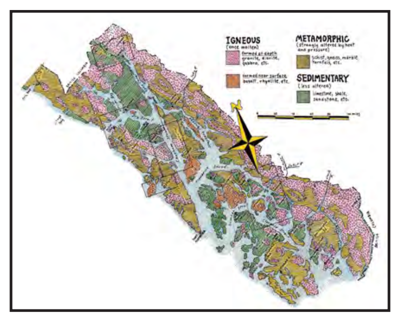
2) USGS topographic map (1:250,000) The northern Lynn Canal area schools occupy the intersection of two worlds. Behind the mountains is the continental interior;immediately to the south lie the fjordlands of SE Alaska. Maps and air photos help us see the BIG PICTURE. Where do we live? What lives around us? What has shaped this place? What processes are going on today? What will the landscape be like tomorrow?

This topographic map is a sort called shaded relief, meaning that shading is used as if the sun were highlighting ridges and mountains, leaving the steepest places in deepest shadow. This sort of map is particularly good for outlining watersheds (the basin that provides water to a particular stream).

Can someone come to the screen and outline the watershed of the Ferebee River, that drains into Chilkoot Lake? Watersheds are important; whatever happens in them is likely to affect the river &/or lake that drains them. The sockeye salmon and eulachon of the Chilkoot system depend on the purity of its water. This in turn depends on the health of the watershed. (To Teacher Notice that 4 locations of stereograms are indicated: Haines, Skagway, Klukwan and Mosquito Lake. It'd be very useful to show your class this slide to orient them before they begin using the stereograms.)

3) bedrock map of SE Alaska Bedrock is the solid mass of rock making up the earth's crust This is a simplified map of Southeast Alaska's bedrock, lumping together our very complex geology according to the 3 basic rock types: **sedimentary, metamorphic and igneous**.

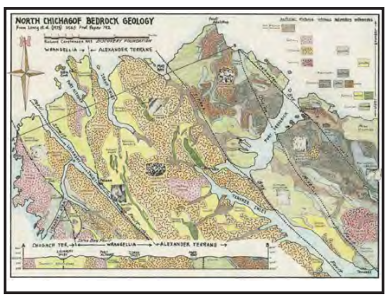
Sedimentary rocks are sediments (sand, gravel, mud, volcanic ash, etc.) that have been cemented together and thus turned to stone. This process of becoming rock usually happens after more sediments pile on, increasing the heat and pressure. If the heat and pressure becomes great enough that the minerals in the sediments begin to alter their shape or chemistry, we get **metamorphic** rocks. This greater heat & pressure usually comes from getting buried deeper, or from getting squeezed by mountain-building. Once there is enough heat & pressure (generally after the rock has been pressed down miles into the earth), the rock melts. When it re-solidifies, it will become an **igneous** rock. So rocks contain clues about their past history.



If an area is made up mostly of sedimentary rock, its history has been relatively calm. But if metamorphic or igneous rocks predominate, there's been a history of more intense burial, erosion and mountain building.

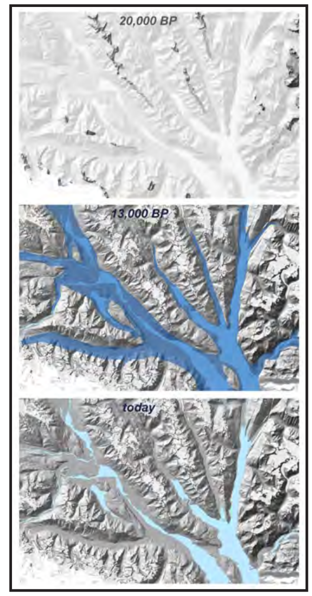
Now look at the Upper Lynn Canal area. The rectangle outlines the area covered by the last slide. What kinds of rocks predominate? The Upper Lynn Canal area has had an intense history, alright. In fact, geologists estimate that in the last 25 million years, the mountains nearby have risen 6 to 8 kilometers! But the mountains are less than 12 kilometers high now. Where did the rest of the rock go? That's right, it eroded away. It's mostly sitting out on the continental shelf offshore from the mouth of Icy Strait, where it's getting buried and turned into sedimentary rock, starting the rock cycle all over again.

4) bedrock geology of the northern Lynn Canal Now let's look more closely at the rocks right around Haines. The main bedrock type is a dark igneous rock called **gabbro**. (You have to walk away from the center of town to find it, because near the school it's buried under marine sediments.) But then notice that there are several other types of rocks in the general rea They're pretty complicated. (*To Teacher You have a brief description of them in the Discovery Foundation Notebook materials.*) In fact, geologists puzzled over this complexity for years, until coming up with a sci-fi type hypothesis to explain them. The reason the rocks are so chopped up into different little pieces, geologists think, is because they ran into North America! They once were at least two separate parts of the earth's crust that drifted into North America, and in the process got all jumbled up. (*To take that thought further, see A Naturalist's look at Southeast Alaska in your packet of materials.*)



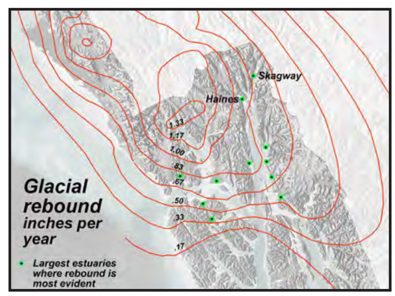
5a) historical sequence - today Here's Lynn Canal today. H, S, and K mark the positions of Haines, Skagway and Klukwan. Let's go back in time to the ending of the great ice age,

5b) historical sequence - 13,000 BP The great weight of ice had pushed the land down. When the ice retreated, the land was 500 feet lower than today and the sea covered far more of it than today, as shown in the middle map. Imagine what a different place the upper Lynn Canal area was during those times! On this map for 13,000 years ago, all 3 Lynn Canal communities were under water. On the future site of Haines, what would become a low saddle was then an ocean pass.

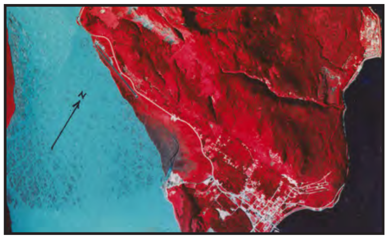


5c) historical sequence - 20,000 BP Here's the area when it was under a mile of ice at the peak of the last Great Ice Age. Then only the highest peaks (those that are sharp today) stuck out of a great ice plateau much like the one that covers Greenland today.

6) map of rebound rates Southeast Alaska is still rising. As this slide shows, the rate of uplift is greatest in the northern portion. The line linking spots rising at 1 inche per year goes through Haines. At this rate, how much will the land have risen in the last 50 years? Yep, about 4 feet! In fact, if you look around Haines' beaches, you can find a lot of evidence that the sea used to be higher than today. Go out to the Sawmill Creek Wetlands, for instance, and notice the new young willows and alders growing out onto the flats. The uplift going on today seems to have 2 causes. First, only 200 years ago, Glacier Bay was full of ice, and the land is rebounding from that. And there is uplift due to mountain-building.



7) 1979 aerial infra-red view of Haines. Some photography is done with film sensitive to a part of the spectrum of sunlight called infra-red. That film is particularly able to highlight differences in vegetation. On this photo, the darker red areas are mixed conifer forest, while the brighter red, less textured areas are deciduous forest and brush, subalpine meadows, or

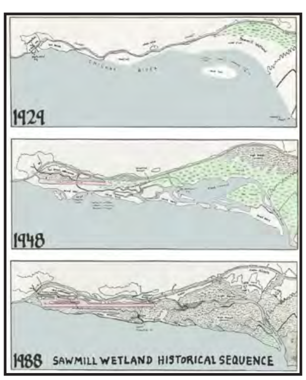


young, second-growth forests. The forests with the largest trees have the roughest texture. The blue-gray areas are mostly unvegetated, like the mudflats of Sawmill Wetland, and the slide areas below Mount Ripinski. Water showing as nearly black on infra-red photos is actually clear, while pale blue water is silty. Why is the water colored differently on the 2 sides of Chilkat Peninsula? (*At the bottom of the slide is the mouth of the Chilkat River, which brings silt into the Chilkat Inlet side.*)

The town of Haines is built on relatively flat land. As we saw in the shoreline map of 13,000 years ago, the Haines Schools and their surroundings sit on an ancient sea bottom. Find the airstrip. The flats extending from the airport towards town are called Sawmill Wetland. This area has been rapidly altered by glacial rebound, as we'll see in thenext slide ...

7b) 1929 oblique aerial of Haines. This historic oblique aerial shows Sawmill Wetland when the entire flats were regularly flooded by Chilkat River. Land was almost 5 feet lower (1993 - 1929 = about 60 years. At 1 inch per year, the land has come up about 60 inches, or 5 feet). Let's see howw subsequent rebound played out in a series of maps.

8) historical series for Sawmill Wetland To make this map series we used the earliest air photos taken in Southeast Alaska, dating back to 1929 and 1948. I've colored the critical Lyngbye sedge belt green. Watch how it migrates as the land rises

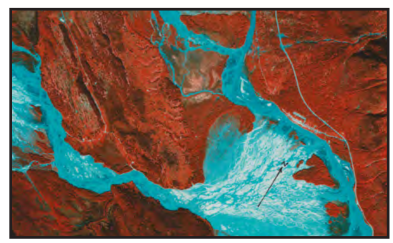


In 1929, only a dirt road bordered the river, and many buildings in the village of Yindastuki were still standing. The river ran right up against where today's highway is located.

By 1948 the land had risen considerably, and the original dirt airstrip had been built. Only a slow side channel of the river flooded the wetlands. Sedges were able to live on what used to be sand bars.

By 1988, almost all of Sawmill Wetland had risen above extreme high tide (20 ft above MLLW) and grasses colonized even the outermost sand bars. Up near the highway, tall alders and cottonwoods took over. Today, when you walk from the river banks back up to the highway, with every foot of elevation gain, you enter an older plant community. This is because the higher ground has been out of the intertidal longer.

9) 1979 aerial infra-red view of Klukwan (*This and the 2 following slides are also covered by stereograms. We recommend you familiarize yourself with the 3D images before projecting the slides for your class. You may want to go back to slide 2, which has rectangles showing stereogram locations. Then begin by orienting students to major features: in this case Klukwan, the Chilkat, Klehini, and Tsirku Rivers, Chilkat Lake and outlet, and the Tsirku and.Klukwan fans.*)



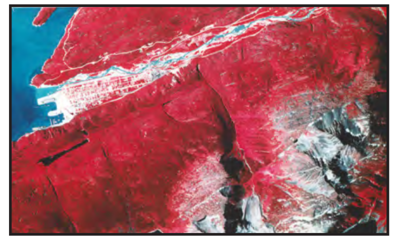
Geographical complexity results in a critical area for bald eagles. The eagles depend on chum salmon, and the salmon depend, for late-season spawning, on very special water conditions. Let's follow a raindrop which falls, say, in August, into Chilkat Lake. Along with the rest of the lake water, it will eventually flow down the outlet stream into the Tsirku River. It might have to wait awhile though, because in August the "outlet" stream often reverses direction and carries Tsirku floodwaters backwards into Chilkat Lake!

Once our drop of water reaches the Tsirku River, it races down to the huge Tsirku Fan. Some of its sister droplets scoot right over the fan into the Chilkat River, but this drop sinks down into the sand and gravel of the fan, and joins the slowly moving body of groundwater. Finally, in December, our drop seeps out of the toe of the Tsirku Fan, just across the Chilkat River from Klukwan. Although the air temperature is 10° F, our water droplet is 35°, and helps to keep a small side channel of the Chilkat from freezing. A chum salmon lays her eggs in the gravel there, then dies. Eagle food!

10) 1979 aerial infra-red view of Mosquito Lake (*Begin by orienting students to the major features: in this case Mosquito Lake, the braided channels of the Chilkat River, the bedrock valley wall and alluvial fans on the right.*)

As we learned earlier, black water on color infra-red photos is clear, while blue water is actually silty. Can you explain why the lakes in this picture are mostly clear, while the river is silty? (*Current in the river keeps the silt suspended. In quieter lakes and ponds, the silt settles to the bottom. Many of the ponds between river channels are fed by initially silty river water, which soon settles clear. Even Mosquito Lake sometimes gets Chilkat River overflow, as evidenced by the shallow muddy looking delta on the right. The palest blue area at the toe of the largest fan, middle right, is not water at all, but a dry, unvegetated gravel flat.*)

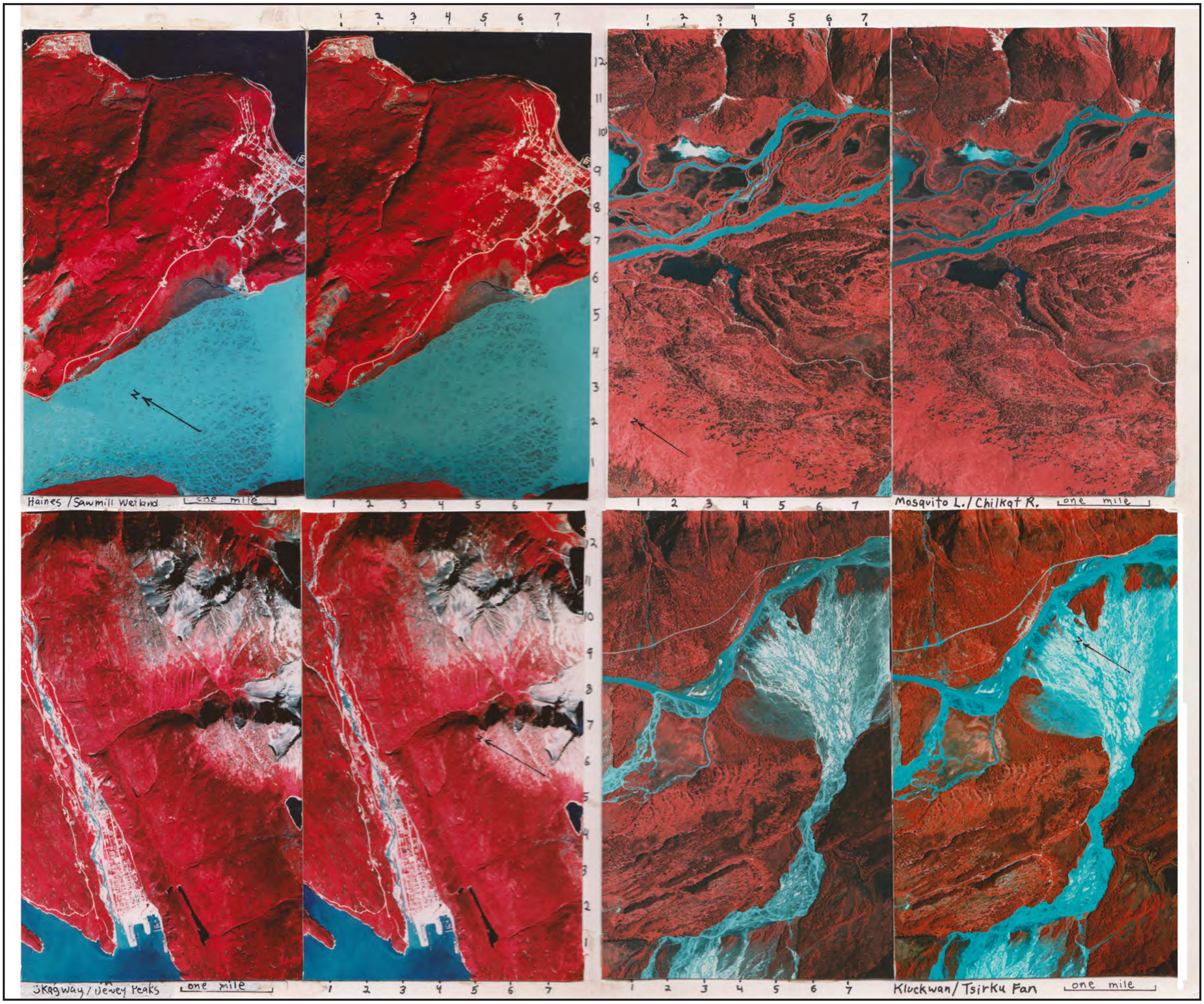
11) 1979 aerial infra-red view of Skagway (*Begin by orienting to the major features: in this case Skagway, Dyea, Skagway and Taiya Rivers, lower and upper Dewey Lakes, and Twin Dewey Peaks.*)



Skagway's forest is even more like those of the interior than the area near Haines. Where on this photo are the conifer-dominated forests? (These are the darker red areas, mostly on high but fairly level slopes, as your stereogram will show. The biggest conifer forest is on the mountainside below upper Dewey Lake.) The other forests shown here, paler reds, are mixed deciduous woodland, with birch and cottonwood and aspen. Why might Skagway have this type of forest on its steep bedrock slopes, rather than the spruce/hemlock forest common elsewhere in Southeast Alaska? (*We can only speculate, but climate must have a lot to do with it. Skagway gets only half the precipitation of even Haines. One result is long summer dry spells which increase the risk of fire. There is evidence of fire occurring in the area about every 50 years.*)[1]

1 PS: RC 2012: in 2005, Kathy Hocker and I traveled to both Haines and Skagway to for a repeat photography project. Several of the old historical images were taken just after major fires. For more information on fire ecology in northern Lynn Canal, see *www.discoverysoutheast/xxxxxxxxxx (upload to website)*

Across the Klehini River from the abandoned mining town of Porcupine



Stereograms for northern Lynn Canal For instructions, see *Using the stereoscopes and stereograms* in the introduction to this manual. You can either print this page, or else scale the stereograms on your monitor and hold a stereoscope to the screen. Note that north is not straight up on these images but at about 10-oclock

Northern Lynn Canal Stereogram Puzzlers

Locations of these photos are shown as rectangles on the Haines area topographic map.

1) To begin, find the pair labeled “Haines/Sawmill Wetland”. Do you see the Haines School (note the oval track)? What are its coordinates? To figure this out, begin at the lower left corner and count over to 7 1/2, then go back and count up to 8 1/2; write 7 1/2—8 1/2. Now look at Mt. Ripinski (1/2—6). For comparison, look at Twin Dewey Peaks on the Skagway/Twin Dewey Peaks stereopair (5—10). How do the shapes of the two peaks differ? Which do you think was over-ridden by ice in the past? Why? Mt. Ripinski is about 3600’ high; Twin Dewey Peaks are about 5600 feet high. What does your answer say about the height of ice in the region in past times?

2) While we're on the Skagway stereogram ...

a) Notice that the city of Skagway occupies a valley floor that trends NE-SW. How many other features can you find that trend in the same direction? Then notice the straight creeks that flow SE-NW, especially the one that issues from the glacier at (7—8). The two sets of trends cut the Skagway area into rectangles - a typical "jointing" pattern for the granites that underlie the Skagway area.

b) Now do you see any major area where this jointing pattern doesn't show up? If not, this would suggest that you are looking mainly at sediments rather than solid rock.

3) Let's now tum to the Klukwan/Tsirku stereopair. Klukwan is at (4—10). The Chilkat River crosses the photos at (0—8 to 8—12). The Tsirku flows from the bottom (about 2—0), up toward the Chilkat.

a) Note the great lobe of sediments at the Tsirku River's mouth (5—7, 7—11). Can you tell if it is forming at present? How?

b) Can you find another fan of about the same size on this stereopair? Why do you think it is vegetated more completely?

c) Follow this fan to its apex at the base of Iron Mountain (1 1/2—11 1/2). Is this apex the source of sediments that built the fan? (Hint think about the slope and drainage patterns on the fan). But this apex has just a small creek in it! Could it be the sediment source for so big a feature? If "Yes" what does this suggest about the rate at which this fan has been built?

d) Is the building going on at present? How does the rate compare to the Tsirku fan?

e) The Chilkat River flows past the two big fans. Where is the river narrowest? What does this have to do with the fans?

f) Now lets put some things together. The 2 big fans have grown out onto the valley floor. Do you see any remnants of the "old" floor outside the fans' limits? How do you think the Chilkat River valley looked before the fans were" built? What plant and animal habitats do you think would have been common on the valley floor in those days? Hold onto that question as we move upstream to ...

4) The Mosquito Lake/Chilkat River stereopair. First study the relationship of Mosquito Lake to the Klukwan and Tsirku fans on your topographic map.

a) The Mosquito Lake area is upstream from the last stereopair. Here the flat valley floor has mostly not been covered by fans. Does its vegetation provide clues to former plant communities downstream near Klukwan before the fans changed things?

b) It seems that the big fans are younger than the valley floor (see 3e). But what about the valley floor in comparison to the valley walls? Notice where they abut, say at (5 1/2—11). Which is the older surface? (Think of the container/contained idea). Using the same reasoning, what is older, the valley wall or the fans? Now can you put together an age sequence with the valley walls, valley floor and fans? If you can, then remove them one at a time in your mind's eye, starting with the youngest. You get 3 pictures: the present and 2 points in the past. Can you feel the landscape moving?

Tips and Answers to the Stereogram Puzzlers

1) Haines pair

Ripinski, having been overridden by ice, is rounded off. Twin Dewey Peaks stood above the ice, and did not get rounded off. During the last Great Ice Age that culminated 20-15,000 years ago, ice covered almost all of SE Alaska. In the Haines-Skagway area, it was about 5000' deep.

2) Skagway

a) The valley that Lower Dewey Lake (5—1 1/2) sits in, and the fault in the rock that points at Upper Dewey Lake (7—4 1/2) both parallel Skagway's valley.

b) The whole area below 5000' was intensely scraped by ice, removing all the sediments. Only Skagway's valley has accumulated significant volumes of sediments since the Great Ice Age, brought down by the river that occupies it.

3) Klukwan/Tsirku

a) The Tsirku fan is indeed active, as is shown by being bared of plants as the river braids back and forth.

b) The Klukwan fan, centered at (2—10). Its vegetation suggests a low rate of sediment accumulation. Apparently the stream which feeds it moves far less material then the Tsirku.

c) This fan's shape points to the sediment source, which is indeed the creek.

d) The creek is bringing sediments down from Iron Mountain. The younger vegetation in the lower middle of the fan 9—8 1/2), and the extra convexity where it projects out into the valley at that point, both suggest continued slow outbuilding. But the activity is much less than the Tsirku's.

e) The river narrows where the fans have built together, pinching the river's course.

f) Pieces of the old valley floor, centered at (2—6), persist as flats across from the Klukwan fan. The fans have been built out onto this level floor.

4) Mosquito/Chilkat

a) The valley here probably looks a lot like it did downstream in the Klukwan area before the fans covered it. The present vegetation upstream gives a clue to the past vegetation in the fan-covered area, but one must be careful in this interpretation. Climate has been different in past times and this affects the plants.

b) The wall is older that the valley floor sediments. The sediments are younger than the fans. Klukwan fan appears to be older than the Tsirku. So we can put together at least 3 scenarios:

- The present, with fans atop valley floor inside the valley walls
- An earlier time with no (or small fans) and a river valley with sediments (but probably less sediments, since they have been continuing to accumulate over time).
- A still earlier time, when there were no sediments, and the valley was a bedrock trench. Depending on where sea level was, it could have been a fiord. (See northern Lynn Canal historical sequence, 13,000 years ago.)

We could go on and on ... Isn't this stuff fun?!!

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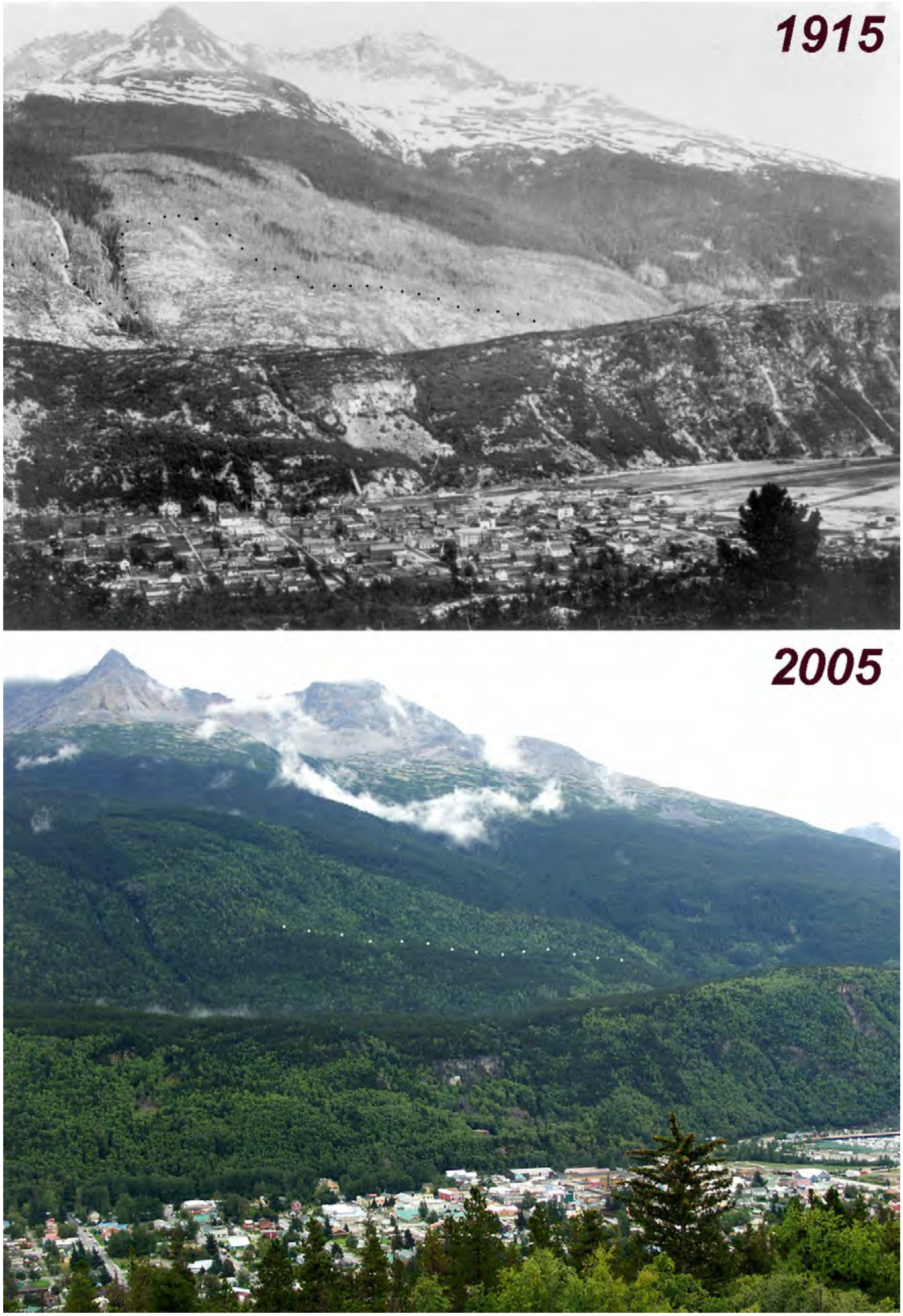
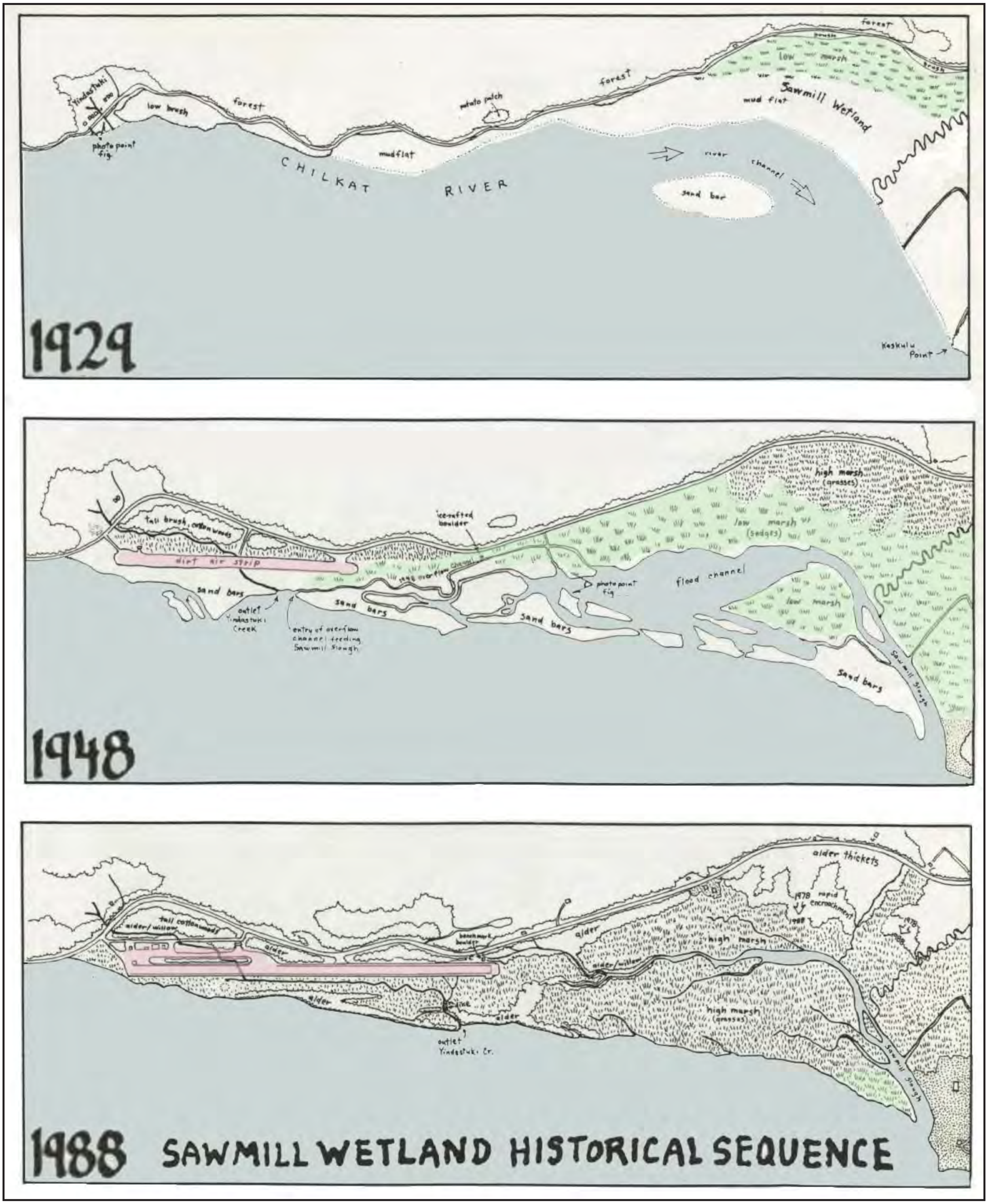
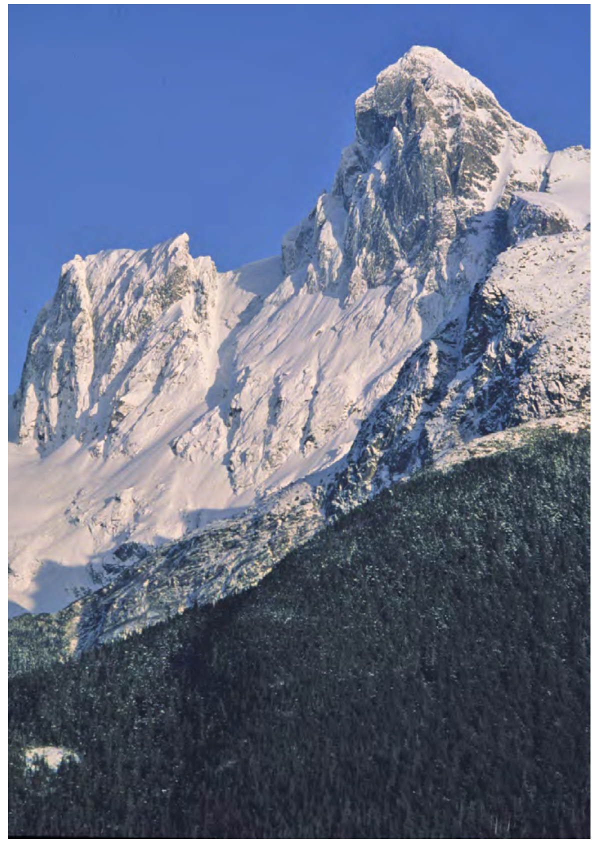


PS RC 2012: In 2005, Discovery naturalist Kathy Hocker and I completed a 2-year repeat photography project on contract with Michael Shepard at Alaska State & Private Forestry. The above pair show changes in the mountains above Skagway. The dotted line shows limit of a forest fire that had recently denuded the granitic slopes in 1915. For full interpretation see www.discoverysoutheast.org/xxxxxxxx

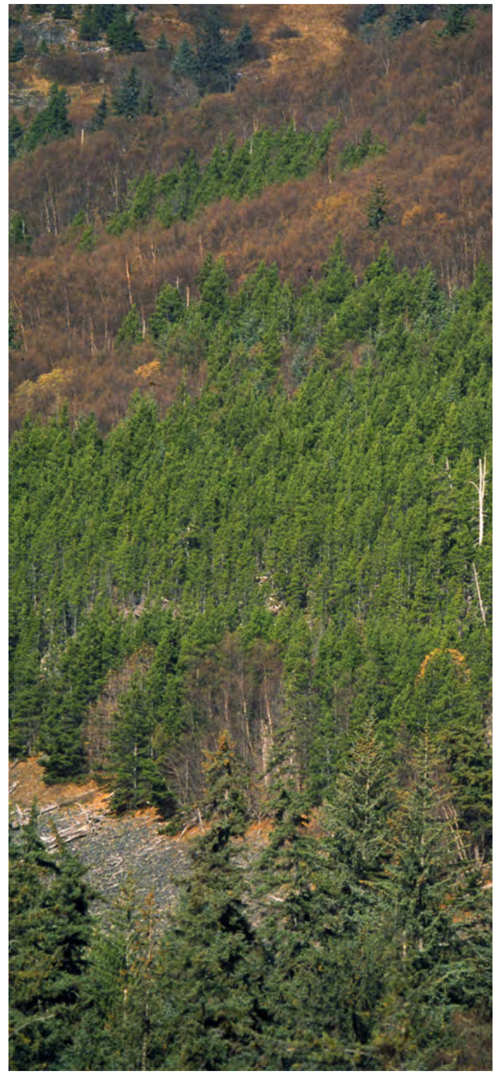


SAWMILL WETLAND HISTORICAL SEQUENCE



Photos taken on the October 1992 Haines trip. Clockwise from top left: "Fire forest" 7 miles north of Haines. Even-aged mix of spruce and birch. • Mount Sinclair, across the canal from Haines. • Dead canopy on left was recently killed by spruce bark beetles. • Upper Chilkat forests are blanketed by loess—airborne fines that occur only along transboundary corridors to drier interior climates. • Recent down-cutting on the 19-mile slide exposed deep-rooting structure of a pair of large cottonwoods

Chilkoot Stream, Showing Native Fish Runs and Traps in Current
Moser, 1902, Albatross expedition



More photos, Haines, 1992. Clockwise from top right: "Fire forest" From foreground to background: Sitka spruce; lodgepole pine; paper birch. • Faintly visible longhouse outline on the bench above Chilkoot River. • Inset: profile showing location. • Granitic boulders in Chilkoot River. • Photo by Commander Jefferson Moser of the Albatross expedition, published in 1902, showing fish traps in the Chilkoot River, approximately same location.

Teaching the Natural History of Southeast Alaska

DISCOVERY FOUNDATION teaching aids and reference materials for Chatham Strait Area Schools

ICY STRAIT SCHOOLS

course outline

FRIDAY EVENING 6 - 9PM

Introductions
- who's who; what's the Discovery Foundation anyway?
- key ideas; a cruise through the handouts
- deer and blackcod as flagship species

Chatham in 3-D - using stereoscopes; some puzzlers about your home locality
Natural communities of the land - changes with time, altitude, wetness
The marine environment - tides & currents; bottom and midwater communities; annual cycle

SATURDAY 10AM - 6PM

Wildlife
- more on deer; bears; some of the minor players
- islands and animal distribution

Geology - rocks, fossils and crustal plates
Field trip prep - Angoon natural history, intertidal, forests
Lunch 1-2pm
Field trip 2-6pm along trail to cemetary and back along beach
- on the way out: exercises characterizing forests
- on the way back: beach geology, intertidal life

SUNDAY 9 AM - 5PM

Intro to school vicinity
Field trip 10-12am characterizing the school grounds forest and bog communities
- in search of a study site for Angoon schools
- applying mapping and descriptive methods to the site

Edibles - the tastebud's opinion of plants and invertebrates
books and publications for the Chatham natural historian
Natural history and the school curriculum - brainstorming on interdisciplinary projects
3-ring circus
- A penultimate perambulation through trophic, systematic and geographic ecology

Evaluations

Natural history of the Icy Strait area

A Discovery Foundation site interpretation workshop

Natural history studies encompass everything from "bugs to bedrock." Obviously this is far more than we can hope to cover in a weekend workshop. But we do hope to impart some of the naturalist's excitement over interrelationships.

For example, what accounts for the presence of shell fossils in the limestone on Elephant Mountain above Hoonah? How does that limestone affect nutrition of Sitka black-tailed deer, and fisheries productivity of Gartina and Spasski Creeks? How did the recent Little Ice Age advance of the Glacier Bay ice sheet influence Gustavus? Hoonah?

A naturalist asks questions like these. Conclusive answers are few and far between, but the result of our curiosity is a deepened sense of place, and an appreciation for the workings of the land. Teaching children to ask these questions is more rewarding than providing them the answers.

A typical natural history sketch proceeds "from the ground up". It begins with the underlying bedrock "skeleton", which is then "fleshed out" with surficial deposits like glacial and river sediments. These are covered with the "skin" of soils, and a "coat" of vegetation. We should probably terminate our analogy at this point, since the area's fauna would have to be likened to fleas or lice.) And many natural history descriptions end with a chapter on people.

This is not the order in which most of us learn about the land. As children we may first be attracted to the doings of our fellow human beings, then to those beings who most resemble people, like mammals and birds, then to fish, bugs, and only later to plants, and still later to rocks and other inanimate objects.

Just as we can guide childrens' interest to bedrock via beavers, we can lead them to a study of nature by way of the layout of human communities. In our work at Juneau area elementary schools we've been delighted at students' reactions to projected air photos. Irs hard to keep kids in their seats as they search for their houses on the screen. And examination of roads and buildings leads easily to natural features, like different forest types, or glacial landforms, especially in a place like Icy Strait and Glacier Bay, where spectacular glacial history has drawn researchers from all over North America.

Let's take ourselves, Homo sapiens, as a starting point, and ask a series of "why" questions that will sooner or later lead us back to bedrock.

First, of all the potential townsites in the Icy Strait area, why have people chosen to settle most densely in Hoonah? Early folks had a lot of places to choose from. What attributes would they have been looking for in a potential home? Think of good beaches, shelter from weather, abundant resources, defense possibilities .....

The next series of questions follow naturally: What formed the beaches? The weather patterns? Why are there good fish streams? Good game populations? Attempting to answer these lead us to consideration of soils, nutrients, activities of erosion and deposition .....

Next questions: Where did the materials for the beaches come from? How did the soils form? Where do the nutrients come from? And the topography that dictates local weather?

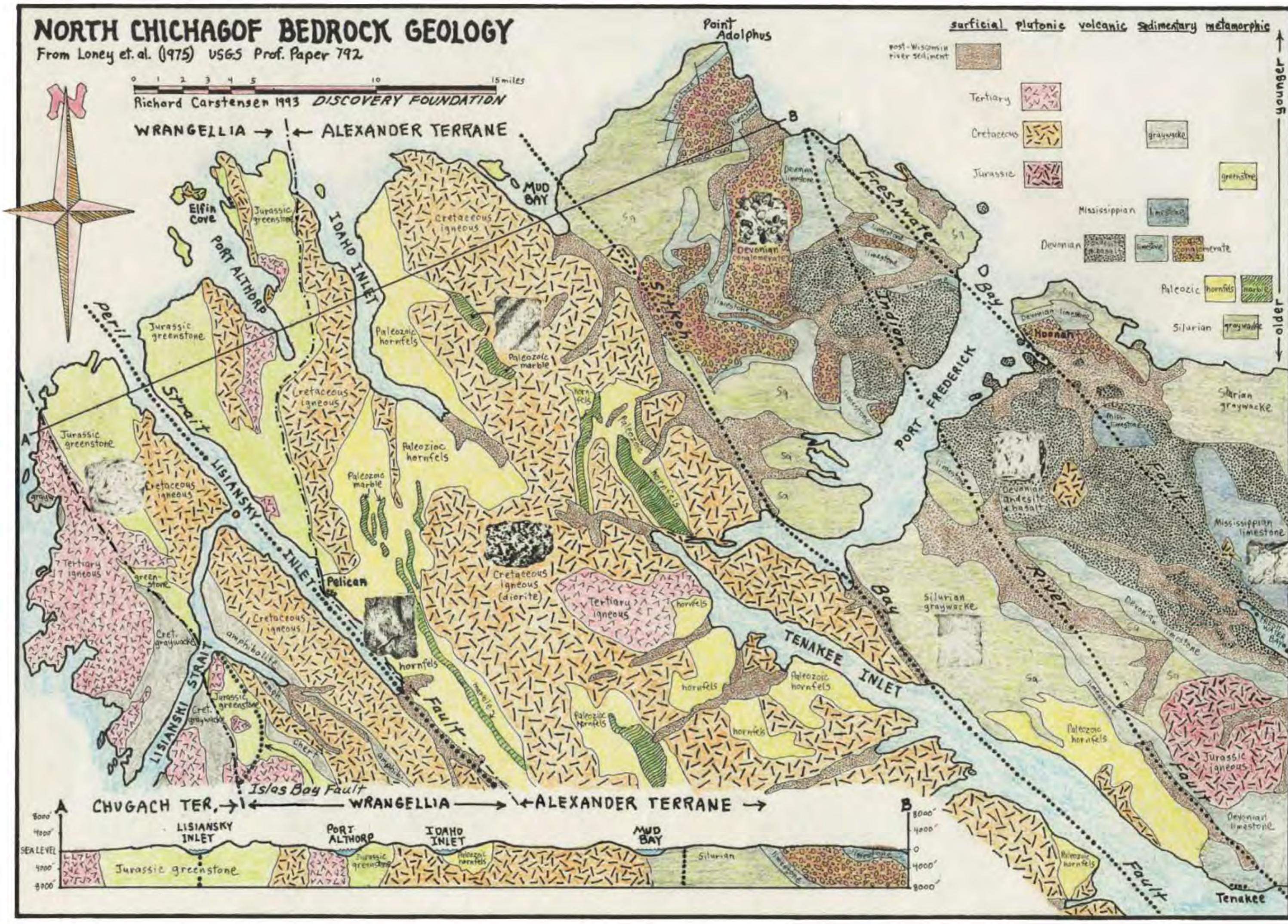
Eventually almost any line of questioning within the immense field of natural history comes to rest on bedrock, and an understanding of its origins. With young children it may make sense to start with mammals; the cuddlier the better. For adults, the bedrock-first approach makes a lot of sense, for the same reason that we start building houses at the basement, rather than the roof.

Bedrock Geology

Our bedrock map of the North Chichagof area is a simplified tracing from Loney et. at. 1975 Reconnaissance geology of Chichagof, Baranof, and Kruzof Islands, southeastern Alaska. USGS professional paper 792. It shows an incredible diversity of rock types, of many different ages. Since the paper was written in the mid seventies, workers have divided northern Chichagof into three major "terranes," from west to east: the Chugach, Wrangellia and Alexander.

To see how these terranes correspond with rocks north of Icy Strait in the Gustavus and Glacier Bay area, study the "Geologic Terranes" map on page 3 of our booklet A Naturalist's Look at Southeast Alaska. Only the dominant rock type in each of the geographic units is shown on our map, and at any particular location, that rock may not be the most important. For example, the Hoonah area is shown within a belt of Devonian "conglomerates", but in fact, conglomerates here are less common than siltstones.

Here is a more detailed description of each rock type. Bear with us. We are going to give you some basic definitions to make the geologic literature more



Rock types of Northern Chichagof. from young to old

Post-Wisconsin

surficial deposits (not solidified into rock yet) On our map, these deposits are shown with fine stipple and are mostly either recent stream and river deposits, or else marine sediments, left between 9000 and 13000 years ago when the sea covered much of today's lowlands. Glacial and rockslide deposits are of course abundant, but occur in patches too small to be mapped on this scale.

Tertiary

plutonic (once-molten rocks that solidified deep in the earth, and thus have coarse crystals) The youngest bedrock shown on this map is a complex on Yakobi and West Chichagof. They are mostly light-mineraled granites, but also include increasingly black-mineraled rocks such as granodiorite, diorite and gabbros.

volcanic (once-molten rocks that solidified at the surface) For you Gustavians, Pleasant Island has a large cap of volcanics unique to the area.

Cretaceous

plutonic These intermediate-age rocks include granodiorite, diorite and gabbros.

sedimentary (once deposits of clay, sand, lime, gravel etc.) Silty sandstones of the outer coast, known as the Sitka graywacke. Also includes rocks made from clay (argillite), gravel (conglomerate), and lime (limestone).

Jurassic

plutonic The oldest once-molten rocks on this map are found in a mass (pluton) between Tenakee Inlet and Freshwater Bay. This includes diorite and various forms of granite.

metamorphic (rocks subjected to enough heat/pressure to change their crystals, but not to melt them) Includes metamorphosed lava flows (greenstones), metamorphosed argillite & shale (schist & phyllite), and meta-graywacke, with occasional metamorphised limestone (marble), in a related complex of formations running through the Wrangellia Terrane.

Mississippian

sedimentary Fossiliferous limestone and shale of the Iyoukeen formation, outcrops from Iyoukeen to Elephant Mountain.

Devonian

volcanic Light-mineraled (andesite) and dark-mineraled (basalt) flows, broken up lows (breccia), vlocnic ash (tuff), minor graywacke, and limestone.

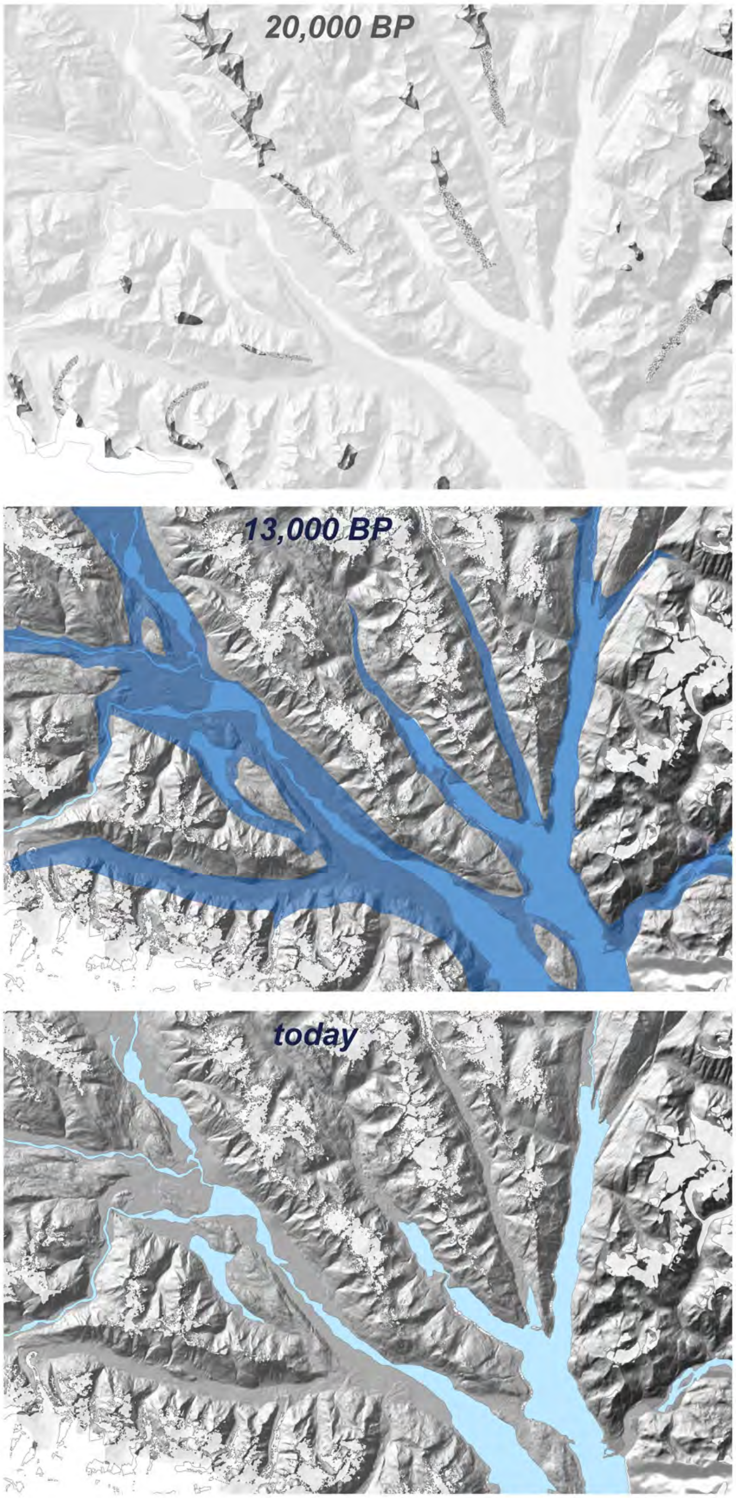
sedimentary The 2 sedimentary types of this age shown are late Devonian limestone, and a diverse member, composed of conglomerate, graywacke, siltstone, argillite, and minor limestone.

Paleozoic ("Paleozoic" is neither older nor younger than Devonian and Silurian, but a broader time category called an "era", which includes the Devonian and Silurian periods. Rocks are described here as Paleozoic simply because they lack fossils which could allow more precise dating.)

metamorphic Two rock types are mapped; rocks metamorphosed by contact with plutonics (hornfels), others metamorphosed by being deeply buried (schist and marble).

Silurian

metamorphic Includes graywacke, argillite, minor conglomerate, siltstone, and limestone.



user-friendly if you want to do do some personal reading. North Chichagof (and Gustavus area) rocks vary in age from about 50 - 300 million years, except for sediments made in recent times that haven't become rock yet.

Glacial history and surficial geology

In North America, the last major phase of the Pliestocene ice ages (a 2 million year period including at least 4 world-wide glacial episodes) is called the "Wisconsin", or for our purposes in speaking to children, the "Great Ice Age". As this glacial advance was peaking 20,000 years ago (first map in historical sequence) all of Southeast Alaska was covered by ice, except for the highest peaks, which protruded like islands through a sea of ice. In the Icy Strait area, land was uncovered by the Wisconsin ice roughly 13,000 years ago (second historical map).

For the next several thousand years, glaciers generally receded in the warming climate. But the land was still slowly recovering from having been pressed down hundreds of feet under the weight of glacial ice. The lowlands between today's Hoonah airport and Spasski Bay lay under the sea, as did the Game Creek valley and the whole Gustavus vicinity.

Then, only a few millennia ago, another series of glacial advances began, minor compared with the Wisconsin, but extremely important north of Icy Strait. The last of these advances we call the Little Ice Age (third historical map). It is best known in Glacier Bay, where ice moved about 60 miles southward, then receded the same distance over the last 2 centuries. At the same time on Chichagof Island, snow fields in some north-facing bowls swelled slightly, but never came close to reaching the lowlands.

Resulting surfaces Most of the surficial deposits shown on our north Chichagof map were laid down by water, either streams and rivers, or the ocean at times of higher sea level. On our field trips we'll be repeatedly stopping to look at the sediments just below the vegetation and organic mat. To describe these materials, we'll consider a gradient of particle sizes, from large to small: boulders, cobbles, gravel, sand, silt and clay.

Glacial till Till is unsorted; that is, it consists of a jumble of all particle sizes, from boulders down to clay. Till blankets many slopes but has been "edited away" from the bedrock map.

Alluvium This is a term for any material deposited by moving fresh water. When streams leave the steep bedrock slopes and encounter more level valley floors or marine terraces, they build fan-shaped deposits. These sites often grow huge Sitka spruce. Similarly, river bottom lands are blanketted with sorted sand, silt and gravel, which supports the highest volume forests of Southeast Alaska.

Talus fans Rocks and gravel falling downslope builds fans which are steeper than alluvial fans. On steep mountainsides this can be the dominant surface type.

Land Mammals of Northern Southeast Alaska

Species	Chichagof I	Admiralty I	Glacier Bay	Haines
Insectivores				
masked shrew	X	X	X	X
dusky shrew	X	X	X	X
water shrew	-	-	X	X
Bats				
little brown bat	X	X	X	X
long-legged bat	-	X	-	-
Rabbits				
pika	-	-	-	X
snowshoe hare	-	-	?	X
Rodents				
beaver	X	X	X	X
porcupine	-	-	X	X
hoary marmot	-	-	X	X
northern bog lemming	?	X	?	?
deer mouse	X	X	X	X
long-tailed vole	X	?	X	X
meadow vole	-	-	-	X
red-backed vole	-	-	X	X
tundra vole	X	?	X	X
muskrat	-	-	-	X
bushy-tailed woodrat	-	-	-	?
red squirrel	I	X	X	X
flying squirrel	-	-	X	X
meadow jumping mouse	-	-	-	X
Hoofed Animals				
black-tailed deer	X	X	X	-
moose		—	X	X
mountain goat	-		X	X
Carnivores				
brown bear	X	X	X	X
black bear	-	-	X	X
wolf	-	-	X	X
Coyote	-	-	X	X
red fox	-	-	[X]	X
lynx	-	-	[X]	X
wolverine	-	-	X	X
river otter	X	X	X	X
marten	I	X	X	X
ermine	X	-	X	X
least weasel	-	—	[X]	X

Marine deposits On the second map in our historical sequence, it is clear that all of today's human communities, and most of the highly productive natural communities, lay under the sea between 13000 and roughly 9000 years ago. Right in Hoonah there are sites more than a hundred feet above sea level which still contain clams and barnacle shells, in a matrix of ancient marine sands and muds.

Lake or pond beds When water stops moving, suspended sediments can settle. If the water level then drops and exposes the bed, high silt content often results in a poorly drained surface.

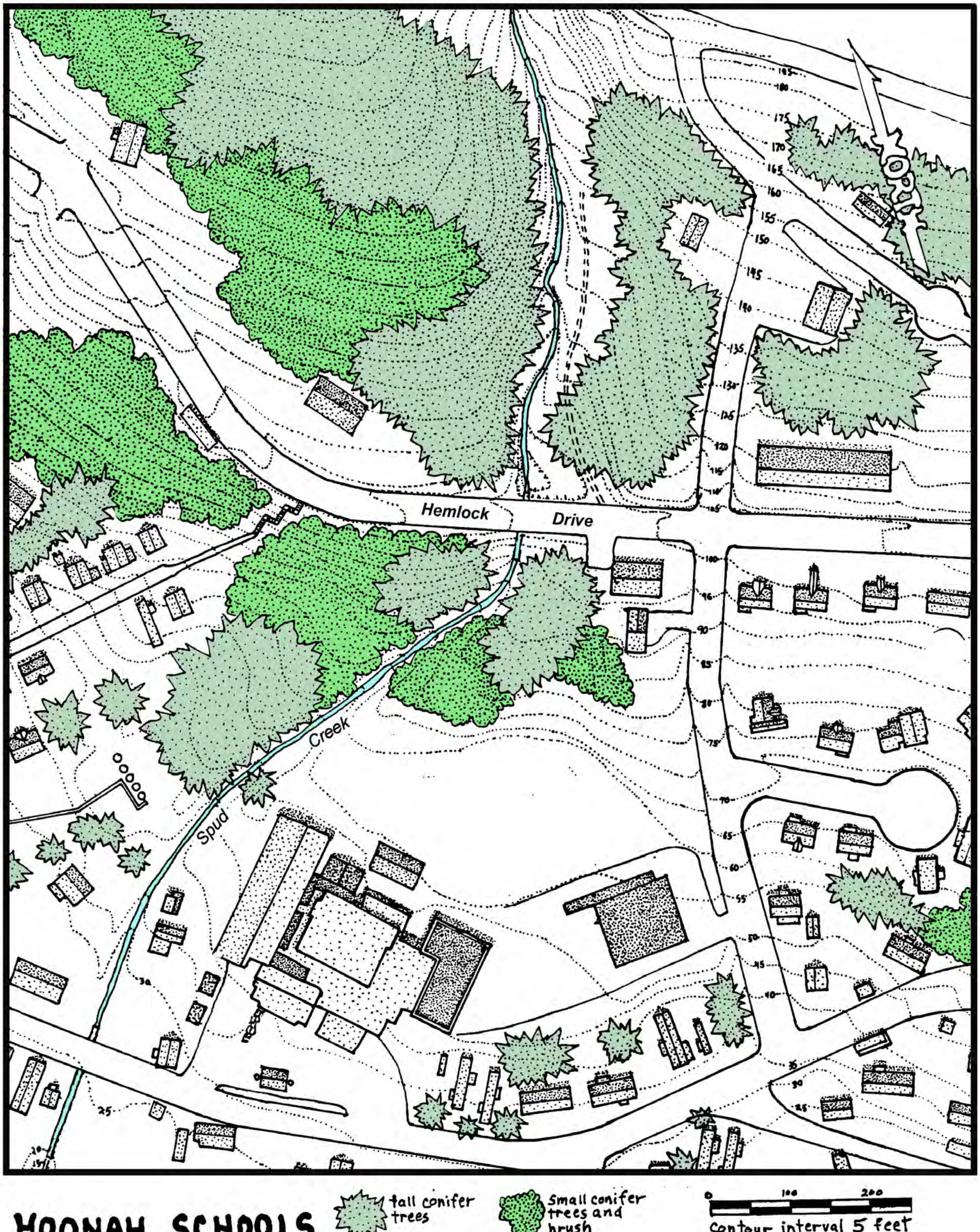
Marine Mammals of Icy Strait

Land carnivores	
sea otter	increasingly common in western Icy Strait
Seals and sea lions	
Steller sea lion	common, non breeder
harbor seal	abundant especially in Glacier Bay, breeder
fur seal	rare in winter, young individuals
elephant seal	rare
Toothed whales	
killer whale	pods of up to 50 transit area
pilot whale	rare
Dall porpoise	common in strait, less seen in side bays
harbor porpoise	common in strait and side bays
Baleen whales	
humpback whale	common in scattered localities, mostly in summer
minke whale	scattered individuals
fin whale	rare
gray whale	rare migrant in west of strait

Geologists often make maps of these different surface types, exotically colored creations that, instead of distinguishing Cretaceous from Jurassic plutons, show curving glacial moraines, or fan-shaped stream deposits. To our knowledge, no such "surficial geology" maps have been made of Hoonah, Pelican, or Elfin Cove. Gustavians are more fortunate; Greg Streveler prepared one for that area, which he can help you locate in a rather obscure publication. If we lived in Arizona, it would be easy to make our own surficial geology maps from air photos, which show features like stream fans in textbook clarity, uncluttered by plants. In lush Southeast Alaska, bare ground is a rarity. Geologists tend to consider plants nuisances, impediments to observation. But to the naturalist, plant communities are dead giveaways to the underlying landforms.

Why? Here in Southeast, where rainfall ranges from a lot to a whole lot, the determining influences on plant communities are not amount of precipitation, but what happens to that moisture after it hits the ground. If it ponds around tree roots and suffocates them you may have a muskeg. If it percolates down through a mix of sand, silt and gravel, providing roots with adequate moisture, but not drowning them beneath a water table that periodically climbs nearly to the surface, a fine stand of old growth may result. And in some places lacking any fine (silt or clay size) particles, such as high energy outwash fans, water can disappear from the rooting layer so quickly that plants like alders die during brief dry spells. Plant communities here are very strongly related to soil drainage, which relates to sediment size, which relates to surficial geologic history. This is why, on field trips, we hope to have you rolling mud around in your hands!

Photos taken on the March 1993 Hoonah trip. Streveler collections of rocks and shells. Clockwise from upper left: Range of sedimentary rocks, from fine (left) to coarse (right) particle size. • Particles within conglomerate rocks are incorporated clasts; crystals within granitic rocks grew in place. • Variety of marine shells excavated and washed from muddy marine sediments in road cut several hundred feet above Hoonah. Age is probably 9000 to 12,000 years. • Series of igneous rocks with intrusives on left and extrusives on right.



HOONAH SCHOOLS
Richard Carstensen 1993 *Discovery Foundation*

Preface RC 2012: This and other slide shows in our *Nature near the schools* workshop series of course literally were ***slide*** shows in the early 1990s; collections of 35-mm slides were included in notebooks placed in all school libraries. For this re-issue of the workshop notes, I've converted the shows to powerpoint format. You can download *icystrait.ppt* from the Discovery website at *www.discovery-southeast.org/xxxxxxxxxxxxxx (needs update)*

Natural History of Icy Strait

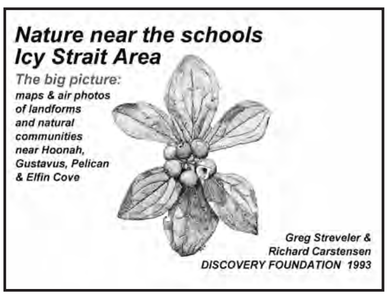
Slide show script

Note to Teachers The natural history workshop for Icy Strait encompassed geology, plant communities, local wildlife, marine ecology, human history and many other topics. These slides are exclusively of maps and air photos, chosen to give the "big picture" of Icy and its environs.

Notes to you as teacher are included in the script in *italics*, and are not intended to be read out loud. You may wish to present some of the technical words, shown in **boldface**, in a separate class before viewing the slides.

If you've never used air photos before, don't be intimidated. We've discovered that students are fascinated (especially when they find their houses or spots they know well). When time permits, we like to have kids come up and point out features on the screen.

The stereogram sheets in this notebook let the kids see selected views around Icy Strait in 3-D. They and the "puzzler" sheet that goes with them make a companion lesson to the slide show. If you have any questions about photo interpretation, or need suggestions on classroom use, contact Discovery, and someone will be glad to help you.



1) title slide

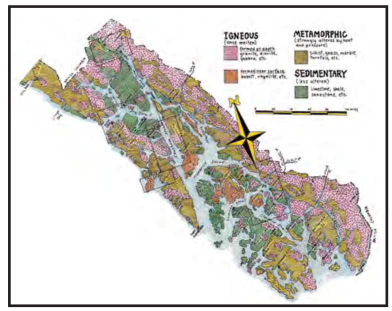
2) USGS topographic map (1:250,000) Maps and air photos help us see the BIG PICTURE. Where do we live? What lives around us? What has shaped this place? What processes are going on today? What will the landscape be like tomorrow?

Icy Strait divides the glacially dominated lands of the Northern SE Alaskan mainland from the older, less glaciated country to the south. Notice that 4 locations of stereograms are indicated with pink outlines: Hoonah, Elfin Cove, Pelican and Gustavus.

The Great Ice Age covered this whole area to a depth of at least 3000 feet Only the major peaks escaped the rounding and gouging effects of the ice, and stand out today as sharp ridges and pinnacles. Some of the high unglaciated peaks show up on the Pelican stereogram.

3) bedrock map of SE Alaska Bedrock is the solid mass of rock making up the earth's crust This is a simplified map of Southeast Alaska's bedrock, lumping together our very complex geology according to the 3 basic rock types: **sedimentary, metamorphic and igneous**.

Sedimentary rocks are sediments (sand, gravel, mud, volcanic ash, etc.) that have been cemented together and thus turned to stone. This process of becoming rock usually happens after more sediments pile on, increasing the heat and pressure. If the heat and pressure becomes great enough that the minerals in the sediments begin to alter their shape or chemistry, we get **metamorphic** rocks. This greater heat & pressure usually comes from getting buried deeper, or from getting squeezed by mountain-building. Once there is enough heat & pressure (generally after the rock has been pressed down miles into the earth), the rock melts. When it re-solidifies, it will become an **igneous** rock.

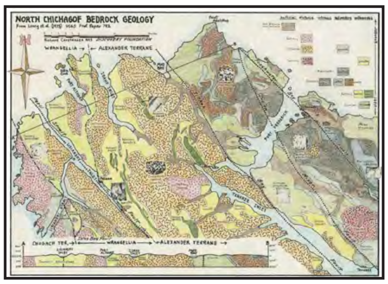


So rocks contain clues about their past history. If an area is made up mostly of sedimentary rock, its history has been relatively calm. But if metamorphic or igneous rocks predominate, there's been a history of more intense burial, erosion and mountain building.

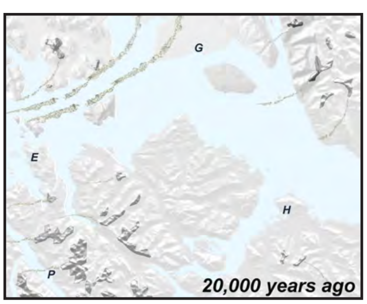
Now look at the area around Icy Strait. The rectangle outlines the area covered by the last slide. What kinds of rocks predominate? A real potpourri! The Icy Strait area has had a varied history. Sedimentary rocks to the east suggest a relatively mild past, but to the west things get more intense. In fact, geologists estimate that in the last 25 million years, the mountains around the western part of ley Strait have risen at least 6 kilometers! But the mountains are less than 2 kilometers high now. Where did the rest of the rock go? That's right, it eroded away. It's mostly sitting out on the continental shelf offshore from Cross Sound, where it is getting buried and turned into sedimentary rock, starting the rock cycle all over again.

4) bedrock geology of north Chichagof area Now let's look more closely at a portion of the Icy Strait area's rocks. Bedrock around Hoonah, labeled **conglomerate**, originated from variety of sediments shed into a marine basin about 400 million years ago. But then notice that there are lots of other types of rocks. They're pretty complicated. (*You have a brief description of them in the Discovery notebook materials.*)

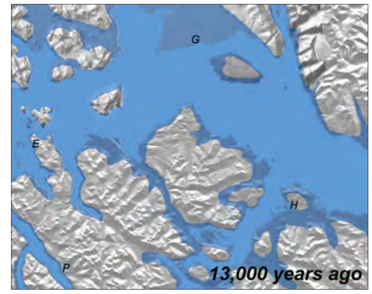
In fact, geologists puzzled over this complexity for years, until coming up with a sci-fi type hypothesis to explain them. The reason the rocks are so chopped up into different little pieces, geologists think, is because they ran into North America! That's right, they once were at least 2 separate parts of the earth's crust that drifted into North America, and in the process got all jumbled up. (*To take that thought further, see* <u>*A Naturalist's look at Southeast Alaska*</u> *in your packet of materials.*)



5) Icy, 20,000 yrs BP At the peak of the Great Ice Age, about 20,000 years ago, almost all of this scene was covered by ice. It was about a mile deep in the northeast corner (upper right), dropping to about half that depth in the southwest (lower left). Future locations of Hoonah, Gustavus, Elfin and Pelican are marked by the letters H, G, E and P. We've also added streaks of morainal debris, dragged off the protruding nunataks by the moving ice. This gives a sense of the principle converging streams.



6) Icy, 13,000 yrs BP By 13,000 years ago, the ice had uncovered this scene, but the land remained depressed. We think it was about 400 feet lower than today (relative to sea level) in the east, and only about 60 feet lower in the west). Here's how the shorelines look according to those assumptions. There were many islands that have since merged, and the land was only sparsely vegetated.

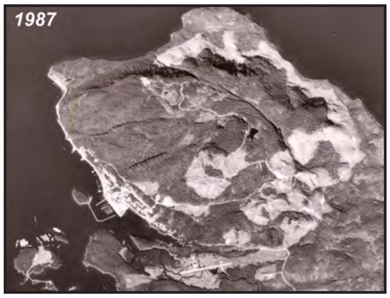


7) Icy, 250 yrs BP At the peak of the Little Ice Age, a giant glacier protruded from what is now Glacier Bay. Where it came to rest is now a shallow, submarine terminal moraine that causes extreme turbulence as tides enter and exit the bay. Outwash rivers created the Gustavus forelands, and the productive bottomlands of Dundas Bay to the west.

8) 1979 aerial infra-red view of Hoonah area Some photography is done with film sensitive to a part of the spectrum of sunlight called infra-red. That film is particularly able to highlight differences in vegetation. On this photo, the gray-red areas that are textured like cauliflower are forest, while the paler, less textured areas are salt marsh, peatlands, brush, subalpine meadows or young, second-growth forests. Blue-gray areas are mostly unvegetated, such as downtown Hoonah and parts of the intertidal zone. Forests with largest trees have roughest texture.

This photograph was taken prior to extensive logging, and so the original mosaic of natural habitats can be studied. The extensive peatland system in the lowlands, and the sedimentary deposits laid down by Gartina and Game Creeks are particularly evident.

9) 1987 aerial b&w, same area About a decade later, logging of Native lands was well underway. How much of the original large-tree forest remains? (*Flip*

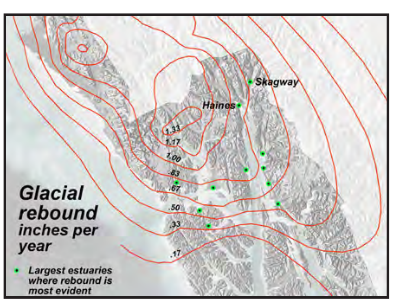


back and forth between this slide and the previous one.)

Before we go on to the next slide, study the airstrip at the bottom of the photo. Find the creek entering these wetlands from the south. This is Gartina Creek. Okay, now let's zoom in ...

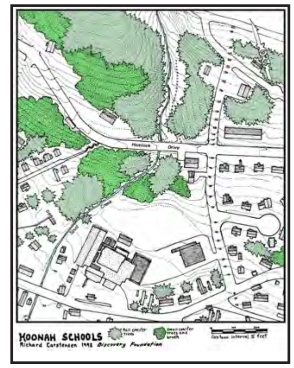
10) color aerial closeup of Gartina slough Here we are looking at a big flat built by Gartina Creek. Identify thesse habitats: open mud flat, salt marsh, to uplift meadow, forest, recent clearcuts. The marsh and meadow are particularly important fish & wildlife habitats. The meadow habitat is far more extensively encountered in northern SE Alaska than in the portions of the region to the south, for reasons that the next slide will illustrate.

11) map of rebound rates When ice in Glacier Bay extended to near Gustavus 200 years ago, this extra weight pressed the land down. When the weight was removed in recent centuries, the land rebounded in proportion to its distance from the ice. (Geologists have recently also found that an undetermined portion of land rise is due to mountain building in the Glacier Bay area.) Notice that the Icy Strait area is rising relative to sea level at more than half an inch per year. This rate is fast enough that gently-sloping tidelands rise above the tide at a rate too fast for forest to immediately colonize. So we get a band of lush meadow that trees and brush are moving out into. As long as the uplift rate remains rapid, this meadow zone between forest and sea will constantly be forming to seaward even as the forest encroaches on it from landward, and we will retain these small but critical areas.



Compare the 4 Icy Strait communities: Hoonah, Gustavus, Elfin and Pelican. Which is rising fastest? (*Gustavus*) Slowest? (*Pelican*)

12) school map 1993 Here's our Discovery Map for Hoonah schools, made during our teacher workshops in 1993. It portrays locations of the cut & fill the school sits on, tall-tree forest, smaller brush, Spud Creek, and surrounding developments. Only the forest area colored in green is was an approximately natural state. In our Nature Studies programs for Juneau Schools, *Discovery Southeast* uses maps like these to record observations on outings from the schools. We've learned that nearby nature is precious for teachers and students who can quickly access such places on foot.[1]



13) school 1982 The above map was made largely by tracing from this earlier 1982 air photo. Spud Creek is highlighted in blue. Of particular interest was the patch of forest between the school and Hemlock Drive. Trace Spud Creek through this forest. A group of large trees persisted close to the school; the rest consisted of smaller, more tightly packed individuals, indicating younger, second-growth forest. Now follow Spud Creek upstream to where it crosses the right-of-way. Notice the fan-shaped feature the excavator is

1 PS, RC 2012 In the early 1990s, Greg Streveler and I were excited by the educational potential of the little patch of forest along Spud Creek. In view of subsequent habitat loss, I removed Greg's following questions from the script. In one sense, keeping them could be considered crying over spilt milk. But it's worth retaining them in footnote form as an object lesson, about the value of nearby nature.

"The small natural area near school is highly classroom-accessible and therefore valuable to protect. If this were to become public policy for the area, what should be its boundaries? Put another way, what is the smallest unit of land that could function as a separate natural system if surrounded by development? Consider that question from the standpoint of a deer, a mink, a humpy, a hemlock tree and a varied thrush. And from that of a class from Hoonah School."

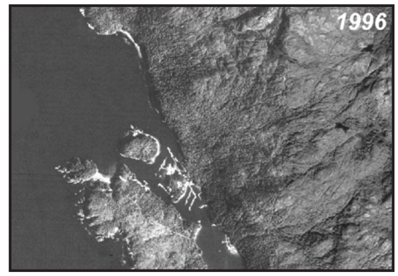
trenching into. This is probably an old delta built by Spud Creek when sea level was up to there. Geologists think this was sometime after glaciers backed off the area about 14,000 years ago, as the land was rebounding from its major loss of ice load. All of Hoonah was once under salt water.

14) school 2007 On this more recent photo, the tall-tree forest north of Spud Creek has been logged. Where is the next-closest intact forest to the school? What is its value to, say, a mink? Or a biology class with 45 minutes to spend outside? Toggle several times between 2007 and 1982. What other changes happened in that interval?

15 aerial view of the Pelican area Lets finish this slide show by considering views of other Icy Strait area communities. This slide shows Pelican, which guards the mouth of the large basin of Pelican Creek. Trace the creek up from its mouth. Follow the various tributaries as far as you can. Collectively they drain the larger basin that occupies most of the view in the slide. The total area drained by the creek is its watershed.

Pelican is built on the raised delta of Pelican Creek, that is,on deposits it has pushed out into Lisianski Inlet, and the upper parts which were eventually lifted out of the intertidal by rebound of the land. But tides in Lisianski are powerful, and normally the longshore currents wash away any such deposits faster than they can accumulate. Do you see anything about Pelican's location that might protect it from longshore currents? (*The islands and the cold storage point both protect the delta.*)

16 aerial B&W of Elfin Cove Elfin cove sits in a tiny notch in the shoreline of Cross Sound, not far from the open sea. Notice the shorelines on the west (left) are notched and eroded, while those inside the cove are more smooth. Which do you think are most exposed to wave action? This area was heavily scoured by ice during the Great Ice Age. The few areas of sediment evident in this photo have been made since that time by small creeks and by material scoured from the shores by waves. Check the preceding geology map (slide 3) to see what bedrock occurs here (*Lowlands of Jurassic greenstone; highlands of Cretaceous granitics.*)



17) 1979 color infra-red of Gustavus forelands Gustavus is a very different place from the other townsites along Icy Strait. It is a large flat made up of the confluence of 3 big river fans that were mostly deposited by water coming out of the Glacier Bay ice sheet prior to 2 centuries ago.

Find the 3 fans by following the flow lines in the water-deposited sediments. The boundaries between them are defined by the present-day course of Good River, which flows out to Icy Strait along the middle-right margin of the slide.

Notice the pattern of forest. Why would most good forests be found along watercourses? Hint: think of what a creek does to the water table when it trenches down. (*Lower water table means improved drainage in an otherwise very marshy area.*)

Annotated bibliography for Icy Strait

City of Hoonah. 1984. *Coastal Management Plan*. 84p. • *A major reference with much useful resource & planning material.*

Cwynar, L. 1990. *A late Quaternary Vegetational history from Lily Lake, Chilkat Peninsula, Southeast Alaska*. Can. Jour. Botany.68, .p 11 06-12. • *Study of vegetation of Haines area from 10,000 years ago to present. Picks up where Engstrom paper leaves off*

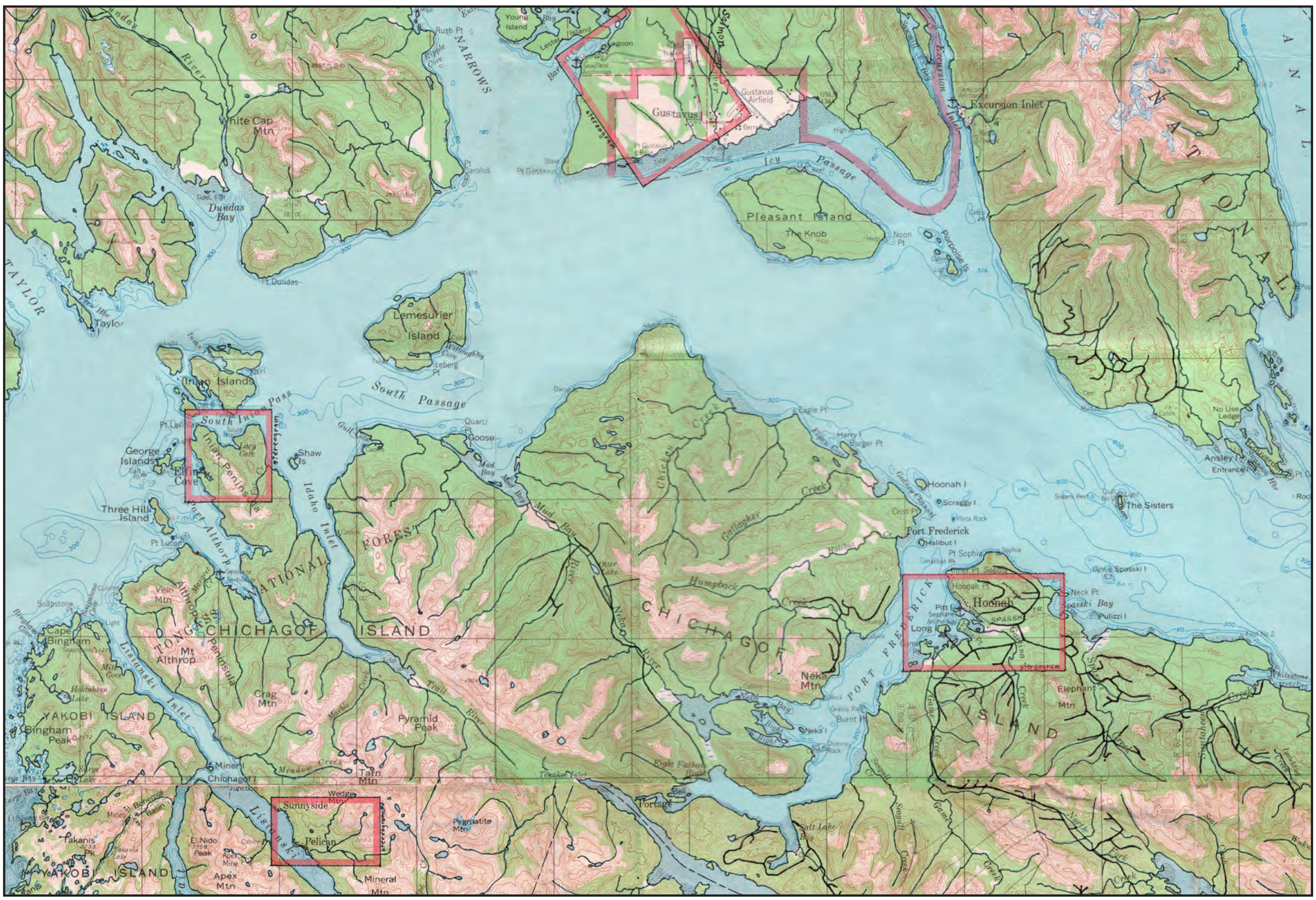
Engstrom, D., et a1. 1990. A *Possible Younger Dryas Record in Southeastern Alaska*. Science 250, p. 1383-85. • *Describes vegetational history from time of deglaciation about 3,500 years ago to the arrival of spruce* *about 10,000 years ago.*

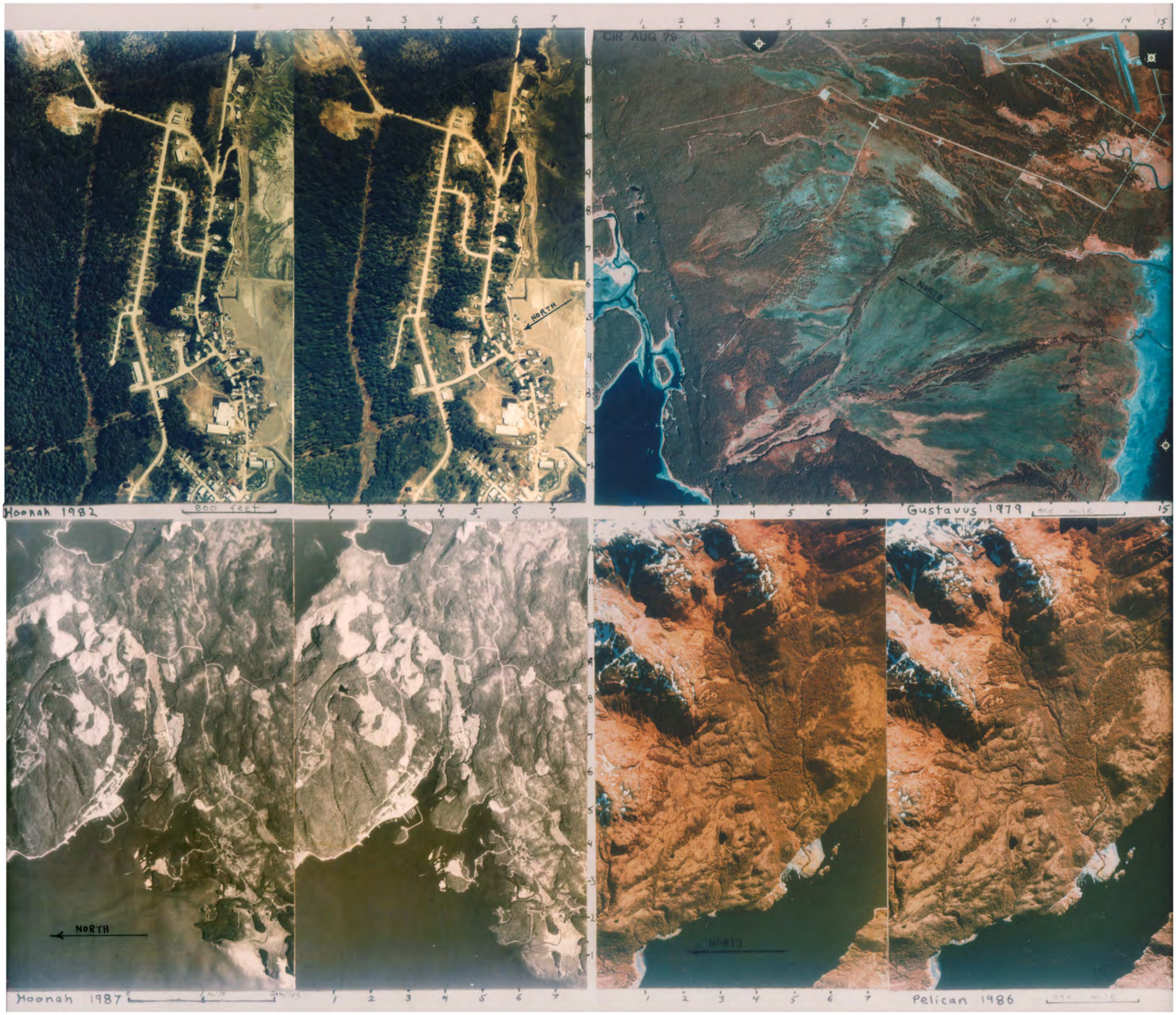
Loney, R. et al 1975. *Reconnaissance Geology of Chichagof, Baranof and Kruzof Islands, Southeastern Alaska*. U.S. Geol. Survey Prof. Paper 792. 104p., map. • *The key geologic reference for the whole Chichagof Island area*.

Flynn, R. 1993. *Ecology of Martens in Southeast Alaska, AK*. Dept.of Fish & Game rept. on proj. W-23-5. 41 p. • *Summary of on-going studv on ecologv and population dynamics of a species threatened by habitat loss and heavy logging on both federal and Native lands of northeastern Chichagof Island.*

Schroeder, R. and M. Kookesh. 1990. *Subsistence Harvest and Use of Fish and Wi ldlife Resources and the Effects of Forest Management in Hoonah, Alaska*. Tech. Paper # 142 , Div. of SubSistence, Ak. Dept. of Fish & Game, Juneau. 325p. • *Comprehensive documentation of subject as stated in title.*

Titus, K. and L. Beier. 1992. *Population and Habitat Ecology of Brown Bears on Admiralty and Chichagof Islands. AK*. Dept. of Fish & Game rept. on Proj. W-23-4. 27p. • *Summary of on-going study on ecology and population dynamics of this threatened species.*





Stereograms for Icy Strait area For instructions, see *Using the stereoscopes and stereograms* in the introduction to this manual. You can either print this page, or else scale the stereograms on your monitor and hold a stereoscope to the screen. Note the north arrows point in different directions on these photo-pairs. Layout of stereograms is constrained by flight-line direction.

Icy Strait stereogram puzzlers

Locations of these photos are shown as pink rectangles on the preceding Icy Strait topographic map.

First, let's look quickly through the entire Icy Strait stereogram collection. On one side of the sheet there are views of 4 areas; 3 are stereograms, and one, of Gustavus, is a single photo which cannot be viewed in stereo. The Gustavus photo is color infra-red, taken from high elevation in 1979. Proceeding clockwise from the Gustavus photo, we come to a 1986 color infrared stereogram of Pelican, then a 1987 black and white stereogram of the Hoonah area. Studying the scale bars, note that these 3 images are “broad scale,” each encompassing more than 10 square miles, and houses can barely be seen. The fourth stereogram, a true color 1982 pair of downtown Hoonah, is finer scale. The scale bar covers only 800 feet, rather than a mile as in the other images, and details of buildings are clearly visible.

On the back side of the sheet are 2 more stereograms. The. longer one is a color infrared of the Hoonah area in 1979, showing forests that have since

been clearcut. The small black and white pair shows Elfin Cove in 1987.

1) Begin with the true color stereogram of downtown Hoonah in 1982. Before trying to interpret air photos, it helps to consider location, compass direction and scale.

a) What are the coordinates of the school? Temporarily close your left eye so the numbers on the edge of the right photo are easier to read. Starting at the lower left corner of this photo, count over, then up to the school. It's over 6, up 2. We write this as 6—2. What are the coordinates of the piles of logs in the upper left corner?

b) Two streets (Hemlock and Raven) intersect at 4—3. Starting at this point, follow Raven Drive which drops downhill to the waterfront. What direction are you going? Was that question too easy? Okay, here's a tougher one. Find a tree which stands by itself so you can clearly see the direction cast by its shadow. About what hour of the day was the photo taken?

c) Spud Creek enters the stereogram at 0—1 and flows down an obvious gully to a culvert under Hemlock Street. Then it runs along the edge of the school grounds to another culvert under First Street, emerging in the intertidal. How far is it as the raven flies from Hemlock culvert to First Street culvert? The easiest way to measure this is to hold the edge of a piece of paper against the scale bar and mark off 800 feet, then slide this up to the culverts. Try measuring this same distance on the map of the school area. Do your measurements agree?

d) If you are from Hoonah, or a particularly observant visitor, you can probably find buildings present today (1993) which are missing on this 1982 stereogram. How many can you name?

2) Now go to the black and white stereogram of the Hoonah area, taken in 1987.

a) What are the coordinates of downtown Hoonah?

b) Find the airstrip. What direction does it lie? Notice that at both ends of the runway, the forests have been cut away for quite some distance. This is called the end clearance zone, maintained for the safety of arriving and departing planes. How long is the entire clearance zone, from east to west? Now find the donught-shaped clearcut on the south slopes of Hoonah Mountain, the one with the patch of remaining trees in the center, at 2—7. What is the diameter (distance across) this clearcut, from north to south?

c) Trace Gartina Creek from where it enters the photos at 7 1/2—9, to the airstrip at 4 1/2—7. Would you say that the forest along either side of Gartina Creek is thicker or sparser than the general region the creek flows through? Any idea why?

3) Flip the page over and study the color infra-red stereogram of Hoonah in 1979. Notice that north is in a slightly different direction than in the 1987 black and whites. This will make it a little tricky to compare photos, so be careful to find landmarks

which occur on both. On these color infra-reds, the darker red areas are conifer forest, the paler pink areas are open habitats like meadow and salt marsh, and the yellowish patches (6—8 for example) are muskeg.

a) On the 1987 black and whites, the largest clear-cut is on the northeast-facing hillside at 1—10 1/2. What are the coordinates of this area on the 1979 CIRs? You can locate it by imagining a line from the little lake at 3—16 (1979s) and Neck Point in Spasski Bay. The cut area occupies a good deal of this line. Examine the pre-clearcut forests on the 1979s. Would you say this forest is bigger or smaller than average for the general area?

b) Were these 1979 CIRs taken during a high or low tide?

c) Game Creek enters the photos at about 8—3, and flows north to the intertidal at 4—7. Do you see any evidence that it may have reached the sea ~here in the past?

4) The single photo of the Gustavus area can't be viewed in stereo, but you may wish to use one lens of the stereoscope to examine it in detail. We forfeited stereo here for 2 reasons: because the terrain is so flat that 3-D doesn't add a great deal of information, and because we could show twice as much area with a single photo. To understand Gustavus you need to understand Bartlett Cove.

a) A prominent ridge runs NE-SW across the left side of the photo, from 3—1 to 2—9. This is not a bedrock ridge, but surficial material. What could account for this pile of loose materials, from boulders down to silt and clay, over a hundred feet high?

b) This ridge is broken through at 3 1/2—1, a place known as Cooper's Notch, and from there a series of pinkish channels runs toward the southeast. At 7—3, they spread out into a huge fan of river deposits, 3 miles across. Do you see other places where the Bartlett Cove ridge (question 4a) was breached by running water? Are they older or younger than Cooper's Notch?

5) Below the Gustavus photo is a stereogram of the Pelican area.

a) Generally the shores of Lisianski Inlet are quite steep. Why is there a large tidal flat at 6—3, in front of town?

b) If you compare the places covered by forest to the open muskeg areas, it becomes quite clear that forests do best on the steeper slopes, while the flat areas are mostly open muskeg. The one obvious exception to this is a sausage shaped patch of very big trees, almost 2 miles long, extending from 5—5 to 7—9. What accounts for this forest?

c) Find the highest point on this stereogram. What are its coordinates? This peak has no name, but at 3500 feet, stands slightly higher than Wedge Mountain, which is just left of the photo, forming the northern edge of the Pelican Creek watershed. Consulting the first map of your historical series, how high did this peak protrude above the ice during the last Great Ice Age?

6) Last and least (in size only!), find the small black and white stereogram of Elfin Cove.

a) What are the coordinates of the head of the cove?

b) Consult your northern Chichagof bedrock geology map. What are the two rock types in the immediate vicinity of Elfin? Of these two types, which forms the high ridge east of town?

c) South Inian Pass is at 1—1. Were these photos taken during a flood or ebb tide?

Answers to the puzzlers

1) Hoonah close-up
a) 1—12
b) South. Tree shadows point north, so the sun is directly south. This occurs at noon.
c) On the photos, the distance is almost exactly the length of the scale bar, or 800 feet. On the map, from culvert to culvert. the distance is about 770 feet.
d) The new pool is at about 6—3. Our Hoonah Schools map shows this and other new buildings. plus the extension of Ravin Drive. There are also new houses on Hemlock Street that don't show on our map.

2) Hoonah b&w 1987
a) 3—5
b) The airstrip lies roughly east-west. The total cleared area is about 2 miles long. The diameter of the donught-shaped clear cut is about 1/2 mile.
c) The margins of Gartina Creek support much bigger trees than the surrounding bogs and scrubby forests, where the soils are too wet for optimum growth. In stereo you can see that the creek is entrenched below the general surface. Ground water slopes from the surroundings down to the creek bed, creating a better-drained area along the channel margins. There are several other reasons why big trees are often found along streams and rivers (*for example see answer 5b, concerning Pelican Creek*), but reprieve from regional high ground water is our best guess for Gartina.

3) Hoonah CIR 1979
a) The clearcut forest is at about 4—19. The area to be cut shows very big trees in 1979.
b) Low tide, extensive areas of tide flat are uncovered. c) At 3—4 is a large delta deposit with no apparent feeder stream.

4) Gustavus 1979
a) This ridge is the terminal moraine, marking the farthest down-bay position of the Glacier Bay ice sheet during the recent little ice age. The ice plowed up a huge pile of unsorted till, then began to melt away in the mid-1700's.
b) Another breach point in the terminal moraine can be found at 2 1/2—6 1/2, spreading into a fan similar to that emerging from Cooper's Notch. At the contact of these two fans, about 8—6, the Cooper fan has erased its neighbor to the north, and must therefore be younger.

5) Pelican 1986
a) This flat is the delta of Pelican Creek, whose sediments were deposited on reaching the sea.
b) This big forest grows on the deposits of Pelican Creek. which over thousands of years has built a level floodplain within a "U-shaped" glacial valley. Stream sediments tend to provide optimum drainage (neither too wet nor too dry) for tree growth.
c) Geologists have determined that maximum ice depth near the outer coast was about 2000 feet deep (2/5 mile). 3500 foot peaks would therefore have protruded as 1500 foot islands through the ice sheet, which lay at about the level of the lowest snow patches on this stereogram.

6) Elfin Cove, 1987
a) 6-2
b) The 2 rock types on the peninsula are Cretaceous granites and Jurassic greenstones. The ridge above Elfin is composed mostly of granitic rock, which is more resistant and survived erosion by many waves of glaciation over the past few million years.
c) Eddy lines on the outside (west) of the pass indicate an ebb tide.

In 1929, the US Navy photographed the cannery just northwest of Hoonah, at what was named Cannery Point. This facility was since converted to a major tourist attraction, hosting ships that visit the area for ice-viewing in Glacier Bay and whales at Point Adolphus

Teaching the Natural History of Southeast Alaska

DISCOVERY FOUNDATION **teaching aids and reference materials for Chatham Strait Area Schools**

CHATHAM STRAIT SCHOOLS

course outline

FRIDAY EVENING 6 - 9PM

Introductions
- who's who; what's the Discovery Foundation anyway?
- key ideas; a cruise through the handouts
- deer and blackcod as flagship species

Chatham in 3-D - using stereoscopes; some puzzlers about your home locality
Natural communities of the land - changes with time, altitude, wetness
The marine environment - tides & currents; bottom and midwater communities; annual cycle

SATURDAY 10AM - 6PM

Wildlife
- more on deer; bears; some of the minor players
- islands and animal distribution

Geology - rocks, fossils and crustal plates
Field trip prep - Angoon natural history, intertidal, forests
Lunch 1-2pm
Field trip 2-6pm along trail to cemetary and back along beach
- on the way out: exercises characterizing forests
- on the way back: beach geology, intertidal life

SUNDAY 9 AM - 5PM

Intro to school vicinity
Field trip 10-12am characterizing the school grounds forest and bog communities
- in search of a study site for Angoon schools
- applying mapping and descriptive methods to the site

Edibles - the tastebud's opinion of plants and invertebrates
books and publications for the Chatham natural historian
Natural history and the school curriculum - brainstorming on interdisciplinary projects
3-ring circus
- A penultimate perambulation through trophic, systematic and geographic ecology

Evaluations

Natural history of the Chatham Strait area

A Discovery Foundation site interpretation workshop

Natural history studies encompass everything from "bugs to bedrock." Obviously this is far more than we can hope to cover in a weekend workshop. But we do hope to impart some of the naturalist's excitement over interrelationships.

For example, what accounts for the presence of deciduous tree leaf fossils in the sand- and mudstones of Kootznahoo Inlet? How do those rock types affect distribution of forest and peatland . . . and in turn the nutrition of Sitka black-tailed deer?

A naturalist asks questions like these. Conclusive answers are few and far between, but the result of our curiosity is a deepened sense of place, and an appreciation for the workings of the land. Teaching children to ask these questions is more rewarding than providing them the answers.

A typical natural history sketch proceeds "from the ground up". It begins with the underlying bedrock "skeleton", which is then "fleshed out" with surficial deposits like glacial and river sediments. These are covered with the "skin" of soils, and a "coat" of vegetation. We should probably terminate our analogy at this point, since the area's fauna would have to be likened to fleas or lice.) And many natural history descriptions end with a chapter on people.

This is not the order in which most of us learn about the land. As children we may first be attracted to the doings of our fellow human beings, then to those beings who most resemble people, like mammals and birds, then to fish, bugs, and only later to plants, and still later to rocks and other inanimate objects.

Just as we can guide childrens' interest to bedrock via beavers, we can lead them to a study of nature by way of the layout of human communities. In our work at Juneau area elementary schools we've been delighted at students' reactions to projected air photos. Irs hard to keep kids in their seats as they search for their houses on the screen. And examination of roads and buildings leads easily to natural features, like different forest types, or glacial landforms, especially in a place like Icy Strait and Glacier Bay, where spectacular glacial history has drawn researchers from all over North America.

Let's take ourselves, Homo sapiens, as a starting point, and ask a series of "why" questions that will sooner or later lead us back to bedrock.

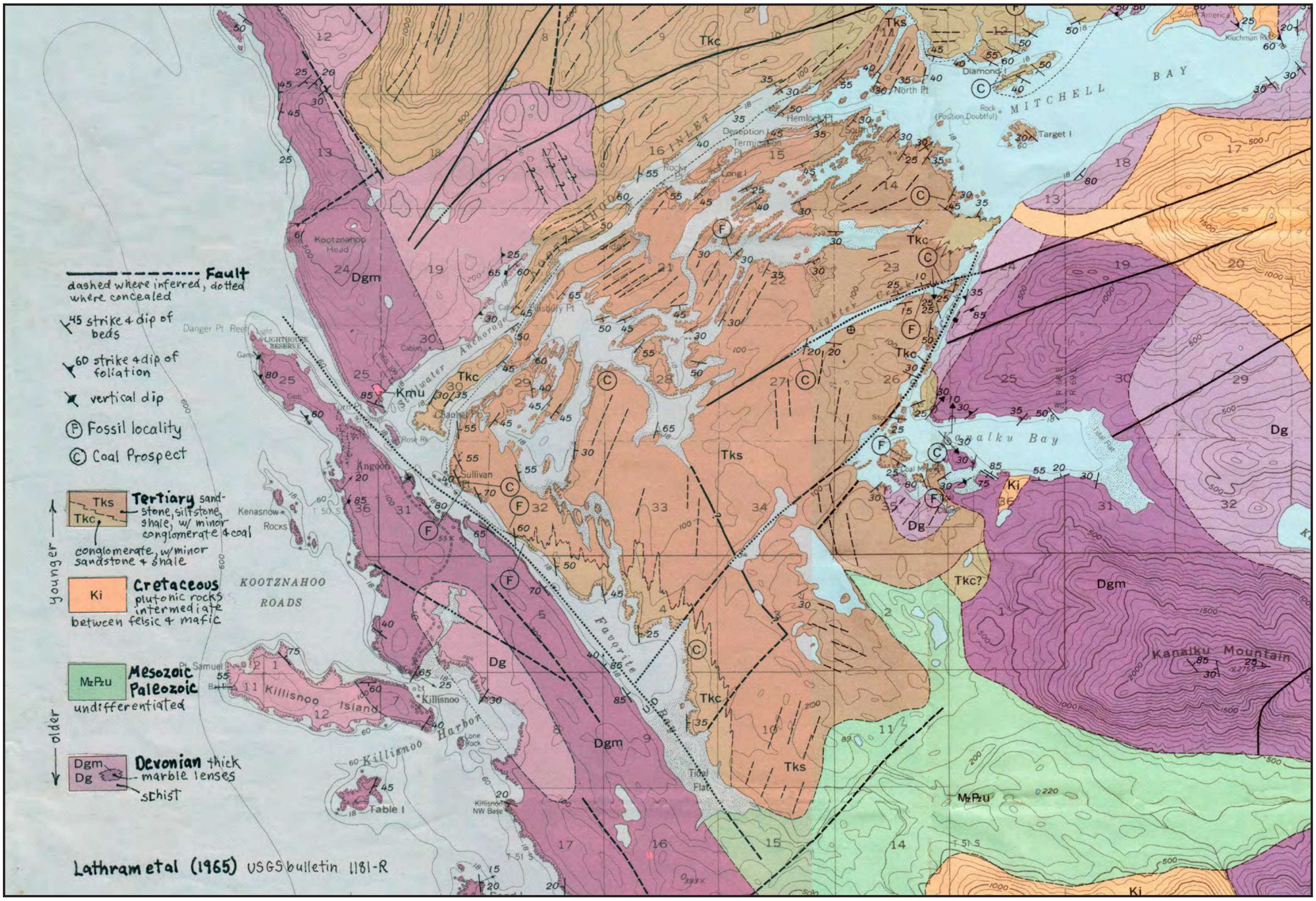
First, of all the potential townsites in the Chatham Strait area, why have people chosen to settle most densely at Angoon? Early folks had a lot of places to choose from. What attributes would they have been looking for in a potential home? Think of good beaches, shelter from weather, abundant resources, defense possibilities .....

The next series of questions follow naturally: What formed the beaches? The weather patterns? Why are there good fish streams? Good game populations? Attempting to answer these lead us to consideration of soils, nutrients, activities of erosion and deposition .....

Next questions: Where did the materials for the beaches come from? How did the soils form? Where do the nutrients come from? And the topography that dictates local weather?

Eventually almost any line of questioning within the immense field of natural history comes to rest on bedrock, and an understanding of its origins. With young children it may make sense to start with mammals; the cuddlier the better. For adults, the bedrock-first approach makes a lot of sense, for the same reason that we start building houses at the basement, rather than the roof.

Coarse sandstone on the beach in Favorite Bay, behind Angoon.



PS RC 2012: Although computers (laughable as they were by today's standards) ***did*** exist back in the Dark Ages when Greg and I gave these workshops, the digital files are on floppy disks, unreadable by any machine in my present fleet. I've been able to update most of the workshop materials from other community workshops by scanning paper originals and running optical character recognition (OCR).

But in the case of Angoon materials, the (nearly-out-of-ink?) dot-matrix printer we were able to borrow gave such low-res output that OCR from scans yields only gibberish. My alternatives were to hand-type it all over again, or just insert raster copies of the scans. Sorry; I chose the latter . . .

Bedrock geology

Our bedrock map of the Angoon area comes from Lathram et. al. 1965 *Reconnaissance geology of Admiralty Island, Alaska*. USGS bulletin 1181-R. In one small area, it shows igneous, sedimentary and metamorphic rock types, of many different ages. Since the paper was written in the mid sixties, crustal plate theory has drastically restructured our understanding of geology. Workers like Dave Brew have divided Southeast Alaska into several different "terranes," or wandering crustal fragments, each with its own geologic history. To see where the Chatham Strait area falls within these terranes, study the "Geologic Terranes" map on page 3 of our booklet *A Naturalist's Look at Southeast Alaska*. The Alexander terrane forms the Chichagof and Catherine

Island side of Chatham, and the Admiralty side is a mix, of Wrangellia and Alexander terrane rocks.

But although we now have a different idea of where Angoon's rocks came from, the old sixties maps are still plenty accurate (sandstone is still sandstone!) To get a bigger geologic picture than just the Angoon area, see the map of Admiralty in Lathram (1965), and for the western side of Chatham strait, consult the maps in Loney et. al. 1975 *Reconnaissance geology of Chichagof, Baranof, and Kruzof Islands, southeastern Alaska.* USGS professional paper 792. Meantime, here is a decription of the rock types near Angoon.

Rock types of the Angoon area, from young to old

Tertiary

sedimentary The areas shown in shades of tan, labelled Tks and Tkc, are nonmarine sandstones, siltstones, shale and conglomerates. Beds are crossbedded and crumbly south of Kootznahoo Inlet and contain abundant plant fossils and thin coal layers. Tree leaves were apparently preserved in the muds of a swamp, about 40 million years ago, and more closely resemble the deciduous species of today's Appalachian mountains than the conifer forests of Southeast Alaska.

Cretaceous

igneous The yellowish colored areas labelled Ki are made of granitic rocks, including quartz diorite and granodiorite.

Mesozoic/Paleozoic (The Mesozoic/Paleozoic boundary was roughly 225 million years ago.)

metamorphic This rock unit is "undifferentiated," which is geologists' lingo for "we didn't have time to look!"

Devonian

metamorphic The oldest rocks near Angoon are those actually underlying town, impure marbles and schist, formed about 350 million years ago. Coral fossils have been found in this same unit, from a bluff north of Chaik Bay.

Glacial History and Surficial Geology

In North America, the last major phase of the Pliestocene ice ages (a two million year period including at least four world-wide glacial episodes) is called the "Wisconsin", or for our purposes in speaking to children, the "Great Ice Age". As this glacial advance was peaking 20,000 years ago (see map in historical sequence) all of Southeast Alaska was covered by ice, except for the highest peaks, which protruded like islands through a sea of ice. In the Chatham Strait area, land was uncovered by the Wisconsin ice roughly 13,000 years ago (see second historical map).

For the next several thousand years, glaciers generally receded in the warming climate. But the land was still slowly recovering from having been pressed down hundreds of feet under the weight of glacial ice. The lowlands between today's Hood and Chaik Bays lay under the sea, as did the area connecting the Kadashan and Sitkoh Bay drainages.

Then, only a few millennia ago, another series of glacial advances began, minor compared with the Wisconsin, but extremely important north of Icy Strait. The last of these advances we call the Little Ice Age (see third historical map). It is best known in Glacier Bay, where ice moved about 60 miles southward, then receded the same distance over the last two centuries. At the same time in the Chatham Strait area, snow fields and an occasional glacier in some north-facing bowls swelled slightly, but never came close to reaching the lowlands.

Resulting surfaces The surficial deposits blanketting bedrock in the Chatham Strait area were laid down either by glaciers, when the Wisconsin ice was receeding, or by the ocean at times of higher sea level, or more recently by streams and rivers. On our field trips we'll be repeatedly stopping at roadcuts or streambanks to look at the sediments just below the vegetation and organic mat. To describe these materials, we'll consider a gradient of particle sizes, from large to small: boulders, cobbles, gravel, sand, silt and clay.

Glacial till Till is *unsorted*; that is, it consists of a jumble of all particle sizes, from boulders down to clay. Till blankets many slopes but has been "edited away" from the bedrock map.

Alluvium This is a term for any material deposited by moving fresh water. When streams leave the steep bedrock slopes and encounter more level valley floors or marine terraces, they build fan-shaped deposits. These sites often grow huge Sitka spruce. Similarly, river bottomlands are blanketted with *sorted* sand, silt and gravel, which supports the highest volume forests of Southeast Alaska.

Talus fans Rocks and gravel falling downslope builds fans which are steeper than alluvial fans. On steep mountainsides this can be the dominant surface type.

Marine deposits On the map showing post-Wisconsin sea levels in our historical sequence, it is clear that all of today's human communities, and most of the highly productive natural communities, lay under the sea between 13000 and roughly 9000 years ago. Near Gambier Bay, tiny marine organisms called foraminifera have been found in clays 475 feet above sea level. On the east side of Admiralty, the high water level was probably less, maybe about 300 feet.

Lake or pond beds When water stops moving, suspended sediments can settle. If the water level then drops and exposes the bed, high silt content often results in a poorly drained surface.

Geologists often make maps of these different surface types, exotically colored creations that, instead of distinguishing Cretaceous from Jurassic plutons, show curving glacial moraines, or fan-shaped stream deposits. To our knowledge, no such "surficial geology" maps have been made in the Chatham Strait area. If we lived in Arizona, it would be easy to make our own surficial geology maps from air photos, which show features like stream fans in textbook clarity, uncluttered by plants. In lush Southeast Alaska, bare ground is a rarity. Geologists tend to consider plants nuisances, impediments to observation. But to the naturalist, plant communities are dead giveaways to the underlying landforms.

Why? Here in Southeast, where rainfall ranges from a lot to a *whole* lot, the determining influences on plant communities are not amount of precipitation, but what happens to that moisture after it hits the ground. If it ponds around tree roots and suffocates them you may have a muskeg. If it percolates down through a mix of sand, silt and gravel, providing roots with adequate moisture, but not drowning them beneath a water table that periodically climbs nearly to the surface, a fine stand of old growth may result. And in some places lacking any fine (silt or clay size) particles, such as high energy outwash fans, water can disappear from the rooting layer so quickly that plants like alders die during brief dry spells. Plant communities here are very strongly related to soil drainage, which relates to sediment size, which relates to surficial geologic history. This is why, on field trips, we hope to have you rolling mud around in your hands!

Plant Communities of the Angoon Area

Our booklet, A Naturalist's View of Southeast Alaska, describes typical northern Southeast Alaskan plant communities as you climb from sea to mountaintop. Here we will only mention some features specific to the Angoon area. First, why does our booklet's profile sketch say *northern* Southeast? The reason may be found on the preceeding page, which has a map of uplift rates in our region. Find Angoon on this map and you will see that the 0.28"/yr. uplift contour runs down Peril Strait, between Mitchell and Hood Bays on Admiralty, and thence to Thomas Bay on the mainland. A third of an inch of glacial rebound each year is only about half of the rate experienced by Hoonah, which in turn is only half that of Gustavus, but it's still enough to produce distinctive coastal plant communities such as meadows, brush and spruce sapling stands on uplifted former tidelands. The best places to look for these communities is at the top of very gently sloping sand or mudflats. These in turn are most abundant at the mouths of large sediment-laden rivers, which, like uplift rate, increase to the north. As a result, middle and southern Chatham Strait has a limited amount of recent uplift habitat compared to places like Glacier Bay and Lynn Canal.

Inland from the beach though, the profile sketch of community types in our booklet accurately represents the array found near Angoon. Forests of many sizes and ages, bogs, fens, brushy slide areas, subalpine meadows, and alpine tundra are all abundant. To illustrate the variety of forest types, let's consider the immediate town vicinity, and make a list of stands of increasing age. In the week we've spent here preparing for the workshop, we haven't yet determined precise dates for some of the more recent stands, but that would make a great project for your classes, interviewing elders, studying old photos, and using clues like tree rings. When one of the following stands is found on our Angoon Schools map, we give coordinates. (Starting in the lower left corner, count over, then up, to the point of interest, same as for stereograms. The elementary school is 1--5 1/2.))

1 to 3 years At 5 3/4--3 1/2 a cluster of trees were dropped for the new antennae. They still retain some shrivelled needles. Surviving saplings show release.

≤10 years At 5 1/2--3 1/2, a few yards closer to the school, is an older cut (but still uncleared on 1982 photos, with tall spruce saplings and vigorous salmonberry and fireweed.

>35 years On 1962 air photos a triangle of freshly cutover land shows between town and the future Forest Service building site. We counted 35 rings on one hemlock from this stand. Longtime Angoon residents should be able to tell you the exact year of the cut. On the 1980 stereograms this area shows as the small trees underlying the north arrow (see puzzler 1e). These 35+ year old trees were in turn cleared for a new street, and the only surviving patch on our map is at 5 1/2--8 1/2.

60? years North of town the 1962 aerials also show a slightly older cutover patch which completely crosses the peninsula. It has come back mostly in spruce. Our guess is about 60 years. Perhaps we'll improve that estimate on the field trip.

150? years Throughout the Angoon area are even-aged hemlock forests, too young to be called old growth, but too old to have been cut by loggers. In the workshop we'll examine "cookies" taken from stumps behind the school (around 6--2 1/2), which suggest a disturbance about 150 years ago. Another similar forest can be found on the cemetery trail after you pass through the 60? year cut. For now we'll guess blowdown.

old growth ≥300 years The forest immediately upslope from the cemetery is very different, with trees of many different sizes, including ancient ones. The canopy is multi-layered and the understory more complex and variable than in younger stands.

Marine Mammals of Northern Southeast Alaska

Land carnivores	
sea otter	increasingly common in western Icy Strait, outer coast
Seals and sea lions	
Steller sea lion	common; breeds mostly on outer coast islands
harbor seal abundant especially in Glacier Bay; breeder	
fur seal	rare in winter, mostly young individuals
elephant seal	rare
Toothed whales	
killer whale	pods transit area
pilot whale rare	
Dall porpoise	common in straits, less in side bays
harbor porpoise	common in straits and side bays
pacific whitesided dolphin	uncommon in Chatham Strait
sperm whale	once present in Chatham Strait/outer coast; hunted out
Baleen whales	
humpback whale	common in scattered localities, mostly in summer
minke whale	scattered individuals
gray whale	common migrant along outer coast
blue whale	once present in Chatham Strait/outer coast; hunted out
fin whale	once present in Chatham Strait/outer coast; hunted out

Above: Second growth just northwest of town, about 60 years old by our estimate in the early 1990s.

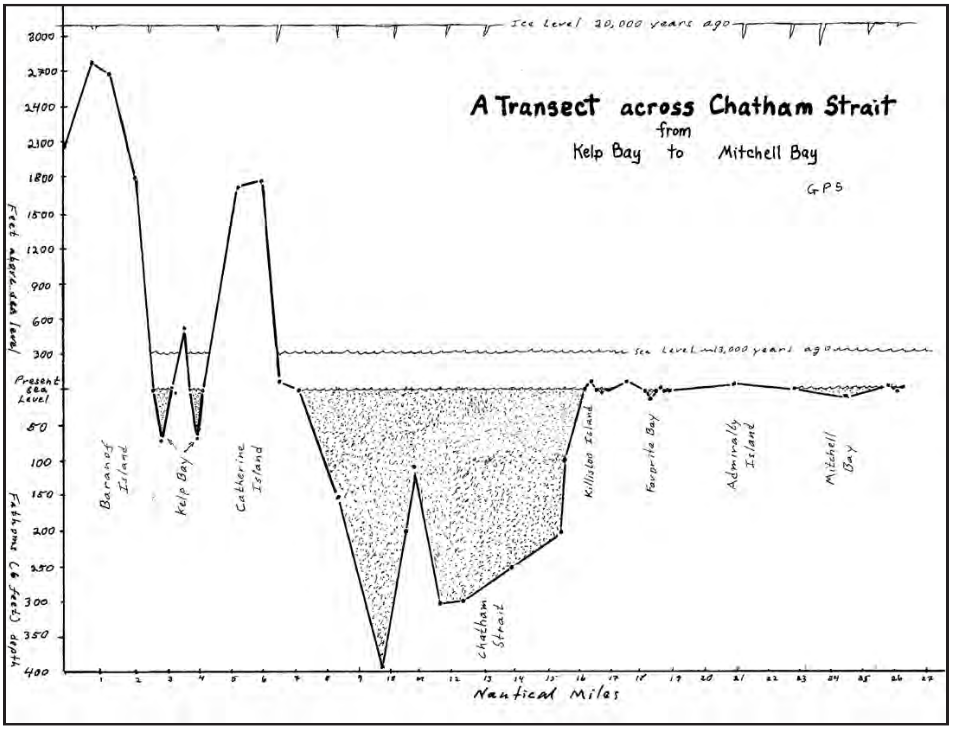
Right: Streveler table comparing mammal richness in the northern Archipelago

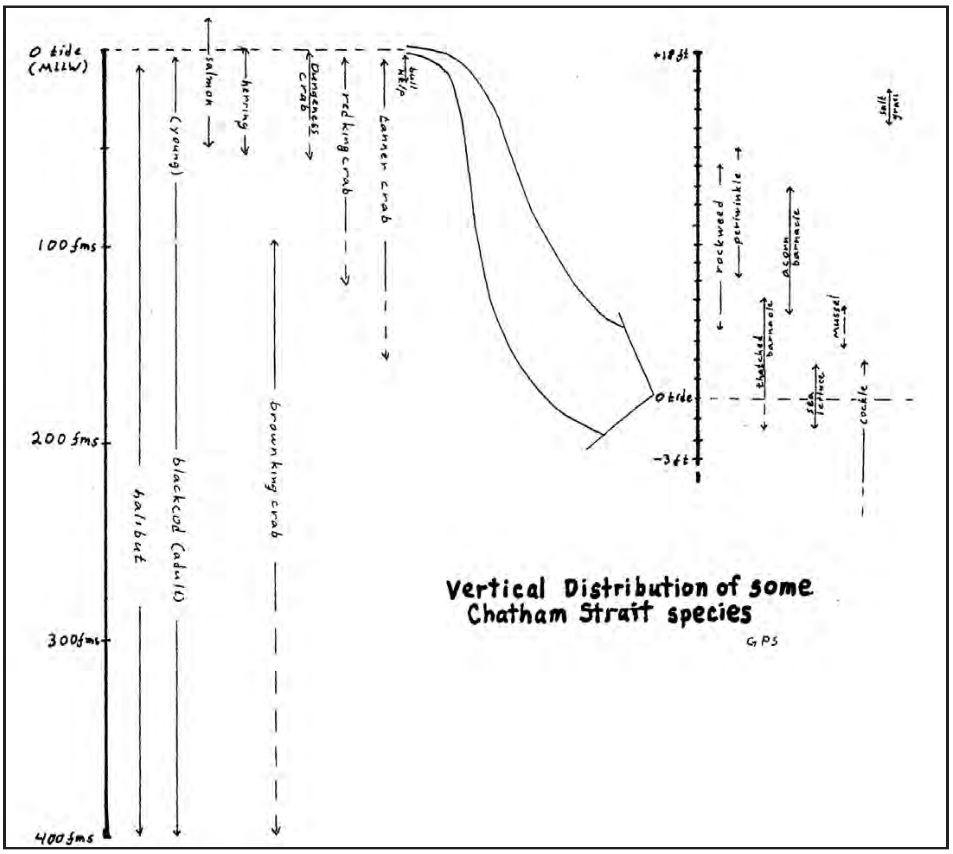
Land Mammals of Northern Southeast Alaska

Species	Chichagof I	Admiralty I	Glacier Bay	Haines
Insectivores				
masked shrew	X	X	X	X
dusky shrew	X	X	X	X
water shrew	-	-	X	X
Bats				
little brown bat	X	X	X	X
long-legged bat	-	X	-	-
Rabbits				
pika	-	-	-	X
snowshoe hare	-	-	?	X
Rodents				
beaver	X	X	X	X
porcupine	-	-	X	X
hoary marmot	-	-	X	X
northern bog lemming	?	X	?	?
deer mouse	X	X	X	X
long-tailed vole	X	?	X	X
meadow vole	-	-	-	X
red-backed vole	-	-	X	X
tundra vole	X	?	X	X
muskrat	-	-	-	X
bushy-tailed woodrat	-	-	-	?
red squirrel	I	X	X	X
flying squirrel	-	-	X	X
meadow jumping mouse	-	-	-	X
Hoofed Animals				
black-tailed deer	X	X	X	-
moose		—	X	X
mountain goat	-		X	X
Carnivores				
brown bear	X	X	X	X
black bear	-	-	X	X
wolf	-	-	X	X
Coyote	-	-	X	X
red fox	-	-	[X]	X
lynx	-	-	[X]	X
wolverine	-	-	X	X
river otter	X	X	X	X
marten	I	X	X	X
ermine	X	-	X	X
least weasel	-	-	[X]	X
domestic dog	I	I	-	-
Totals	17(1?)	17(2?)	29(2?)	33(2?)
Introduced	3	1	0	0

Key
X - populations established in the wild
- - populations not established in the wild
[] - rare
I - introduced

GPS





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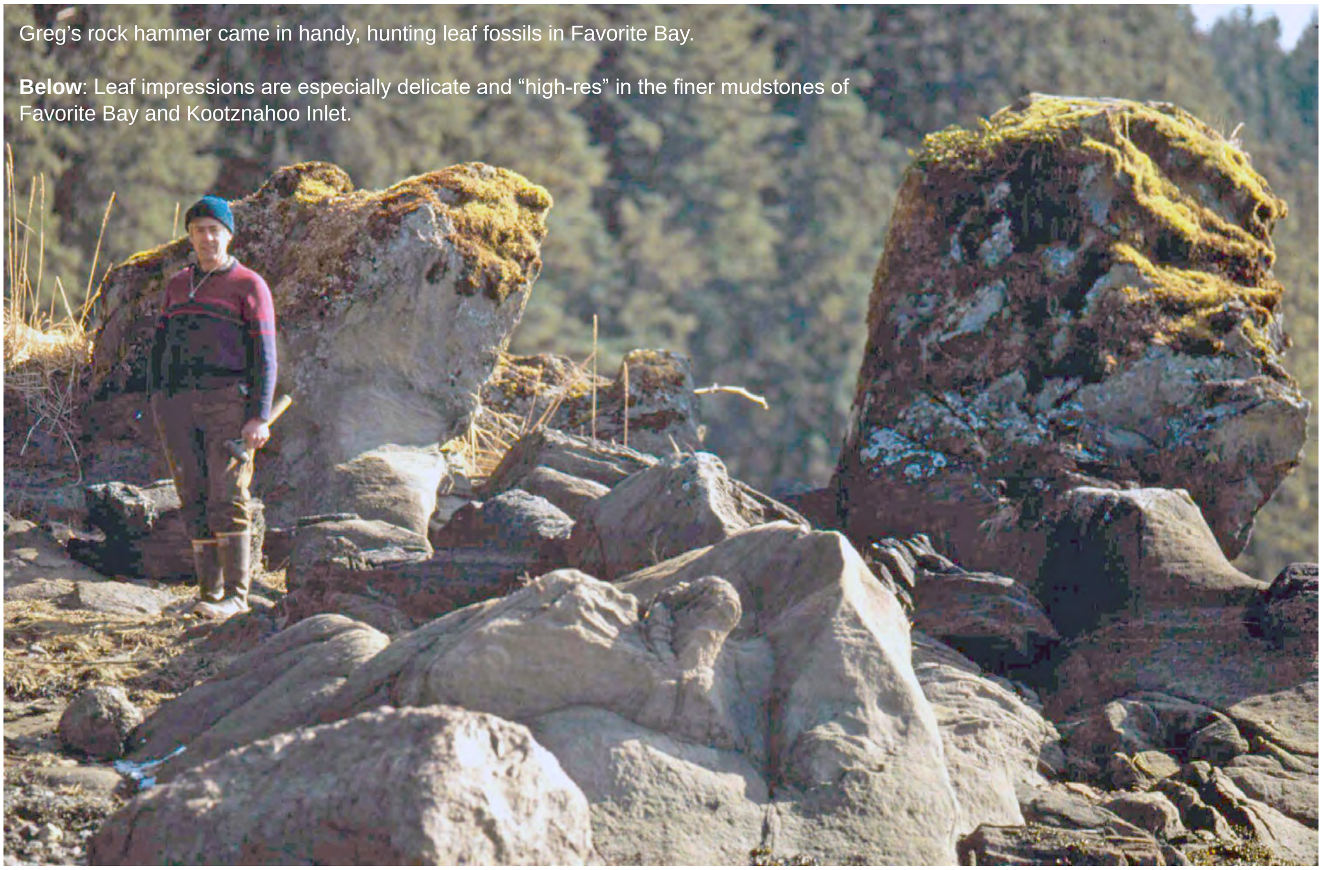
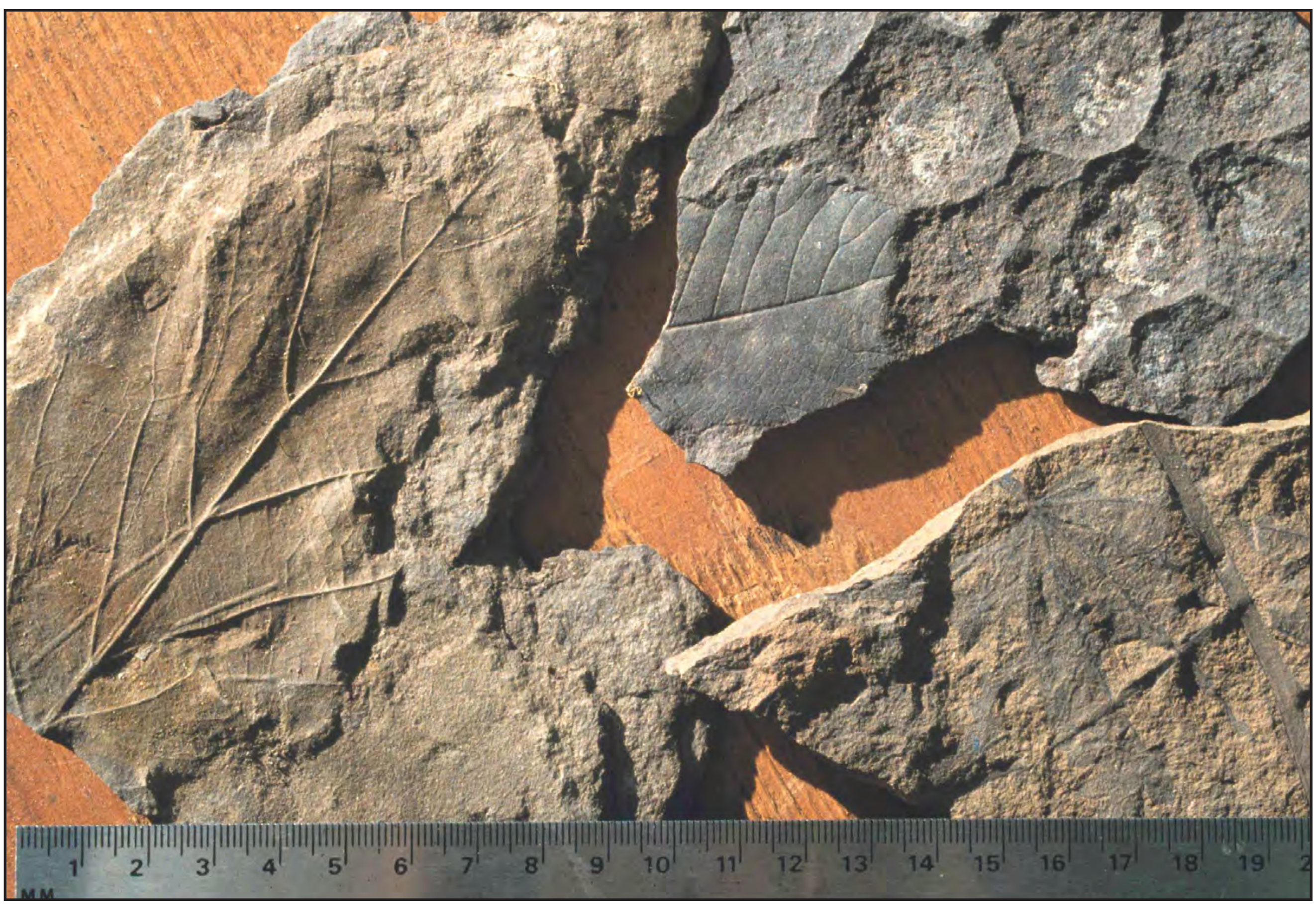


Greg's rock hammer came in handy, hunting leaf fossils in Favorite Bay.

Below: Leaf impressions are especially delicate and "high-res" in the finer mudstones of Favorite Bay and Kootznahoo Inlet.



Preface RC 2012: This and other slide shows in our *Nature near the schools* workshop series of course literally were ***slide*** shows in the early 1990s; collections of 35-mm slides were included in notebooks placed in all school libraries. For this re-issue of the workshop notes, I've converted the shows to powerpoint format. You can download *chatham.ppt* from the Discovery website at *www.discovery-southeast.org/xxxxxxxxxxxxxx (needs update)*

Natural History of Chatham Strait

Slide show script

Note to Teachers The natural history workshop for Chatham Strait encompassed geology, plant communities, local wildlife, marine ecology, human history and many other topics. These slides are exclusively of maps and air photos, chosen to give the "big picture" of Angoon and its environs.

Notes to you as teacher are included in the script in *italics*, and are not intended to be read out loud. You may wish to present some of the technical words, shown in **boldface**, in a separate class before viewing the slides.

If you've never used air photos before, don't be intimidated. We've discovered that students are fascinated (especially when they find their houses or spots they know well). When time permits, we like to have kids come up and point out features on the screen.

The stereogram sheets in this notebook let the kids see selected views around Chatham in 3-D. They and the "puzzler" sheet that goes with them makes a companion lesson to the slide show. If you have any questions about photo interpretation, or need suggestions on classroom use, contact Discovery, and someone will be glad to help you.

1) title slide

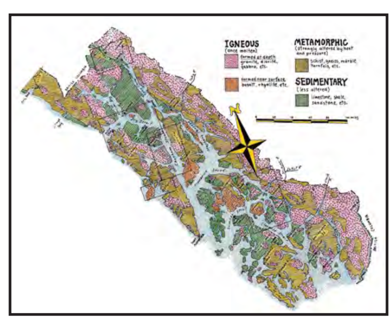
2) USGS topographic map (1:250,000) The Chatham Strait area schools occupy the heartland of SE Alaska, a glacially-scoured landscape of rounded peaks, lush valleys, and complex inlets dominated by the great trench of Chatham Strait. Maps and air photos help us see the BIG PICTURE. Where do we live? What lives around us? What has shaped this place? What processes are going on today? What will the landscape be like tomorrow?

This topographic map is a sort called shaded relief, meaning that shading is used as if the sun were highlighting ridges and mountains, leaving the steepest places in deepest shadow. This sort of map is particularly good for outlining watersheds (the basin that provides water to a particular stream). A series of watersheds on Admiralty Island drain westward into Chatham Strait; northward from Angoon they include Thayer Creek, Fishery Creek, Florence Creek and Ward Creek. Can someone come to the screen and outline the Florence Creek watershed? It is being heavily logged right now. How might that affect residents of the watershed such as salmon, deer and brown "bear? And people?

Notice that 4 locations of stereograms are indicated: Angoon, Kelp Bay, Kadashan estuary, and Tenakee. The landscape here can be studied in 3D under a stereoscope.

3) bedrock map of SE Alaska Bedrock is the solid mass of rock making up the earth's crust This is a simplified map of Southeast Alaska's bedrock, lumping together our very complex geology according to the 3 basic rock types: **sedimentary, metamorphic and igneous**.

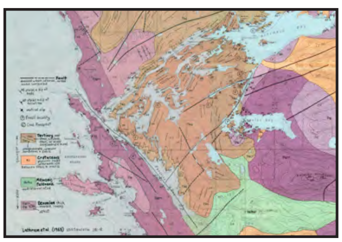
Sedimentary rocks are sediments (sand, gravel, mud, volcanic ash, etc.) that have been cemented together and thus turned to stone. This process of becoming rock usually happens after more sediments pile on, increasing the heat and pressure. If the heat and pressure becomes great enough that the minerals in the sediments begin to alter their shape or chemistry, we get **metamorphic** rocks. This greater heat & pressure usually comes from getting buried deeper, or from getting squeezed by mountain-building. Once there is enough heat & pressure (generally after the rock has been pressed down miles into the earth), the rock melts. When it re-solidifies, it will become an **igneous** rock.



So rocks contain clues about their past history. If an area is made up mostly of sedimentary rock, its history has been relatively calm. But if metamorphic or igneous rocks predominate, there's been a history of more intense burial, erosion and mountain building.

Now look at the Chatham Strait area The rectangle outlines the area covered by the last slide. What kinds of rocks predominate? The Chatham area has had an intense history, alright. In fact, geologists estimate that in the last 25 million years, the mountains of Baranof Island across from Angoon have risen 6 to 8 kilometers! But the mountains are less than 2 kilometers high now. Where did the rest of the rock go? That's right, it eroded away. It's mostly sitting out on the continental shelf offshore from the mouth of Chatham Strait, where it is getting buried and turned into sedimentary rock, starting the rock cycle all over again.

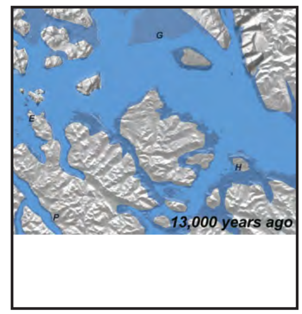
4) bedrock geology of the Angoon Now let's look more closely at Angoon's rocks. The main bedrock type right around town is a kind of impure, crumbly marble, a metamorphosed form of muddy limestone that formed in an offshore marine basin about 400 million years ago. Another very different and much younger group of conglomerates and shales with abundant plant fossils is found just across Favorite Bay. These rocks were formed less than 30 million years ago in upland valleys in times before glaciers carved them into the extreme landscape of today. But then notice that there are several other types of rocks in the general area. They're pretty complicated. (*You have a brief description of them in the Discovery Foundation Notebook materials*.)



In fact, geologists puzzled over this complexity for years, until coming up with a sci-fi type hypothesis to explain them. The reason the rocks are so chopped up into different little pieces, geologists think, is because they ran into North America! That's right, they once were at least two separate parts of the earth's crust that drifted into North America, and in the process got all jumbled up. Chatham Strait forms the boundary between two crustal blocks or terranes. (*To take that thought further, see "A Naturalist's look at Southeast Alaska" in your packet of materials.*)

5) 20,000 BP At the peak of the Great Ice Age (Wisconsin glaciation) Chatham Strait was occupied by a moving ice river about 3000 feet thick. Future locations of Angoon and Tenakee Springs are marked by the letters A and T. We've also added streaks of morainal debris, dragged off the protruding nunataks by the moving ice. This gives a sense of the principle converging streams.

6) 13,000 BP By 13,000 years ago, the ice had uncovered this scene, but the land remained depressed. Most of this section of Chatham Strait was about 300 feet lower than today (relative to sea level) There were several islands that have since merged, and the land was only sparsely vegetated. The low valley connecting Kadashan and Sitkoh bays was a marine pass



7) today With rebounding land, some of the island complexity was lost. But behind Angoon, that has been more than compensated for by the spectacularly convoluted Mitchell Bay, and associated lakes.

8) 1979 aerial infra-red view of Mitchell and Favorite Bays Color infra-red photography is sensitive to the infra-red part of the spectrum, able to highlight differences in vegetation. On this photo, darker red areas are forest, while the brighter pink, less textured areas are peatland, brush, subalpine meadow or younger, second-growth forests.

The intricate waterways of Mitchell Bay were formed during the Great Ice Age as ice gouged westward toward Chatham Strait, digging most deeply where the rocks were most easily eroded. The more resistant marble bedrock on the Angoon side of Favorite Bay stood up better to ice erosion. Today it nearly dams up Mitchell Bay,

forcing water to flow through a shallow mouth north of town.

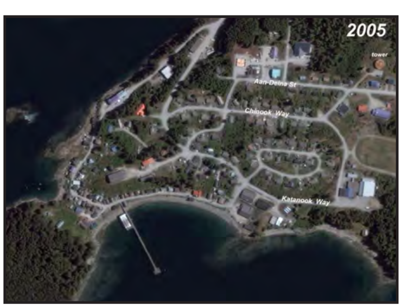
Find the road to Killisnoo at the very bottom of the photo. 1979 was the road to the lake. Let's check out how that looks in a more recent image. . .

9) google earth of Favorite Bay Google Earth shows a variety of forest textures, from coarse-canopy old growth to finner textured, younger stands. These are even-aged forests, with tree-crowns all about the same diameter and height. What do you think made these patches with young forests on them? You can drive the new road and check your answer(s). (*We've checked some of these and found them to be a mix of logged second-growth and blow-down stands.*)

10) 1980 aerial of Angoon Zooming into an early photo of downtown Angoon, we can study forests of several different ages, the result of clearing at various times and subsequent regrowth. This photo was taken when the school was quite small. The track area had been cleared but construction hadn't begun. Let's move forward in time a quarter century. Much of the second-growth will be lost to construction, but in the remainder we can watch the canopy texture change.

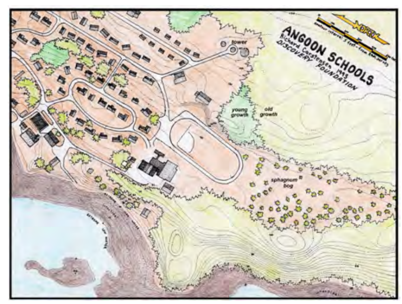
11) 2005 aerial of Angoon Toggle back and forth for awhile between 2005 and 1980. The school has been enlarged, A new street, Aan Deina, was added uphill from Chinook Way.

Find the communications tower (labelled) in the upper right corner. The next view is to the northwest from the top of this tower.

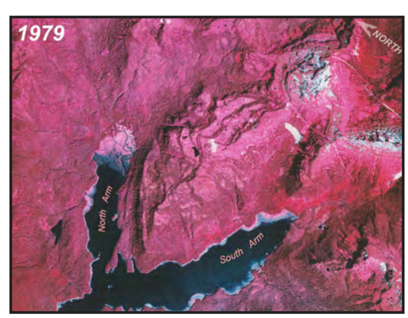


12) view out That's Chichagof Island in the background, across Chatham Strait. In the mid-distance is Danger Point, and on the right, the entrance to Kootznahoo Inlet. Only in Angoon could you climb an ungated tower for this kind of perspective (*PS 2012: granted, this was prior to 9/11. . .*)

13) 1993 Discovery map of the school vicinity On this Discovery map created for our workshop in 1993, the new school building and track had been built. We mapped habitats quickly accessible by classes on foot. Light green indicates old-growth conifer forest. Darker green is young-growth recovering from logging. Tan shades indicate human-made clearings except where labelled "sphagnum bog". These upland habitats along with the adjacent offer a perfect sampling of the natural communities of the area. Angoon is fortunate to have this great study area so near the school.

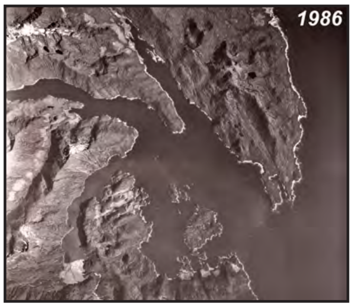


14) 1979 aerial infra-red view of upper Hood Bay The mountain ridge between the 2 arms of Hood Bay is a big block of Tertiary lava flows tilted up at an angle by mountain building. You can see the eroded edges of these flows on the mountain top. Their flat surfaces are occupied by pale red muskegs; the steep eroded edges are better-drained and occupied by forest. Can you tell which way the lava flows slope? Yep, toward the south arm of Hood Bay. Notice the large variety of habitats on the mountain and down in the Bay. Large salt marshes are found at the head of each arm. The country shown here is very



important for Angoon subsistence.

15) 1986 aerial of Kelp Bay Like Hood Bay, Kelp Bay has always been important to Angoon's subsistence way of life. Like Hood Bay, it has a large variety of habitats, and so has many foods that can be harvested. Notice that now another use is being made of the country: clearcut logging. Do you see the clearcuts on this 1986 slide? Can you tell what habitats the logging has occurred in? How do you think these clearcuts have affected the animals and plants Angoon people use for food?



16) 1986 aerial infrared of Tenakee and Indian River. Tenakee is a small town strung out along the beach and is hard to find on the photo. Look for the boat harbor. It's much easier to find the large clearcuts and road in the Indian River Valley. Notice the large mountains in the upper right of the photo. Why are these peaks sharp while all the lower ridges are rounded? (*The lower ridges were overridden by Wisconsin Ice, 20,000 years ago. The sharp peak protruded.*)

PS RC 2012: In 2005, Discovery naturalist Kathy Hocker and I completed a 2-year repeat photography project on contract with Michael Shepard at Alaska State & Private Forestry. That included attempts to replicate aerial obliques such as this view up Favorite Bay to Angoon, taken by the US Navy in 1926. For full interpretation see www.discoverysoutheast.org/xxxxxxxx


CHATHAM STRAIT
ADMIRALTY
Tenakee (Tenakee Springs P.O.)
INLET
Kadashan Bay
Corner Bay
Trap Bay
South Passage Pt
North Passage Pt
Tyoukeen Cove
Gypsum
Cabin
Redcliff Is
Cedar I
Pavlof Hbr
Pavlof River
Wachusett Cove
Outer Pt
East Pt
Cannery
Hill Pt
Cannery Pt
Lake Kathleen
Jims Cove
Ward Creek
Lake Florence
Fishery Pt
Fishery Creek
Marble Bluffs
Marble Cove
Thayer Pk
Thayer Lake
Thayer Lake Lodge
Thayer Creek
Parker Pt
Kook L
Basket Bay
Little Basket Bay
Basket Lake
Dip 2
White Rk
Peninsular Pt
Pt Hayes
Morris Reef
Pt Craven
Florence Bay
Sitkoh Bay
Sitkoh Lake
Chatham
Todd
Lindenberg Hbr
Lindenberg Head
Pt Benham
Saook Bay
Pt Kennedy
Paradise Flats
Pt Moses
Lake Eva
Hanus Bay
Dead Tree
Catherine Island
Thatcher Channel
Traders Is
Fairway I
Svensen Rk
Eva Is
Pt Thatcher
Middle Arm
Portage Arm
South Arm
The Basin
Crow Cabin
Pt Lull
North Pt
South Pt
Fresh Water Lake
Mitchell Bay
Kootznahoo Head
Danger Pt
Angoon
Kenasnow Rks
Kootznahoo Roads
Pt Samuel
Killisnoo I
Killisnoo
Killisnoo Hbr
Table I
Sand I
Favorite Bay
Kanalku Bay
Kanalku Mtn
Hood Bay
Distant Pt
House Pt
Village Pt
Chaik Bay
Rocky Pt
Russian Reef
Woody Pt
T 46 S
T 47 S
T 48 S
T 49 S
T 50 S
T 51 S
T 52 S
R 66 E
R 67 E
R 68 E
R 69 E
stereogram

Stereograms for Chatham Strait area For instructions, see *Using the stereoscopes and stereograms* in the introduction to this manual. You can either print this page, or else scale the stereograms on your monitor and hold a stereoscope to the screen. Note the north arrows point in different directions on these photo-pairs. Layout of stereograms is constrained by flight-line direction. Locations of these photos are shown as pink rectangles on the preceding Chatham Strait topographic map.

First, let's look quickly through the entire Chatham Strait stereogram collection. On one side of the sheet there are views of four areas. The Angoon/Kootznahoo Inlet photo is color infra-red, taken from high elevation in 1979. Proceeding clockwise from this photo, we come to a 1986 color infra-red stereogram of Tenakee Springs, then a 1986 color infra-red stereogram of Kadashan River estuary, which lies just south of Tenakee Springs across Tenakee Inlet. Studying the scale bars, note that these three images are "small scale," each encompassing more than ten square miles, and houses can barely be seen. The fourth stereogram, a true color 1980 pair of downtown Angoon, is larger scale. The scale bar covers only 400 feet, rather than a mile as in the other images, and details of buildings are clearly visible.

On the back side of the sheet is one more stereogram, a black and white of the Kelp Bay area in 1986. Locations of all five stereograms are shown as rectangles on the xeroxed topographic map of Chatham Strait.

1) Begin with the true color stereogram of downtown Angoon in 1980. These pictures were taken just as the track area was being cleared and leveled. Before trying to interpret air photos, it helps to consider location, compass direction and scale.

a) What are the coordinates of the High School? Temporarily close your left eye so the numbers on the edge of the right photo are easier to read. Starting at the lower left corner of this photo, count over, then up to the school. It's over 5, up 3 1/2. We write this as 5--3 1/2. What are the coordinates of the Elementary School?

b) Chinook Way is the highest street in town in these 1980 photos (though not any more!) What direction does Chinook Way run? Was that question too easy? Okay, here's a tougher one. Find a tree which stands by itself so you can clearly see the direction cast by its shadow. About what hour of the day was the photo taken? (It may help you to know that the pictures were taken May 23rd.) Were they taken during high or low tide?

c) How far is it as Raven flies from the Elementary to the High School? The easiest way to measure this is to hold the edge of a piece of paper against the scale bar and mark off 400 feet, then slide this up to the schools. Try measuring this same distance on the *Discovery Foundation* map of Angoon Schools. Do your measurements agree?

d) If you are from Angoon, or a particularly observant visitor, you can probably find streets and buildings present today (1993) which are missing on this 1980 stereogram. How many can you name? Use the *Discovery Foundation* map of Angoon Schools to help locate changes.

e) Study the forest covered by the north arrow, in the upper right corner of the stereogram. Why do you think the trees are smaller in this area?

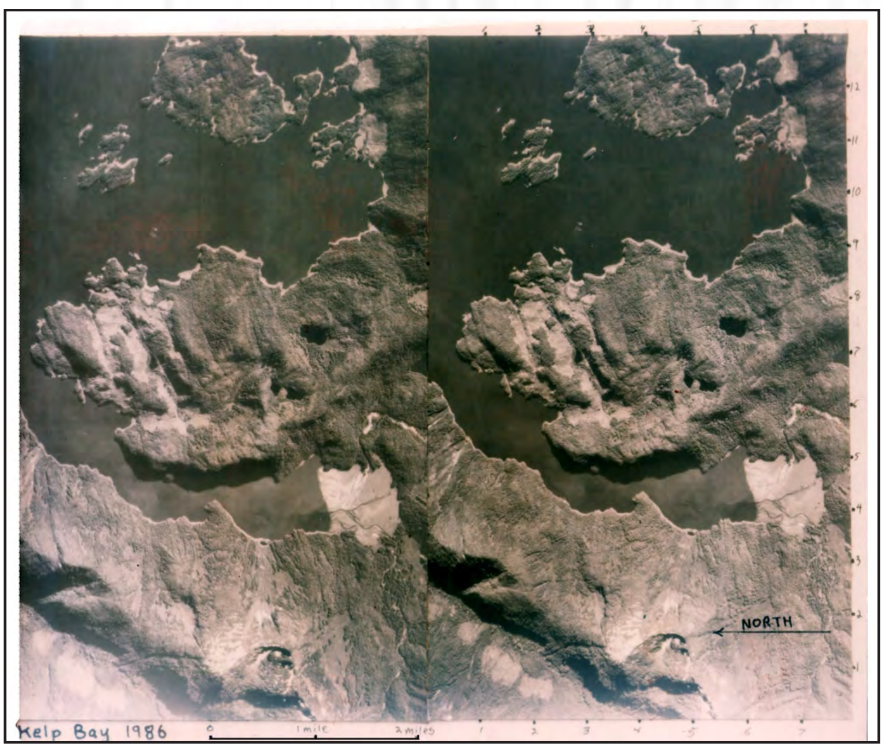
2) Now go up to the color infra-red stereogram of the Angoon area, taken in 1979.

a) What are the coordinates of downtown Angoon?

b) How far is it as Raven flies from Angoon to the ferry terminal? What major feature has been added on the Killisnoo peninsula since these 1979 photos?

c) Compare these air photos to the geology map of the Mitchell Bay area. As we will see, bedrock type has a strong influence on plant communities. The Killisnoo peninsula on the bottom of the stereogram is made of impure Devonian marbles and schist. So is the country to the northeast of Kootznahoo Inlet, on the left side of the stereogram. Everything else is much younger fossil-bearing sandstone, siltstone and conglomerate. On color infra-red photos, muskegs appear paler pink than the reddish forests. Do the muskegs seem to occur more commonly on the marble and schist or on the sandstones and conglomerate?

d) Now look among the reddish forested areas for patches that appear very smooth, for



example at 8--4. These are "even-aged" forests, with small, tightly-packed trees all the same height. One important disturbance to the forests near Angoon has been logging. Many forests close to the water were cut for the whaling and herring plants at Killisnoo, and are now even-aged stands from 60 to 100 years old. But some of the even-aged patches are too far from the beach to have been cut and dragged away in the days of oxen and hand saws, for example the patches near the lake at 0--5. What could have destroyed these forests? (Hint; study the ups and downs of the landscape. Are the even-aged patches on the tops of mounds or the bottoms of depressions?)

3) Moving to the left, look at the color infra-red 1986 stereogram of Tenakee Springs. The Indian River enters the photos at 0--2 and meets the sea at 7--8.

a) The village of Tenakee is far less conspicuous than the mile-long clearcuts along the Indian River. Can you find it? What are the coordinates? From a ferry, would you be able to see the Indian River clearcuts?

b) Were these photos taken during a high or low tide?

c) Where are the biggest forests remaining on these photos?

d) Peaks which were not covered by the Wisconsin-age ice, about 20,000 years ago, are sharper and more angular than those which were over-ridden (like the 1300 foot hill under the north arrow). What area on this stereogram (give coordinates) protruded from the ice?

4) Below the Tenakee photos is a stereogram of the Kadashan River, one of the finest salmon streams in Southeast and a center of dispute between timber and conservation interests. The road entering the Kadashan drainage comes from Corner Bay, just off the photos at 1--13. The Kadashan estuary includes about one square mile of mudflat (bluish colored, centered at 2--5), and another square mile of intertidal sdeges (peach colored, centered at 6--5).

a) The historical sequence map of the Chatham area 13,000 years ago shows that much of the Kadashan drainage was under the sea, to a depth of 300 feet against the surrounding hillsides. Find this level on your stereogram (for example just above the Corner Bay to Kadashan road), and notice that here the slope suddenly steepens. The gently sloping lowlands are ancient marine terraces. Was there more or less salmon spawning and rearing habitat 13,000 years ago?

b) If you compare the places covered by forest to the open muskeg areas, it becomes clear that forests do best on the steeper slopes, while the flatter marine terraces are more often muskeg or scrub forest. Exceptions are places where streams come down onto the terraces, depositing "alluvial fans," which commonly produce giant trees. Name two places (give coordinates) where these fans have already been logged. Notice the squiggly lines. What causes them? Were trees removed by cable or cat?

c) Do you see any evidence that the Kadashan estuary is presently rising (glacial rebound)?

5) On the back of the sheet is pasted a black and white stereogram of the Kelp Bay area.

a) Look for sharp ridge crests in the high country. What parts of this stereogram protruded from the ice during the Wisconsin glaciation? Does your answer agree with the nunatak position shown on the historical series map?

b) Kelp Bay is unique among these stereogams in having an active glacial river, which drains the dramatic knife-edged peaks five miles to the south, seen on a clear day from Angoon. Do you see any evidence that this is a glacial stream?

Answers to the puzzlers

1) a) 2--6 1/2

b) Chinook Way runs North-South. Tree shadows point northeast, so the sun is in the southwest. This occurs in the late afternoon in late May, which is only one month from the summer solstice. (In Southeast Alaska the summer sun sets in the northwest. Only on the spring and fall equinoxes does the sun rise directly in the east and set directly in the west.)

c) On the photos, the distance is about 600 feet. Measurements from the map should agree closely.

d) Since 1980 the High School has added a new gym and shop, and a track in the cleared area. New modulars have been added by the Elementary School at about 1--5. And a new street has been built above and paralleling Chinook Way, about where the north arrow lies on the 1980 stereograms.

e) The small trees in the upper right are only about 30 years old. In the 1962 air photos of Angoon the area has been freshly clearcut.

2) a) 2 1/2--2 1/2.

b) About 2 miles. A road now runs from the bend in the old ferry terminal road (5 1/2--3) to the new water-source lakes, just off the stereogram, at 8--3 1/2.

c) Muskegs appear to be more common on the marble/schist bedrock type than on the sandstone/conglomerate type. We have no clear explanation for this, other than an observation that the young (Cenozoic) sandstone/conglomerate rocks, unmetamorphosed, are quite a bit more crumbly, with steeply dipping beds, and are easily penetrated by tree roots and wedged apart by frost. Therefore the drainage may be generally better than on the much harder marble and schist.

d) Besides logging, the major disturbance to forests in the Angoon area lowlands is wind. Blowdown forests occur especially on knobs whereas trees in basins and gullies often escape. One clear example is at 6 1/2--5 /2, where parallel sandstone ridges strike roughly north-south. Tops of the ridges show smooth even-aged blowdown stands, while the gullies in between them have bigger trees, surviving old-growth forests.

3 a) 6 1/2--5. Except for the eastward edge of the largest cut, the Indian River logging is hidden from the Inlet by the low ridge above Tenakee Springs.

b) Low tide, extensive areas of tide flat are uncovered at the mouth of Indian River, 7--8.

c) Biggest trees are on the slopes above the mouth of Indian River, centered at 4 1/2--8. This is what the cutover stands used to look like.

d) Knife-edge ridges in the upper left corner protruded. Compare the historical series map of high ice positions.

4) a) There was less good salmon habitat 13,000 years ago. Steep mountains plunged straight into deep fiords. Spawning and rearing sterams today are mostly found on low gradient marine terraces or alluvial bottomlands.

b) Clearcuts occur at 1--11 and 3--7. The squiggly lines show alder stringers which have colonized deeply eroded cat trails. (Cable yarding shows on air photos as radiating lines, like wheel spokes.)

c) A row of young spruce trees grows at 4--5 1/2 on recently uplifted spits. At the head of the estuary, notice a "rougher-looking" area at 7--4 1/2. These are former tidelands, now barely supratidal meadow. Check the Hicks and Shofnos map in our booklet for uplift rate; the 0.44"/yr contour passes through Tenakee. This is enough to result in obvious uplift communities, especially in low-gradient estuaries like Kadashan.

5) a) The sharp ridge at 5--1. This also shows on our ice limit map.

b) The appropriately named Glacier River flows into the South Arm of Kelp Bay at 7--5. Evidence is the silt plume filling the eastern part of the head of South Arm. The Clear River also enters the South Arm, at 6--4. The water here is darker (less silty).

Teaching the Natural History of Southeast Alaska

DISCOVERY FOUNDATION **teaching aids and reference materials for Chatham Strait Area Schools**

SITKA SCHOOLS

course outline

FRIDAY EVENING 6 - 9PM

Introductions
- who's who; what's the Discovery Foundation anyway?
- key ideas; a cruise through the handouts
- deer and blackcod as flagship species

Chatham in 3-D - using stereoscopes; some puzzlers about your home locality
Natural communities of the land - changes with time, altitude, wetness
The marine environment - tides & currents; bottom and midwater communities; annual cycle

SATURDAY 10AM - 6PM

Wildlife
- more on deer; bears; some of the minor players
- islands and animal distribution

Geology -rocks, fossils and crustal plates
Field trip prep - Angoon natural history, intertidal, forests
Lunch 1-2pm
Field trip 2-6pm along trail to cemetary and back along beach
- on the way out: exercises characterizing forests
- on the way back: beach geology, intertidal life

SUNDAY 9 AM - 5PM

Intro to school vicinity
Field trip 10-12am characterizing the school grounds forest and bog communities
- in search of a study site for Angoon schools
- applying mapping and descriptive methods to the site

Natural history of the Sitka area

A Discovery site interpretation workshop

Natural history studies encompass everything from "bugs to bedrock." Obviously this is far more than we can hope to cover in a weekend workshop. But we do hope to impart some of the naturalist's excitement over interrelationships.

For example, the Saint Lazaria Islands are made of andesite lava flows, "pervasively jointed to equant blocks ranging from 10 to 30 cm across." Does that have something to do with its world class sea bird nesting habitat? How does the deep layer of volcanic ash from Mount Edgecumbe's eruption affect Sitka's array of forest and muskeg? What is it about Sitka Sound's currents and bottom topography that make this place so rich in marine life of many varieties, from plankton to whales?

A naturalist asks questions like these. Conclusive answers are few and far between, but the result of our curiosity is a deepened sense of place, and an appreciation for the workings of the land. Teaching children to ask these questions is more rewarding than providing them the answers.

A typical natural history sketch proceeds "from the ground up". It begins with the underlying bedrock "skeleton", which is then "fleshed out" with surficial deposits like glacial and river sediments. These are covered with the "skin" of soils, and a "coat" of vegetation. We should probably terminate our analogy at this point, since the area's fauna would have to be likened to fleas or lice.) And many natural history descriptions end with a chapter on people.

This is not the order in which most of us learn about the land. As children we may first be attracted to the doings of our fellow human beings, then to those beings who most resemble people, like mammals and birds, then to fish, bugs, and only later to plants, and still later to rocks and other inanimate objects.

Just as we can guide childrens' interest to bedrock via beavers, we can lead them to a study of nature by way of the layout of human communities. In our work at Juneau area elementary schools we've been delighted at students' reactions to projected air photos. Its hard to keep kids in their seats as they search for their houses on the screen. And examination of roads and buildings leads easily to natural features, like different forest types, or glacial landforms, especially in a place like Icy Strait and Glacier Bay, where spectacular glacial history has drawn researchers from all over North America.

Let's take ourselves, *Homo sapiens*, as a starting point, and ask a series of "why" questions that will sooner or later lead us back to bedrock.

First, of all the potential town sites on the outer coasts of Baranof and Chichagof, why have people chosen to settle most densely in Sitka Sound? Early folks had a lot of places to choose from. What attributes would they have been looking for in a potential home? Think of good beaches, shelter from weather, abundant resources, defense possibilities .....

The next series of questions follow naturally: What formed the beaches? The weather patterns? Why are there good fish streams? Good game populations? Attempting to answer these lead us to consideration of soils, nutrients, activities of erosion and deposition .....

Next questions: Where did the materials for the beaches come from? How did the soils form? Where do the nutrients come from? And the topography that dictates local weather?

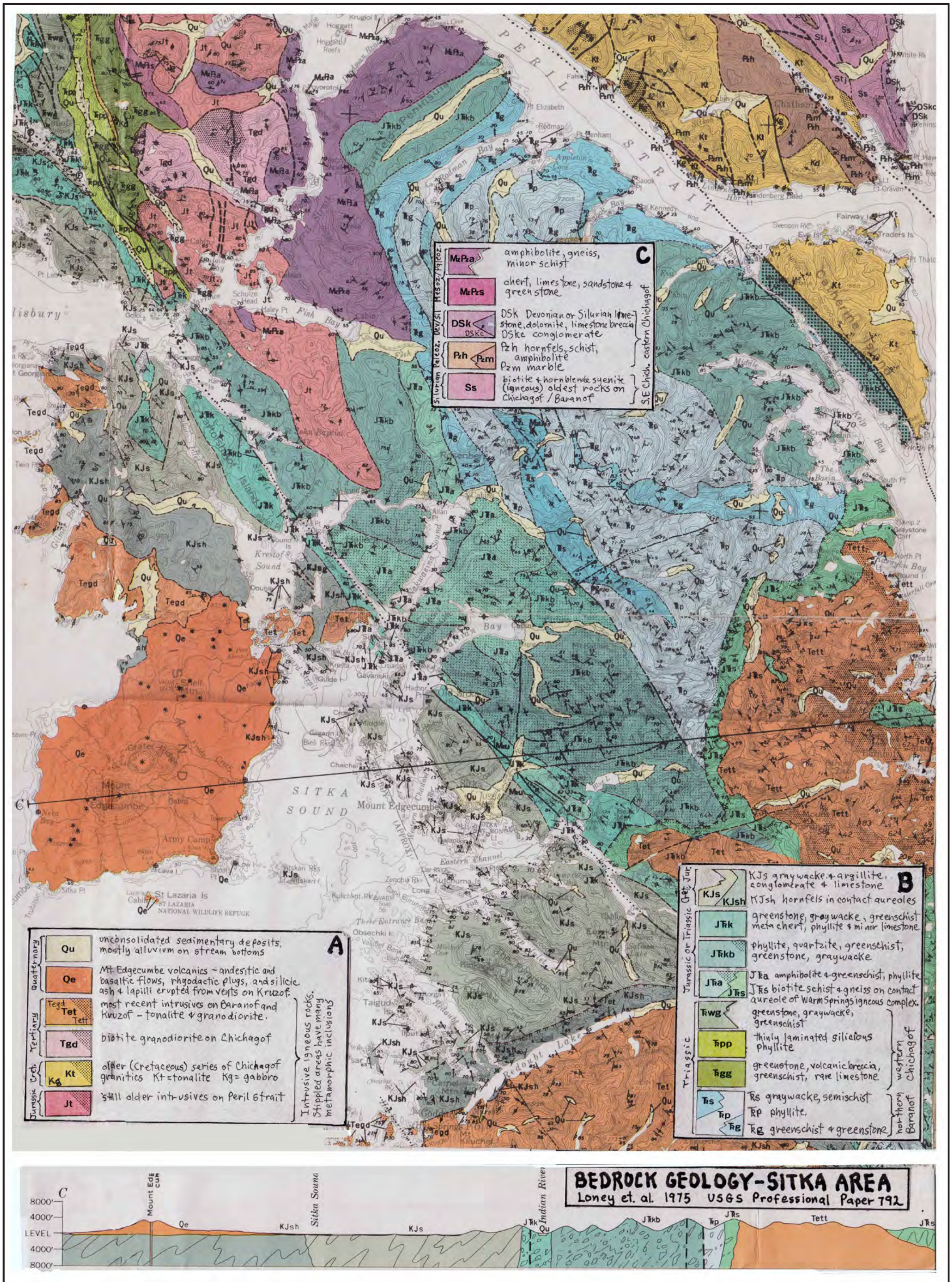
Eventually almost any line of questioning within the immense field of natural history comes to rest on bedrock, and an understanding of its origins. With young children it may make sense to start with mammals; the cuddlier the better. For adults, the bedrock-first approach makes a lot of sense, for the same reason that we start building houses at the basement, rather than the roof.

Bedrock geology

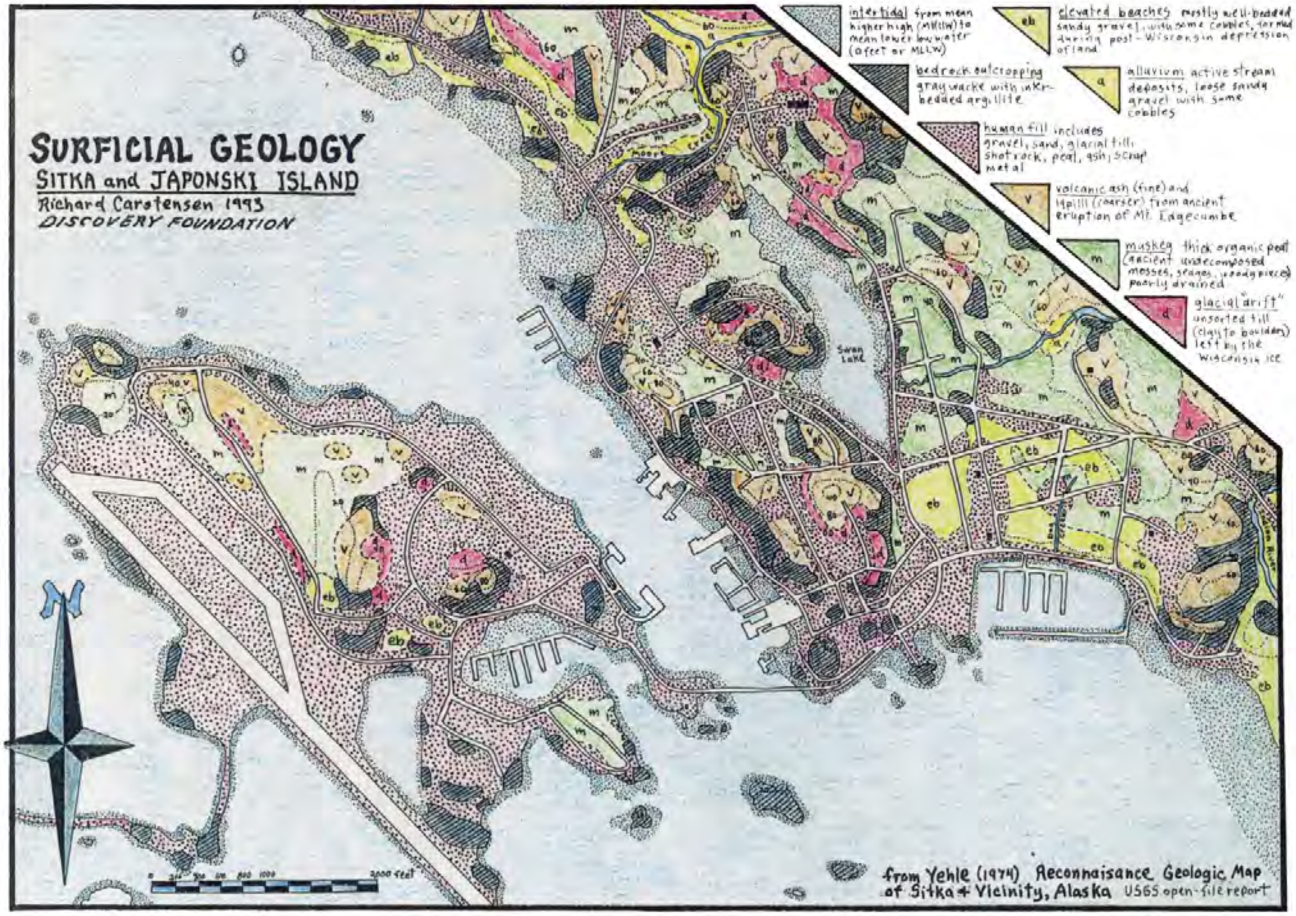
Our bedrock map of the Sitka area comes from Loney et al 1975 *Reconnaissance geology of Chichagof, Baranof and Kruzof Islands, southeastern Alaska*. USGS professional paper 792. In one small area, it shows igneous, sedimentary and metamorphic rock types, of many different ages. The keys, insets A, B and C, list the rocks in order of increasing age, from recent stream sediments and Edgecumbe volcanics to 400 million year old Silurian intrusives (a time when the first arthropods were crawling out of the sea).

Since the paper was written in the mid seventies, crustal plate theory has drastically restructured our understanding of geology. Workers like Dave Brew have divided Southeast Alaska into several different "terranes," or wandering crustal fragments, each with its own geologic history. To see where the Sitka Sound area falls within these terranes, study the *Geologic terranes* map on page 3 of our booklet *A naturalist's look at Southeast Alaska*. Kruzof and all but northern Baranof fall within the Chugach terrane.

But although we now have a different idea of



BEDROCK GEOLOGY-SITKA AREA
Loney et. al. 1975 USGS Professional Paper 792
A
Qu unconsolidated sedimentary deposits, mostly alluvium on stream bottoms
Qe Mt. Edgecumbe volcanics - andesitic and basaltic flows, rhyodactic plugs, and silicic ash & lapilli erupted from vents on Kruzof.
Tegd Tet Tett most recent intrusives on Baranof and Kruzof - tonalite & granodiorite.
Tgd biotite granodiorite on Chichagof
Kt Kg older (Cretaceous) series of Chichagof granitics Kt=tonalite Kg= gabbro
Jt still older intrusives on Peril Strait
Intrusive igneous rocks. Stippled areas have many metamorphic inclusions
Quaternary
Tertiary
Jurassic Cret.
B
KJs graywacke & argillite, conglomerate & limestone
KJsh KJsh hornfels in contact aureoles
JTrk greenstone, graywacke, greenschist meta chert, phyllite & minor limestone
JTrkb phyllite, quartzite, greenschist, greenstone, graywacke
JTra JTrs JTra amphibolite & greenschist, phyllite JTrs biotite schist & gneiss on contact aureole of Warm Springs igneous complex.
Trwg greenstone, graywacke, greenschist
Trpp thinly laminated siliceous phyllite
Trgg greenstone, volcanic breccia, greenschist, rare limestone
Trs Trp Trg Trs graywacke, semischist Trp phyllite Trg greenschist & greenstone
Jurassic or Triassic
Triassic
western Chichagof
northern Baranof
C
MzPza amphibolite, gneiss, minor schist
MzPzs chert, limestone, sandstone & greenstone
DSk DSkc DSk Devonian or Silurian limestone, dolomite, limestone breccia DSkc conglomerate
Pzh Pzm Pzh hornfels, schist, amphibolite Pzm marble
Ss biotite & hornblende syenite (igneous) oldest rocks on Chichagof / Baranof
S.E. Chich. eastern Chichagof
PERIL STRAIT
SITKA SOUND
Mount Edgecumbe
St Lazaria Is
ST LAZARIA NATIONAL WILDLIFE REFUGE
Krestof Sound
Salisbury Sound
Fish Bay
Rodman Bay
Kelp Bay
Hoonah Sound
Eastern Channel
Redoubt Lake
8000'
4000'
LEVEL
4000'
8000'
Sitka Sound
Indian River



where Sitka's rocks *came from*, the old 1970's maps are still plenty accurate. Graywacke is still graywacke! Speaking of which, the Sitka road system and the entire eastern shoreline of Sitka Sound is labelled *KJs* on the geology map. This stands for Cretaceous (*K*)/Jurassic (*J*) rocks of the Sitka Graywacke (*s*) formation. If you look this type up in the map key (inset B), you'll find that it includes graywacke (an impure sandstone, relatively coarse-grained), argillite (more fine-grained), and minor amounts of conglomerate (rock with "clasts" or embedded pebbles and cobbles. Other rocks present in small amounts within the *KJs* group are greenschist, slate, limestone, greenstone and chert, but on the whole, the Sitka Graywacke is remarkably uniform in this area.

Profile "c" at the bottom of the bedrock map shows a section from Mount Edgecumbe through the Indian River. This shows that the Sitka Graywacke also underlies most of Sitka Sound, along with the related *KJsh*, or hornfels, altered by contact metamorphism. Extruded onto this glacially planed surface is the pimple-like formation labelled "*Qe*" for quaternary (*Q*) Edgecumbe Volcanics (*e*). The quaternary period encompasses the last two million years, during which flows and pyroclastics (ejected materials) have erupted from a northeast-trending line of vents. The last big bang from this line was of course the eruption, about 9,000 years ago, which scattered deep ash over the Sitka area, and even left thin layers near the bottom of peat bogs in Juneau.

Recalling our admittedly-loose "earth as organism" analogy, we've just accounted for the "skeleton". Volcanic ash belongs to the category of surficial deposits, with which we can begin to "flesh things out. ... "

Glacial history and surficial geology

In North America, the last major phase of the Pleistocene ice ages (a 2 million year period including at least 4 world-wide glacial episodes) is called the "Wisconsin", or for our purposes in speaking to children, the "Great Ice Age". As this glacial advance was peaking 20,000 years ago, all of Southeast Alaska was covered by ice, except for the highest peaks and perhaps some seaward-facing headlands, which protruded like islands through a sea of ice. In the Sitka area the ice was roughly 2800 feet thick, and melted away from the land about 14,000 years ago.

For the next several thousand years the land was still slowly recovering from having been pressed down hundreds of feet under the weight of glacial ice. Today's lowlands lay under the sea then. Just exactly how high the post-Wisconsin sea level stood against the outer coast is still unclear, but it seems agreed that it stood lower than farther inland where the ice had been thickest. (In Juneau the ice was about 5000 feet thick, and post-Wisconsin sea level was about 500 feet higher than today.)

Resulting surfaces Our surficial geology map comes from Yehle (1974) *Reconnaissance engineering geology of Sitka and vicinity. Alaska*. USGS open-file report 74-53. While the bedrock map lumps all surficial deposits as "*Qu*", and gives detail to rock types, the surficial geology map lumps bedrock (diagonal lines) and gives details to the unconsolidated deposits which overlie the bedrock. These surficial deposits were laid down either by glaciers, when the Wisconsin ice was receding, or by the ocean at times of higher sea level, or more recently by streams and rivers. On our field trips we'll be stopping at roadcuts or streambanks to look at the sediments just below the vegetation and organic mat.

To describe these materials, we'll consider a gradient of particle sizes, from large to small: boulders, cobbles, gravel, sand, silt and clay.

Glacial till ("*d*" on the surficial map. Drift is an older term that includes till) Till is unsorted; that is, it consists of a jumble of all particle sizes, from boulders down to clay. Till blankets many slopes but has been "edited away" from the bedrock map.

Alluvium ("a") This is a term for any material deposited by moving fresh water. On the surficial map these show as narrow stringers along creeks. On a broader scale, streams leaving steep bedrock slopes and encountering more level valley floors or marine terraces build fan-shaped deposits. These sites often grow huge Sitka spruce. Similarly, river bottom lands are blanketed with sorted sand, silt and gravel, which supports the largest trees of the Peril Strait area.

Talus fans (no map occurance) Rock and gravel falling downslope builds "*colluvial*" fans that are steeper than alluvial fans. On steep mountainsides this can be the dominant surface type.

Marine deposits ("eb" for elevated beach. The timing and exact elevation of post-Wisconsin sea level is poorly understood here compared to places like Juneau. According to the Yehle report there's clear evidence for marine deposits 35 feet above today's mean sea level, fairly good evidence (a whale vertebra) at 65 feet, and topographic suggestions (suddenly steepened slopes) at 275 feet.

Volcanic ash (*v*) Reddish fine ash and coarser lapilli (or corn pumice) covers a great deal of the Sitka area. Unloved by builders, because it turns to soup when worked with a shovel or bulldozer, the layered ash seems to have been deposited in "3 different eruptions occurring within short intervals."

Fill (coarse stipple) Even in 1974, more than half of the surfaces of Sitka and Japonski Island were covered with human-placed fill. Rather than add more stipple in places like Verstovia School, we've left the Yehle surfaces unchanged, so that the natural landforms may be interpreted.

Plant communities of the Sitka area

Our booklet, *A naturalist's look Southeast Alaska*, describes typical northern Southeast Alaskan plant communities as you climb from sea to mountaintop. Here we will only mention some features specific to the Sitka area.

First, why does our booklet's profile sketch say *northern* Southeast? The reason may be found on the map of uplift rates in our region. Find Sitka on this map. While there's no contour running as far south as Sitka, it's believed that the uplift rate is about 0.1"/yr. uplift contour runs between Kruzof and Baranof Islands. A tenth of an inch of glacial rebound each year is only about half of the rate experienced by Angoon, which is only half of Hoonahs, which in turn is only half that of Gustavus.

Sitka's uplift rate is just barely rapid enough to produce the distinctive coastal plant communities such as meadows, brush and spruce sapling stands on uplifted former tidelands. The best place to look for these communities is at the top of very gently sloping sand or mudflats. These in turn are most abundant at the mouths of large sediment-laden rivers, which, like uplift rate, increase to the north. As a result, Sitka Sound has a limited amount of recent uplift habitat compared to places like Glacier Bay and Lynn Canal.

Inland from the beach though, the profile sketch of community types in our booklet accurately represents the array found near Sitka. Forests of many sizes and ages, bogs, fens, brushy slide areas, subalpine meadows, and alpine tundra are all abundant.

To the old-growth and sub-forest descriptions on the profile, we should add yellow-cedar for the Sitka

Marine Mammals of Northern Southeast Alaska

Land carnivores	
sea otter	increasingly common on outer coast
Seals and sea lions	
Steller's sea lion	common; breeds mostly on outer coast islands
harbor seal	abundant
fur seal	rare in winter, mostly young individuals
elephant seal	rare
Toothed whales	
killer whale	pods transit area
pilot whale	rare
Dall porpoise	common in straits, less in side bays
harbor porpoise	common in straits and side bays
pacific whitesided dolphin	uncommon
sperm whale	once present; hunted out
Baleen whales	
humpback whale	common in scattered localities, mostly in summer
minke whale	scattered individuals
gray whale	common migrant along outer coast
blue whale	once present on outer coast; hunted out
fin whale	once present on outer coast; hunted out

Land Mammals of Northern Southeast Alaska

SPECIES	Stikine	Mitkof	Baranof	Chichagof	Admiralty	Glac. Bay	Haines
Insectivores							
masked shrew	X	X	X	X	X	X	X
dusky shrew	X	X	X	?	X	X	X
water shrew	-	-	-	-	-	X	X
Bats							
little brown bat	?	X	X	?	X	X	?
long-legged bat	-	-	-	-	X	-	-
Rabbits							
pika	-	-	-	-	-	-	X
snowshoe hare	-	-	-	-	-	?	X
Rodents							
beaver	X	X	I	X	X	X	X
porcupine	-	X	-	X	X		
hoary marmot	X	-	-	-	-	X	X
northern bog lemming	X	-	-	?	?	?	?
deer mouse	X	X	X	X	X	X	X
long-tailed vole	X	X	?	X	X	X	X
meadow vole	X	X	-	-	X	-	X
red-backed voles	X	-	-	?	-	X	X
tundra vole	-	-	X	X	-	X	X
muskrat	X	-	-	-	X	-	X
bushy-tailed woodrat	-	-	-	-	-	-	?
red squirrel	X	X	I	I	X	X	X
north. flying squirrel	?	X	-	-	-	X	X
meadow jumping mouse	-	-	-	-	-	-	X
western jumping mouse	X	-	-	-	-	-	-
Hoofed Animals							
black-tailed deer	X	X	X	X	X	X	-
moose	X	X	-	x	-	X	X
mountain goat	X	-	I	-	-	X	X
Carnivores							
brown bear	X	X	X	X	X	X	X
black bear	X	X	-	-	-	X	X
wolf	X	X	-	-	-	X	X
coyote	?	x	-	-	-	X	X
red fox	x	-	-	-	-	x	X
lynx	-	-	-	-	-	x	X
wolverine	X	X	-	-	-	X	X
river otter	X	X	X	X	X	X	X
marten	X	X	I	I	X	X	X
mink	X	X	X	X	X	X	X
ermine	?	X	X	X	X	X	X
least weasel	-	-	-	-	-	?	?
feral dog	-	-	I	I	I	-	-
Totals	27(4?)	21(0?)	16(1?)	18(4?)	18(1?)	30(3?)	34(4?)
Introduced	0	0	4	3	1	0	0

Key X = established in the wild - = not established in the wild
x = rare I = introduced

area. Cedar gives a great deal to the "personality" of forests here.

Local variations in forest and bog communities depend on surface types (discussed above), whose main influence on vegetation is drainage—that is, how well or poorly it gets rid of moisture. Other important influences are elevation (which dictates temperature and snow depth), and since the last major disturbance. Around Sitka itself, the most important disturbance is logging. The beginning of the Verstovia nature trail, for example, passes through a second-growth stand that appears to have been cut early in the century.

Notice on the *Climate and tide data* map in our booklet that Sitka has the least snow and the lowest number of heating degree days of any town except Ketchikan, less even than more southerly communities such as Petersburg and Wrangell that are closer to the refrigerating effect of the Coast Range icefields. During the February 1993 storm that dumped 3 feet of snow on Juneau and Angoon, Sitka got about 3 inches.

Annotated references

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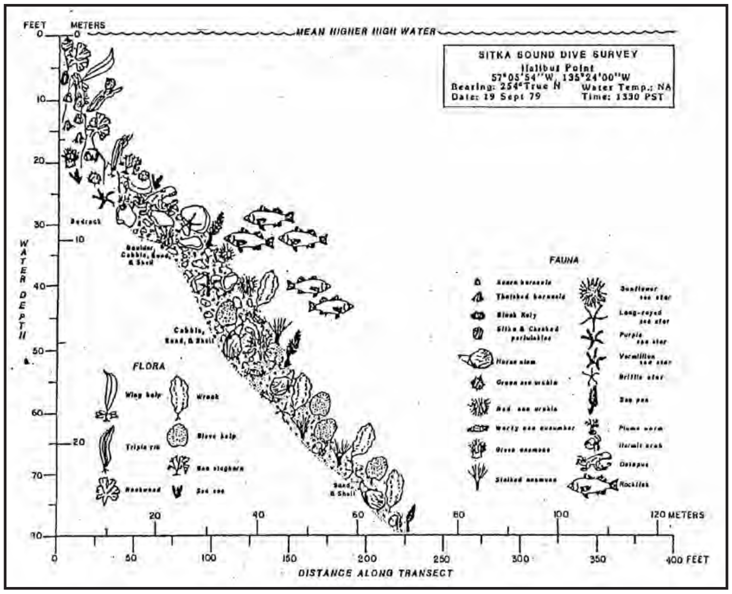

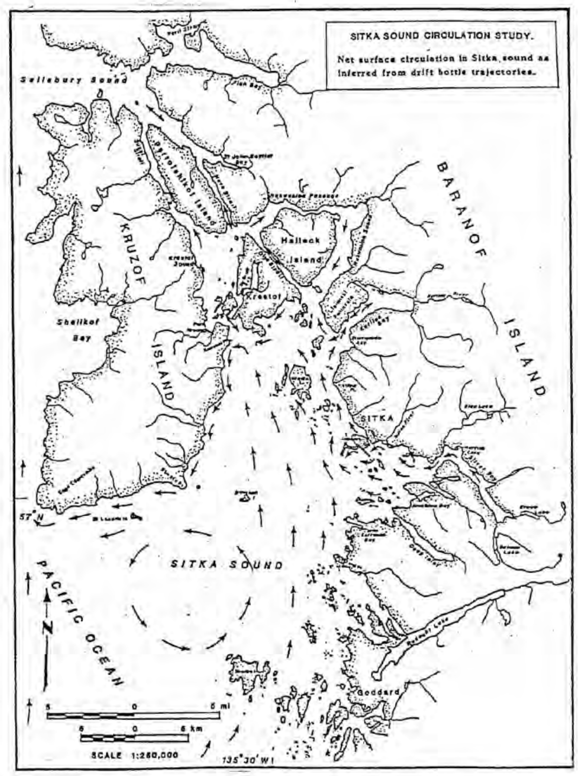

the Mount Edgecumbe Volcanic Field, Kruzof Island, Southeastern Alaska. U.S. Geo1. Survey Misc. Investigations Ser. Map 1-1983. • *Detailed map of field, giving ages of manv of the features and compositions of the various deposits*.

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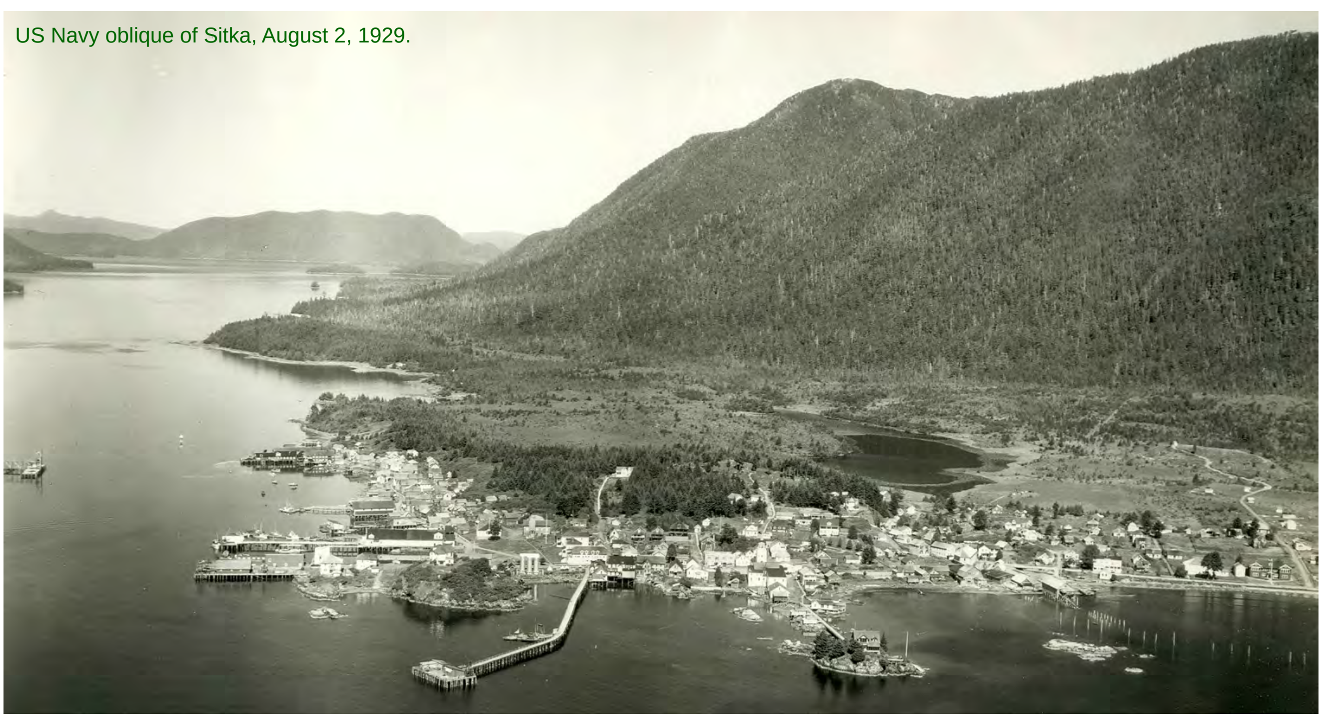

US Navy oblique of Sitka, August 2, 1929.

Preface RC 2012: This and other slide shows in our *Nature near the schools* workshop series of course literally were ***slide*** shows in the early 1990s; collections of 35-mm slides were included in notebooks placed in all school libraries. For this re-issue of the workshop notes, I've converted the shows to powerpoint format. You can download *sitka.ppt* from the Discovery website at *www.discoverysouth-east.org/xxxxxxxxxxxxxx (needs update)*

Natural History of the Sitka area

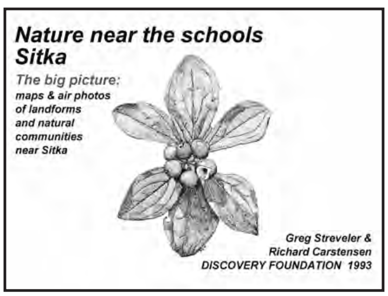
Slide show script

Note to Teachers The natural history workshop for Sitka encompassed geology, plant communities, local wildlife, marine ecology, human history and many other topics. These slides are exclusively of maps and air photos, chosen to give the "big picture" of Sitka and its environs.

Notes to you as teacher are included in the script in *italics*, and are not intended to be read out loud. You may wish to present some of the technical words, shown in **boldface**, in a separate class before viewing the slides.

If you've never used air photos before, don't be intimidated. We've discovered that students are fascinated (especially when they find their houses or spots they know well). When time permits, we like to have kids come up and point out features on the screen.

The stereogram sheets in this notebook let the kids see selected views around Sitka in 3-D. They and the "puzzler" sheet that goes with them makes a companion lesson to the slide show. If you have any questions about photo interpretation, or need suggestions on classroom use, contact Discovery, and someone will be glad to help you.



1) title slide

2) USGS topographic map (1:250,000) The Sitka area schools sit in one of the most dramatic landscapes on earth. Maps and air photos help us see the BIG PICTURE. Where do we live? What lives around us? What has shaped this place? What processes are going on today? What will the landscape be like tomorrow?

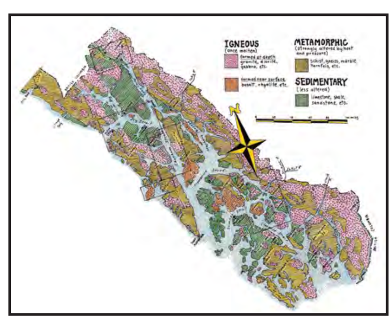
This topographic map is a sort called shaded relief, meaning that shading is used as if the sun were highlighting ridges and mountains, leaving the steepest places in deepest shadow. This sort of map is particularly good for outlining watersheds (the basin that provides water to a particular stream). The largest one on this map is that of the Katlian River, with 2 main branches draining icefields in the high mountains behind Sitka, emptying into Katlian Bay. Can someone come to the screen and outline the watershed of Indian River, Starrigavan Creek, Blue Lake? How are each of these watersheds important to life (human and otherwise) in Sitka (think of salmon and drinking water, for instance).

Notice that 3 locations of stereograms are indicated: Sitka, Starrigavan and Mount Edgecumbe. The landscape here can be studied in 3D under a stereoscope.

3) bedrock map of SE Alaska Bedrock is the solid mass of rock making up the earth's crust This is a simplified map of Southeast Alaska's bedrock, lumping together our very complex geology according to the 3 basic rock types: **sedimentary, metamorphic and igneous**.

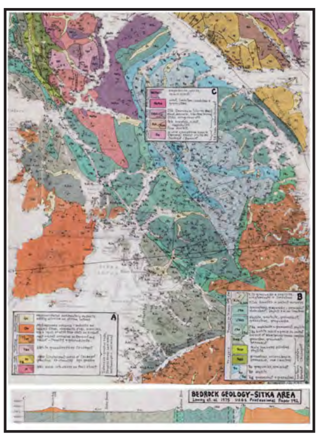
Sedimentary rocks are sediments (sand, gravel, mud, volcanic ash, etc.) that have been cemented together and thus turned to stone. This process of becoming rock usually happens after more sediments pile on, increasing the heat and pressure. If the heat and pressure becomes great enough that the minerals in the sediments begin to alter their shape or chemistry, we get **metamorphic** rocks. This greater heat & pressure usually comes from getting buried deeper, or from getting squeezed by mountain-building. Once there is enough heat & pressure (generally after the rock has been pressed down miles into the earth), the rock melts. When it re-solidifies, it will become an **igneous** rock.

So rocks contain clues about their past history. If an area is made up mostly of sedimentary rock, its history has been relatively calm. But if metamorphic or igneous rocks predominate, there has been a history of more intense burial, erosion and mountain building.

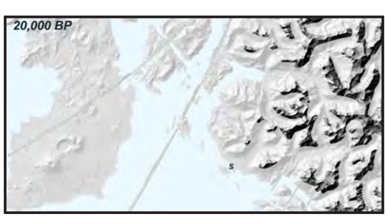


Now look at Sitka. The rectangle outlines the area covered by the last slide. What kinds of rocks predominate? Yep, the Sitka area has had an intense history, alright. In fact, geologists estimate that in the last 25 million years, the mountains behind Sitka have risen 6 to 8 kilometers! But the mountains are less than 2 kilometers high now. Where did the rest of the rock go? That's right, it eroded away. It's mostly sitting out on the continental shelf offshore from Sitka, where it is getting buried and turned into sedimentary rock, starting the rock cycle allover again.

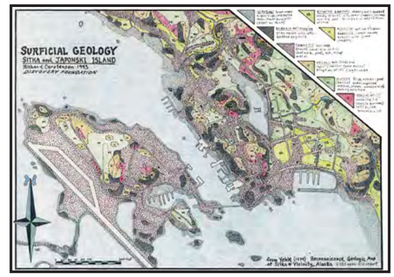
4) bedrock geology Now let's look more closely at Sitka's rocks. The main bedrock type right around town is a kind of muddy sandstone called greywacke ("wacke" is Welsh for rock). It is still not very highly metamorphic. But then notice that there are lots of other types of rocks. They're pretty complicated. (*You have a brief description of them in the Discovery Notebook materials.*) In fact, geologists puzzled over this complexity for years, until coming up with a sci-fi type hypothesis to explain them. The reason the rocks are so chopped up into different little pieces, geologists think, is because they ran into North America! That's right, they once were at least 2 separate parts of the earth's crust that drifted into North America, and in the process got all jumbled up. (*To take that thought further, see <u>A naturalist's look at Southeast Alaska</u> in your packet of materials.*)



5) Sitka 20,000 years ago At the peak of the Great Ice Age, glaciers covered all of Sitka Sound, and even the mountains around present-day Sitka, to a depth of about 2800 feet. This map shows the summits and ridges higher than that, which stood above the sea of ice. Although today's Mount Edgecumbe is 3200 feet high, its summit did not exist yet! It's easy to tell which peaks above town were not glaciated, because they appear sharper and more angular than the lower foreground ridges.



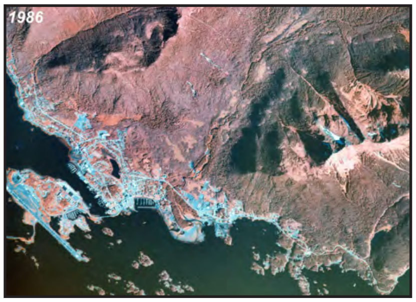
6) surficial geology On this map, bedrock has been all lumped together (the dark hatched spots) and deposits of sediments are put in various categories. Notice first of all the areas people filled with rock and gravel. Like all Southeast Alaskan towns, easy-to develop land is scarce, and one way around that is to build your own. Sitka greywacke makes good fill material when blasted in a quarry. One of the reasons Sitka needs lots of fill is because much of the land originally was covered by muskeg ("*m*" on map), or peat bog. Peat is unstable; one solution is to cap it with rock. Little remnants of the once-extensive peatland still remain here and there around town. Are any of your homes near one of these?



Much of the rest of Sitka is covered with volcanic ash deposits ("*v*" on the map). These are left over from a major eruption of Mt. Edgecumbe or one of its companion peaks about 9000 years ago. It also makes a poor foundation and is often removed or filled over before people build on it. Finally, notice that some areas near downtown and Swan Lake are labelled "elevated beach" ("*eb*" on the map). Geologists have found beach sands and gravels up to about 35 feet above mean sea level, and the volcanic ash is absent below that line.

Putting these 2 facts together, they have deduced that about 9000 years ago, the sea was about 35 feet higher at Sitka than today. Since sea level world-wide hasn't changed much between now and then, geologists think the explanation is that the land has risen. Mostly, they think, this rise is due to slow rebound of the land, which was pressed down by a great load of ice about 20,000 years ago, during the Great Ice Age.

7) 1986 aerial infra-red of Sitka Some photography is done with film sensitive to a part of the spectrum of sunlight called infra-red. That film is particularly able to highlight differences in vegetation. On this photo, the gray-red areas that are textured like cauliflower are forest, while the brighter red, less textured areas are mostly muskeg, brush, alpine meadows or young, second-growth forests. The blue-gray areas are mostly

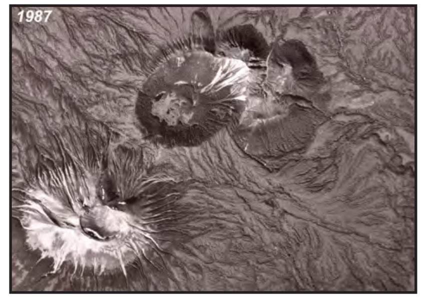


unvegetated, like downtown Sitka and parts of the intertidal zone. Also evident on this photo is the sharp peak of Mt Verstovia, which was tall enough to escape being over-run by ice during the Great Ice Age. Ever thing else in the photo was under the ice then and got rounded off.

8) 1989 color aerial of Sitka This closer view of downtown Sitka shows Swan Lake, and an intriguing variety of forests and peatlands at the edge of town, on the right. The beginning of the Gavan Hill trail passes through an open sphagnum bog here.

9) 1986 aerial infra-red of Starrigavan watershed Creek features stand out nicely in this photo. Notice the Halibut point area, a delta built of materials carried by Granite Creek and dumped when veloc-ity was slowed as it entered the sea. Also notice the gravel quarry a little way up the Creek. These gravel deposits may well have been laid down at an earlier time, when the sea reached farther up-valley, and the creek made a delta at that point. The story of Starri-gavan Creek seems to be a little different. The valley bottom extends far inland with little rise in elevation. Notice the large clear-cut in Starrigavan Valley, where all of the old-growth forest has been removed from the lowlands and valley walls. What effect would you predict this to have on populations of deer in the valley?

10 1987 b&w of Mt Edgecumbe Here we look at the truly unique part of the Sitka area: Mt. Edge-cumbe, Crater Ridge and their related features are the only real volcanoes in SE Alaska The last major erup-tion, 9000 years ago, spread a plume of ash northeastward as far as Glacier Bay and Juneau (so which way was the wind blow-ing from at the time?). We've already mentioned the ash around Sitka, which can be several feet thick. On Kruzof Island it is dozens of feet thick in places. But notice on the photo that you can see the patterns of some older volcanic lava flows radiating out from the volcanoes. This is because the lava flowed down the land's slope like water would, until it cooled enough to solidify. And so, today, running water follows the same slopes; where creeks form, they trench into the flows and improve the drainage, allowing stringers of trees to grow along their banks. It is these darker bands of trees in the peatlands that we see on the photo, just like flow-lines in the old lavas!



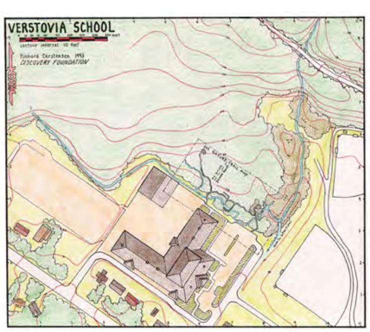
Now look for the two small cones with lakes in their craters. These must be very young, since their slopes are hardly eroded at all. Probably they are made of ash rather than lava; the good forests on them suggests that they are well-drained. Nobody knows their exact age, but the forests on them suggest that they are at least a couple of hundred years old. And there are no records of eruptions since the Russians arrived around 1800.

11) 1989 color aerial of Verstovia School First, find the school on the photo. It was built recently, and so to find suitable flat land, the site had to be back away from the beach almost where the mountain starts to rise up. At places like this near the toes of mountains, materials washing down often create alluvial fans of coarse materials that drain well, and so large trees may grow there. Verstovia School trail is at the lower edge of a fan like this. Can you pick out the area next to school that the trail is located in? But not all the forests along the trail have big trees,

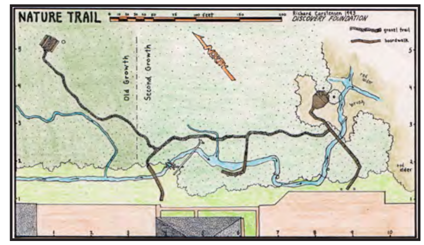
do they? There are 2 reasons for that. First, the part nearest the school is flat and boggy, which is the kind of place trees just naturally grow slowly. And second, the big stumps scattered here and there show that there has been logging of some of the best trees in past times. Now find the landfill and ballfield nearby. Do you see the bright green edge to the vegetation between these constructed features and the trail area? Those are places where trees have blown down and now greenery has sprung up in recent times. Blow-down often becomes much more prevalent in a forest once an edge is opened up by human development. The Verstovia trail forest will probably lose a lot more trees to blowdown in the future. However, left to its own devices, the forest will repair this damage and grow new, wind-firm edges. Some scientists believe that in the long run it is good for the forest if trees occasionally blow over, because when the tree roots tip up, they plow up the soil,improving the drainage and bringing nutrients to the surface.

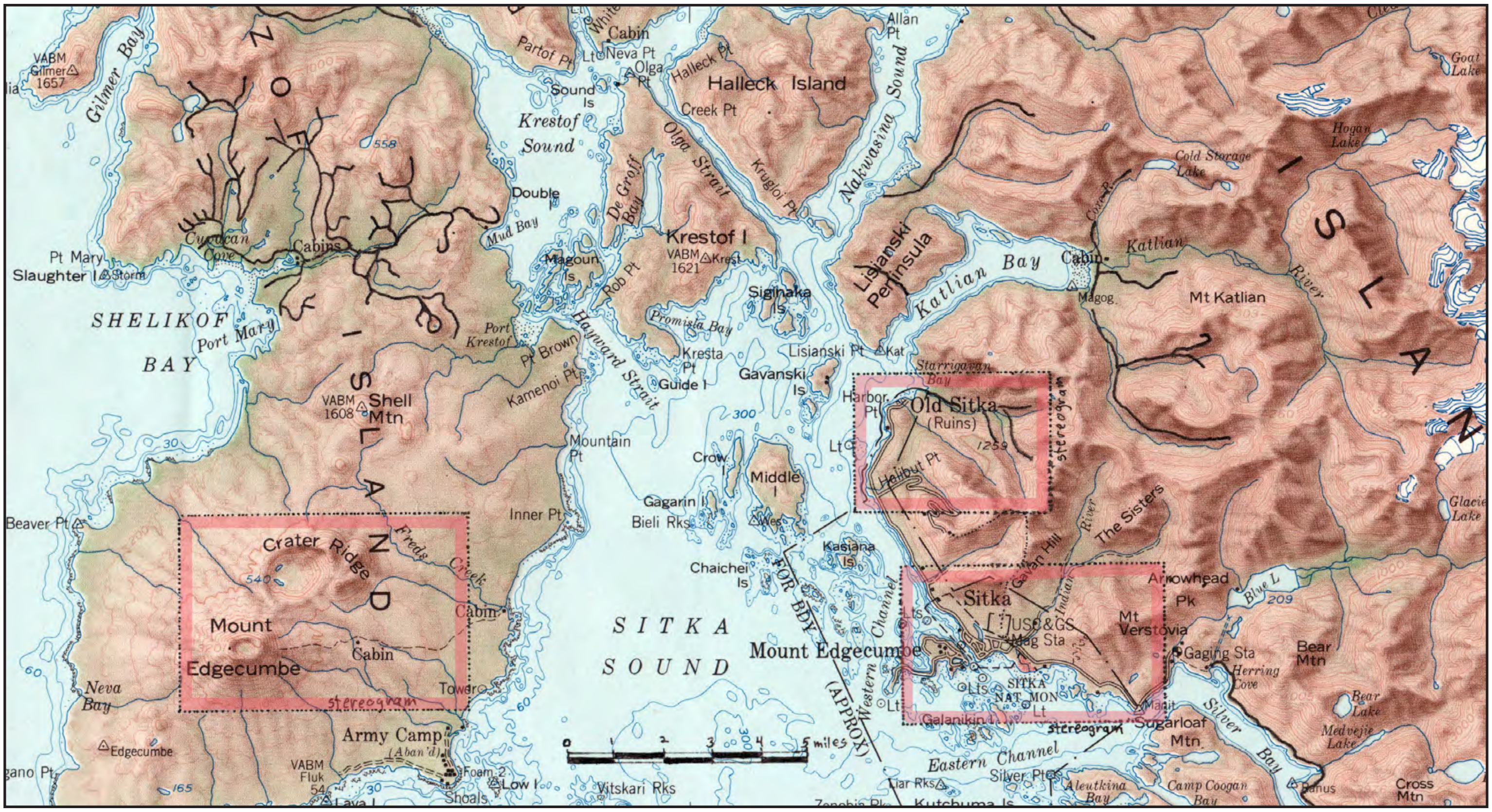
12) 1993 map of Verstovia School Here's our Discovery map of the school grounds and the forested hillside above. Notice the creek has 2 main tributaries: one coming from the west (from somewhere near the "north" arrow), and the other from the north, through a culvert under the upper road (coordinates 9—8, or over 9, up 8). This map has red lines showing 10 foot contours. Judging from these contour lines, where is the flattest area? (*The school site and playground.*) Is this a naturally level area? (*No. It was levelled by placement of fill.*) So what effect did that have on the west tributary of the creek? Where did this creek flow before the school fill was placed? (*It probably ran more directly downslope. The city planning department and the historical museum both have old air photos taken before development of the area. You could research the creek's history by examining such photos.*)

13) 1993 map of Verstovia Trail



Now study the nature trail map. The preceding school grounds map has a rectangle showing where this close-up view is located. Like the school grounds map, the nature trail map has coordinates on the sides. What are the coordinates of the observation platform? (9—3 1/2) The beginning of the trail is in young second growth forest, and the end is in ancient old growth. We've drawn a line on this map showing the boundary, but we haven't followed it far back into the woods. On your field trips, remember to look for this important boundary. What differences can you find in understory plants? In winter snow conditions? You can use copies of these maps in the field to record your observations.





Sitka stereogram puzzlers

Locations of these photos are shown as pink rectangles on the above shaded relief map.

First, let's look quickly through the entire Sitka stereogram collection. On one side of the sheet there are views of 4 areas. In the upper left are color infrared photos of the Indian River drainage, taken from high elevation in 1986. Proceeding clockwise from this photo, we come to a 1987 black and white stereogram of Mount Edgecumbe. Studying the scale bars, note that these 2 images are "broad scale," each encompassing more than 10 square miles, and houses can barely be seen. Below the Edgecumbe pair is a 1989 color stereogram of downtown Sitka. The 4th stereogram is also a color 1989 pair for Verstovia Elementary School and the High School. These lower 2 stereograms are finer scale. The scale bar covers only 800 feet, rather than a mile as in the other images, and details of buildings are clearly visible.

On the back side of the sheet are 2 more stereograms, color infra-reds of Starrigavan Creek and Port Alexander on the southern tip of Baranof.

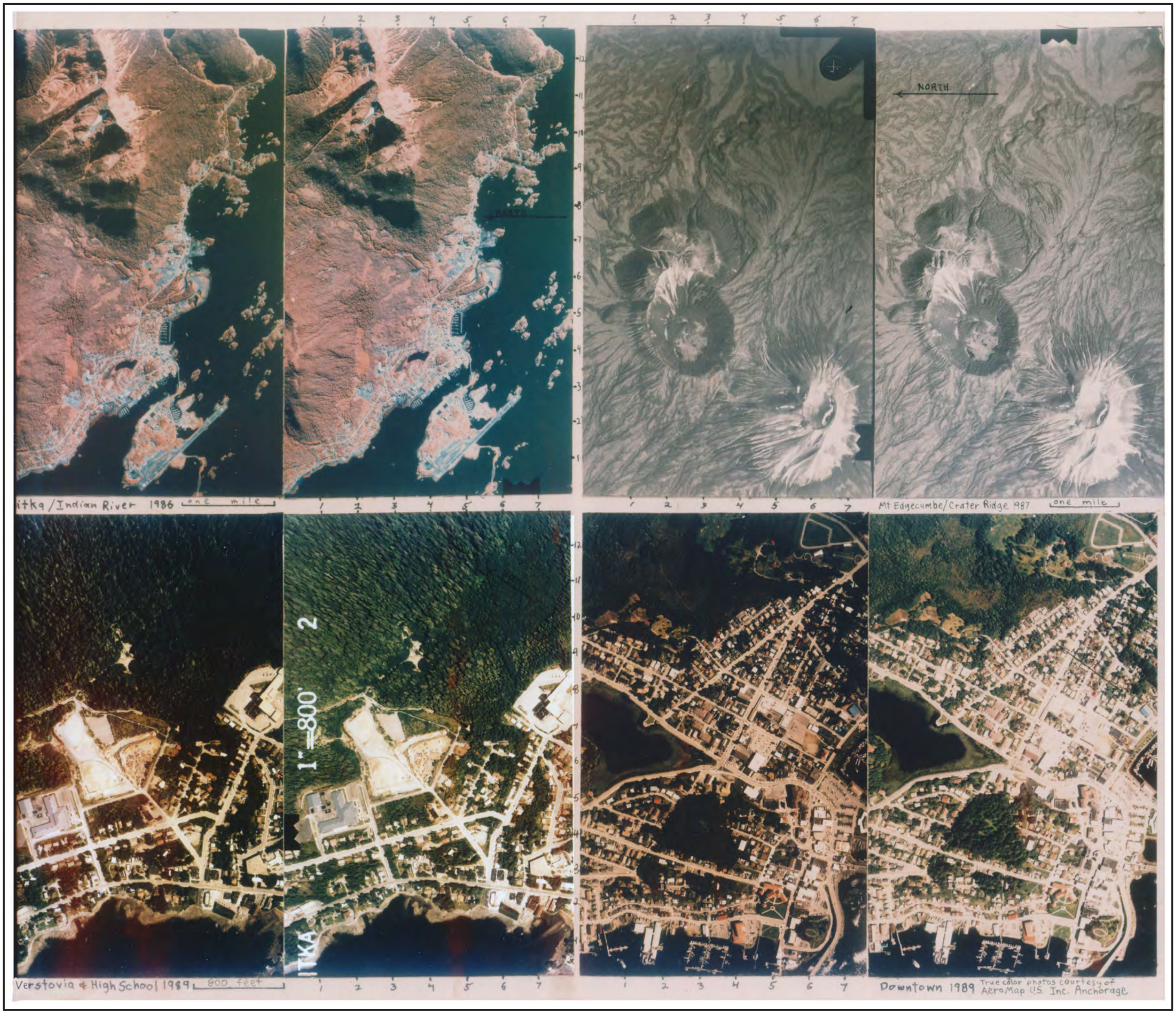
1) Begin in the lower left, with the true color stereogram of Verstovia School and the High School. Before trying to interpret air photos, it helps to consider location, compass direction and scale.

a) What are the coordinates of the High School? Temporarily close your left eye so the numbers on the edge of the right photo are easier to read. Starting at the lower left comer of this photo, count over, then up to the school. It's over 7 1/2, up 7 1/2. We write this as 7 1/2—7 1/2. What are the coordinates of the Elementary School?

b) If you follow Kashevarof Street downhill from Verstovia School to Halibut Point Road, what direction are you going? (*The north arrow is in the upper right of the right hand photo.*) Was that question too easy? Okay, here's a tougher one. Find a tree that stands by itself so you can clearly see the direction cast by its shadow. About what hour of the day was the photo taken? (*It may help you to know that the pictures were taken August 10.*)

c) How long is Verstovia School, along the waterfront side? The easiest way to measure this is to hold the edge of a piece of paper against the scale bar and mark off 400 feet, then slide this up to the school. Try measuring this same distance on the Discovery map of Verstovia School. Do your measurements agree?

d) Study the forest covered by the north arrow, in the upper right comer of the stereogram. Why do you



Stereograms for the Sitka area For instructions, see *Using the stereoscopes and stereograms* in the introduction to this manual. You can either print this page, or else scale the stereograms on your monitor and hold a stereoscope to the screen. Note the north arrows point in different directions on these photo-pairs. Layout of stereograms is constrained by flight-line direction. Locations of these photos are shown as pink rectangles on the preceding Chatham Strait topographic map.

think the trees are smaller in this area?

2) Now go to the right, to the stereogram of downtown Sitka.

a) Are the shores of Swan Lake deep or shallow? Why do you think so?

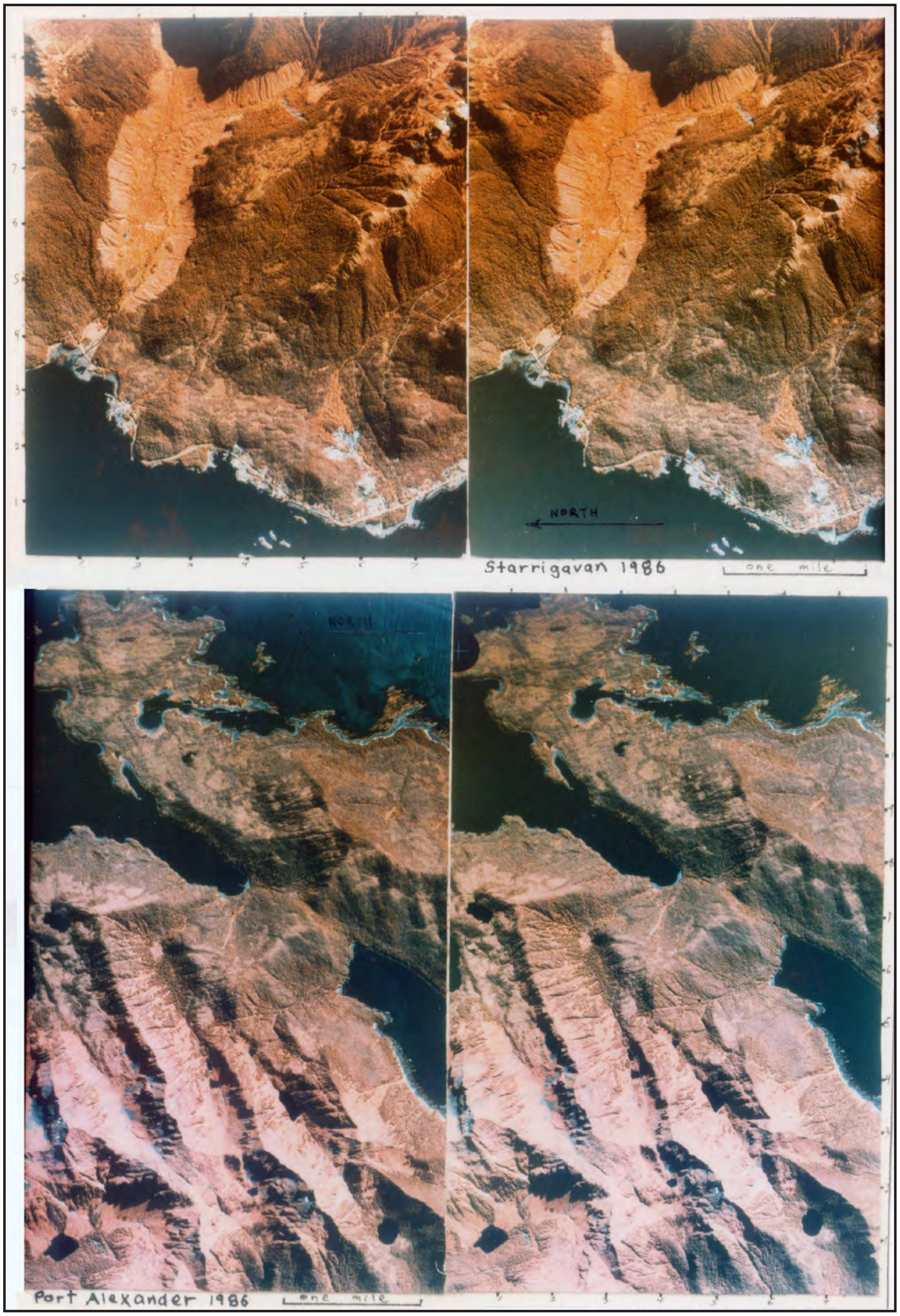
b) Gavan Hill trail is clearly visible in the upper left, running from 3—10 to 1—13. What natural community does this first part of the trail pass through?

c) Find the large parking lot at 4 1/2— 6 1/2. Now find this same area on the surficial geology map. What landform is it on?

3) Go up to the color infra-red stereogram of Sitka and the Indian River.

a) At 2—5 is a patch of big trees. What landform do they grow on? (Hint, study the slopes above.)

b) Follow the ridge which descends from Mount Verstovia (2 1/2—10) to Indian River. At what



coordinates does the topography change from sharp and angular to more gently rounded? This is about the 2800 foot elevation, the highest ice level of the Wisconsin glaciation. (see map in handout)

4) On the 1987 black and whites, Mount Edgecumbe is the taller volcano at 6—2. Crater Ridge is the much deeper crater at 3—5.

a) Why are the inner walls of Crater Ridge forested, while the Edgecumbe Crater is bare?

b) What is the large, fan-shaped landform centered at 6—9?

c) In the upper left, why do forests grow best along streams?

5) On the back of the sheet, go first to the stereogram of the Starrigavan Creek area. Give coordinates for the following features:

a) a fresh landslide

b) a gravel quarry

c) a stand of large, river bottom spruce

d) an angular, unglaciated peak

6) Finally, go down to the stereogram of Port Alexander. The town's coordinates are 3—11.

a) Compared to the Sitka area, would you say that !here are more or less forests on south Baranof Island?

b) Find a ridge where it's easy to pinpoint the difference between angular and rounded topography. The ice here was only about 2000 feet thick. Why might it have been thicker over Sitka?

Answers to the puzzlers

1) Verstovia School

a) 2—4 1/2

b) Kashevarof Street runs downhill to the south. Tree shadows point northwest, so the sun is in the southeast. This occurs in the late morning on August 10, which is only a month and a half from the summer solstice. (In Southeast Alaska the summer sun sets in the northwest. Only on the spring and fall equinoxes does the sun rise directly in the east and set directly in the west.)

c) On the photos, the distance is slightly under half of the 800 foot scale bar, or a little under 400 feet. Measurements from the map give slightly over 350 feet.

d) The small, tightly packed, darker green trees in the upper right are only about 20 years old, while the taller trees in the upper left are ancient old growth. In 1978 air photos the area's been freshly clearcut.

2) Downtown Sitka

a) The shores are shallow. The light green fringe is yellow pond lily, which usually roots in mud at 3 to 5 foot depth.

b) The trail begins in open, ponded muskeg, or sphagnum bog.

c) The surficial geology map shows this area as neb," or elevated beach. This is land that was intertidal just after the great ice age, when the land was still depressed. Such sites have the best natural drainage in the Sitka area, and don't require the fill (shown as coarse stipple) that covers most of the developed area.

3) Indian River

a) Looking upslope from this triangle of big trees, we see several stream gullies carved into bedrock. This landform is the alluvial fan of the combined creeks. Fans are well-drained, and often support large-tree forests.

b) The contact from sharp to rounded is at about 3—10. Our map of 20,000 years ago shows the summit of Mt Verstovia as an island in the ice.

4) Mt Edgecumbe

a) The pit of Crater Ridge is much deeper. The lowest point in the Edgecumbe crater is 2638 feet, while the Crater Ridge pit descends to less than 400 feet, almost to sea level. Much of the summit of Edgecumbe is above climatic tree line. (Also, comparing the two craters, which eruption blew out more material? !)

b) This fan is not a stream deposit, as revealed by its steep, bulbous foot, but rather a lava flow. It appears to have originated not from Edgcumbe, but from Crater Ridge.

c) Most gentle slopes on Kruzof, blanketted in thick ash, are poorly drained and boggy. Only on the steeper stream banks does improved drainage encourage trees.

5) Starrigavan

a) 5—8;

b) 6—2;

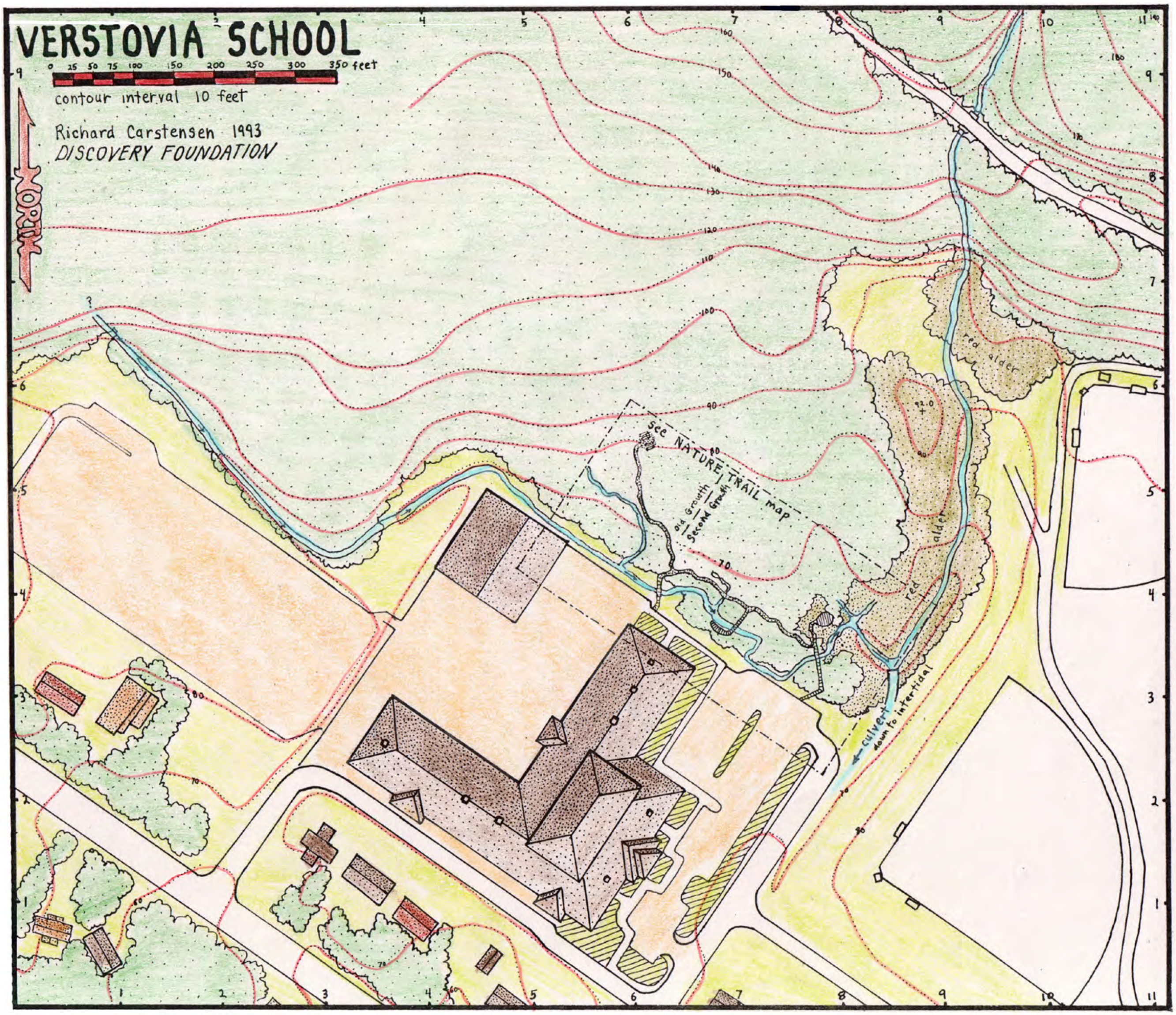
c) 1 1/2—4 1/2 These large trees are all that remains of the clearcut alluvial spruce forest.

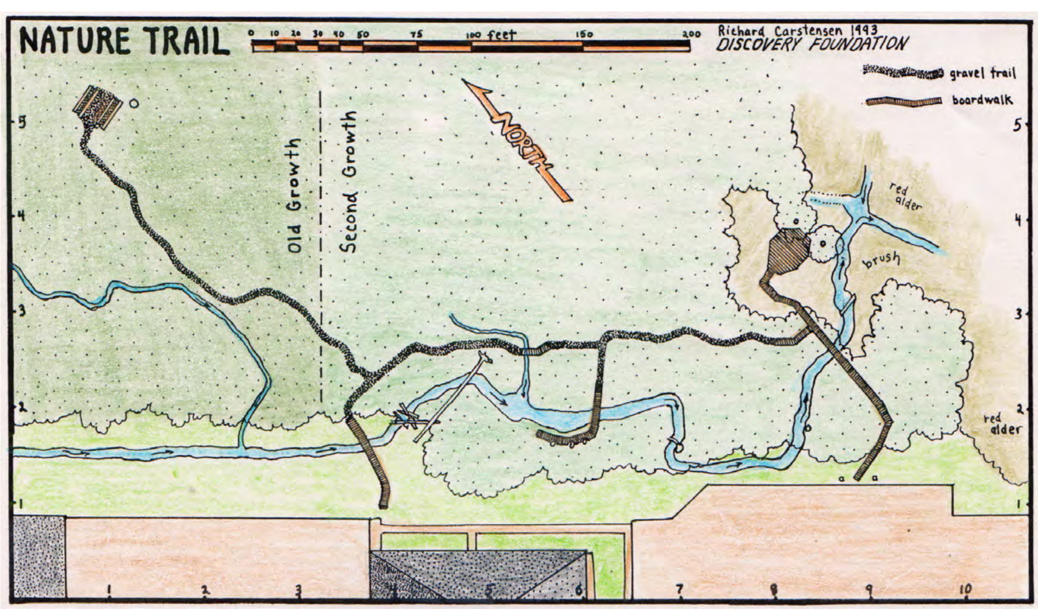
d) 8—8.

6) Port Alexander

a) Big forests are much scarcer on southern Baranof, restricted to bay heads and a few small valleys.

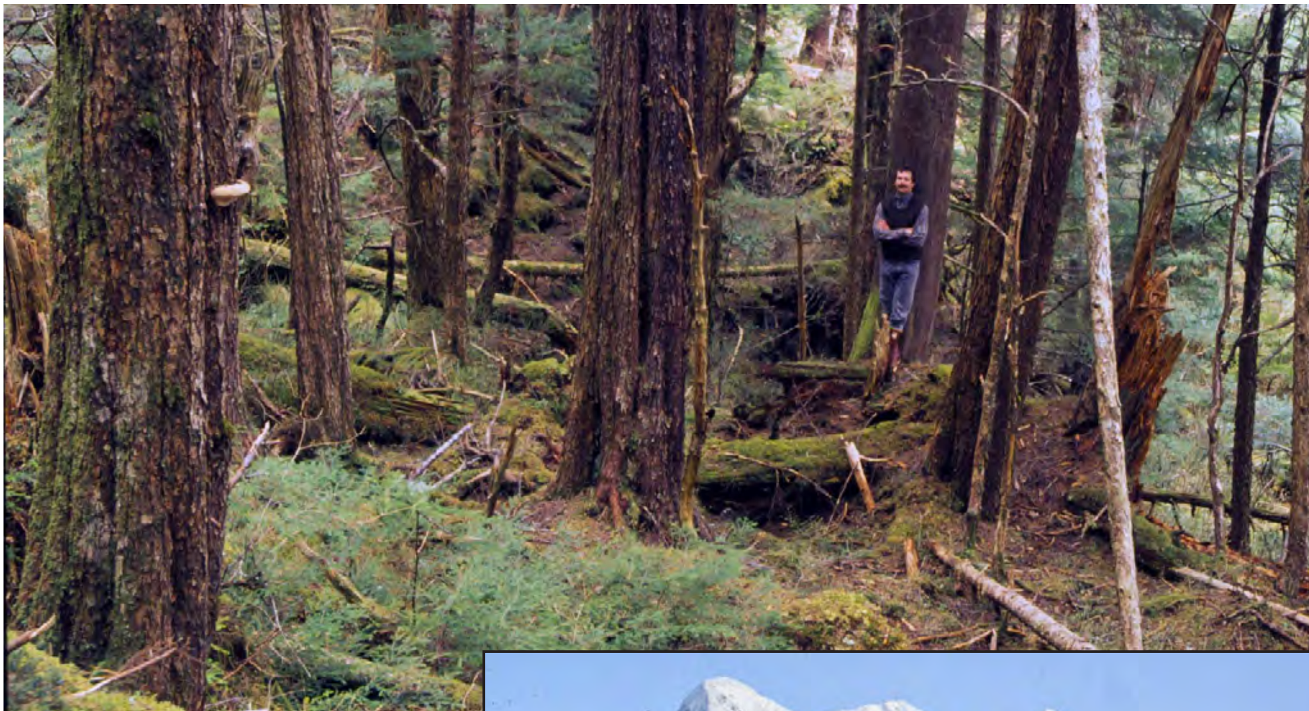
b) Sitka and PA are both on the outer edge of Baranof, which had the shallowest ice in Southeast at the Wisconsin peak. But Sitka is close to an area of high mountains, centered around the Glacial River (*flows into Kelp Bay on eastern Baranof*). This range probably served as an additional accumulation area for ice, raising the level at Sitka.

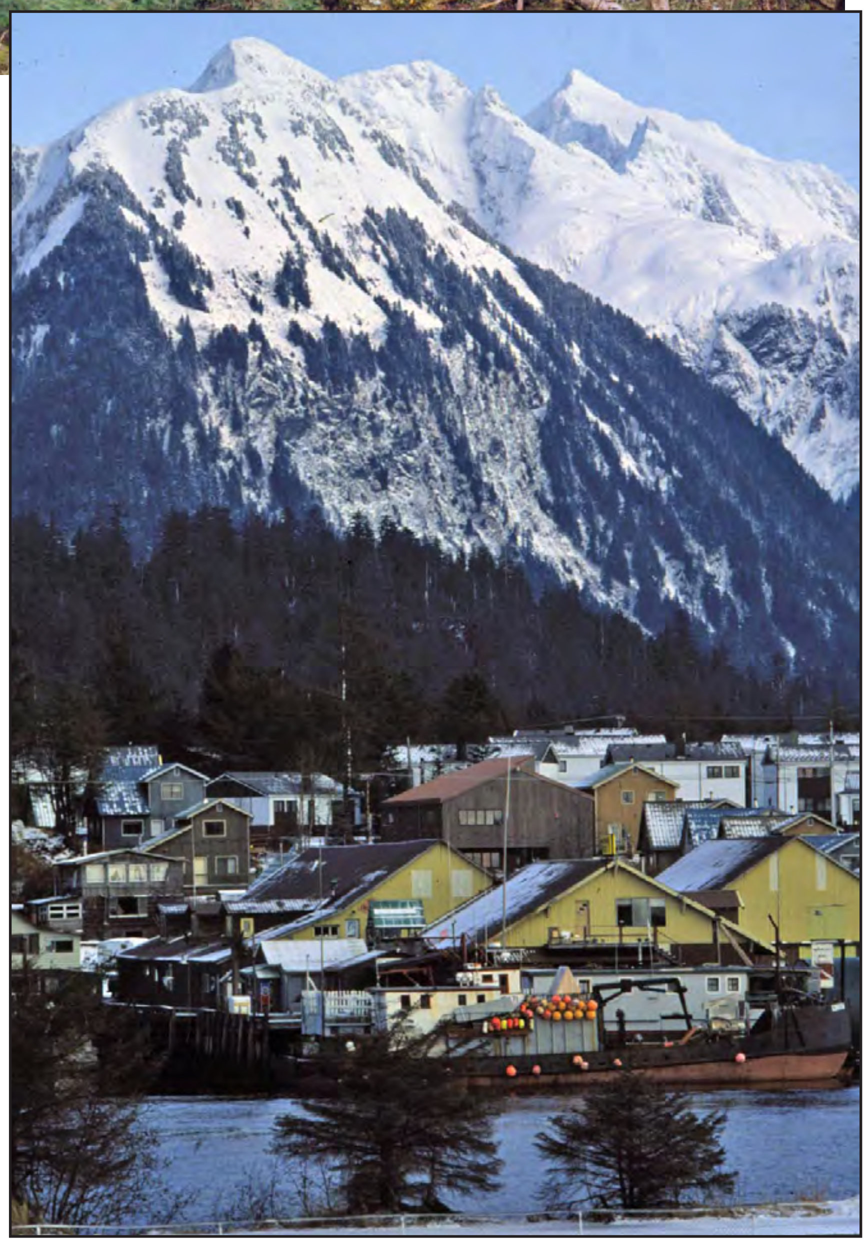




Above: Discovery map of Verstovia Elementary.

Left: The boardwalk trail behind the school—area outlined on above map.





Above: Founding *Discovery Southeast* director Scott Brylinski moved from Juneau to Sitka after helping us launch the educational nonprofit. Our Sitka workshop was a chance for Greg Streveler and me to reconnect with Scott, who helped with our pre-workshop reconnaissance. Here he's leaning against an ancient yellow-cedar on the hillside above Don Odenheimer's, home to the Naturemobile during our Sitka sojourn.

Right: View northeast from Japonski Island across the channel to Sitka. During the Wisconsin glaciation the ice level was about 2800 feet. Foreground mountains, below that level, are ice-rounded. The distant, more angular peaks, above that height, stuck out.

The herring spawned while we were in Sitka! From top to bottom, here's a zoom-in sequence: egg-frosted rocks in the mid-to-low intertidal, with Annahootz in the distance; *Fucus* completely coated; macro of eggs on algae.

Teaching the Natural History of Southeast Alaska

DISCOVERY FOUNDATION teaching aids and reference materials for Chatham Strait Area Schools

PETERSBURG SCHOOLS

course outline

FRIDAY EVENING 6 - 9PM

Introductions
- who's who; what's the Discovery Foundation anyway?
- key ideas; a cruise through the handouts
- deer and blackcod as flagship species

Chatham in 3-D - using stereoscopes; some puzzlers about your home locality
Natural communities of the land - changes with time, altitude, wetness
The marine environment - tides & currents; bottom and midwater communities; annual cycle

SATURDAY 10AM - 6PM

Wildlife
- more on deer; bears; some of the minor players
- islands and animal distribution

Geology -rocks, fossils and crustal plates
Field trip prep - Angoon natural history, intertidal, forests
Lunch 1-2pm
Field trip 2-6pm along trail to cemetary and back along beach
- on the way out: exercises characterizing forests
- on the way back:beach geology, intertidal life

SUNDAY 9 AM - 5PM

Intro to school vicinity
Field trip 10-12am characterizing the school grounds forest and bog communities
- in search of a study site for Angoon schools
- applying mapping and descriptive methods to the site

Edibles - the tastebud's opinion of plants and invertebrates
books and publications for the Chatham natural historian
Natural history and the school curriculum - brainstorming on interdisciplinary projects
3-ring circus
- A penultimate perambulation through trophic, systematic and geographic ecology

Evaluations

Natural history of the Stikine area

A Discovery site interpretation workshop

Natural history studies encompass everything from "bugs to bedrock." Obviously this is far more than we can hope to cover in a weekend workshop. But we do hope to impart some of the naturalist's excitement over interrelationships. For example, what do the 2000 year old ftsh traps at Sandy Beach tell us about beach processes since that time? Why are the large trees on northern Mitkof mostly found along drainages and beaches? Why are both ends of the Narrows especially good fishing spots?

A naturalist asks questions like these. Conclusive answers are few and far between, but the result of our curiosity is a deepened sense of place, and an appreciation for the workings of the land. Teaching children to ask these questions is more rewarding than providing them the answers.

A typical natural history sketch proceeds "from the ground up". It begins with the underlying bedrock "skeleton", which is then "fleshed out" with surficial deposits like glacial and river sediments. These are covered with the "skin" of soils, and a "coat" of vegetation. We should probably terminate our analogy at this point, since the area's fauna would have to be likened to fleas or lice.) And many natural history descriptions end with a chapter on people.

This is not the order in which most of us learn about the land. As children we may first be attracted to the doings of our fellow human beings, then to those beings who most resemble people, like mammals and birds, then to fish, bugs, and only later to plants, and still later to rocks and other inanimate objects.

Just as we can guide childrens' interest to bedrock via beavers, we can lead them to a study of nature by way of the layout of human communities. In our work at Juneau area elementary schools we've been delighted at students' reactions to projected air photos. Irs hard to keep kids in their seats as they search for their houses on the screen. And examination of roads and buildings leads easily to natural features, like different forest types, or glacial landforms, especially in a place like Icy Strait and Glacier Bay, where spectacular glacial history has drawn researchers from all over North America.

Let's take ourselves, Homo sapiens, as a starting point, and ask a series of "why" questions that will sooner or later lead us back to bedrock.

First, of all the potential townsites in the Frederick Sound area, why have people chosen to settle most densely at Petersburg and Wrangell? Early folks had a lot of places to choose from. Things that attracted people are not uniformly distributed. What attributes would they have been looking for in a potential home? Think of good beaches, shelter from weather, access to abundant resources, defense possibilities .....

The next series of questions follow naturally: Why are the attractive features where they are? What formed the beaches? The weather patterns? The good ftsh streams? Halibut and crab concentrations? Good game populations? Attempting to answer these lead us to consideration of soils, nutrients, activities of erosion and deposition .....

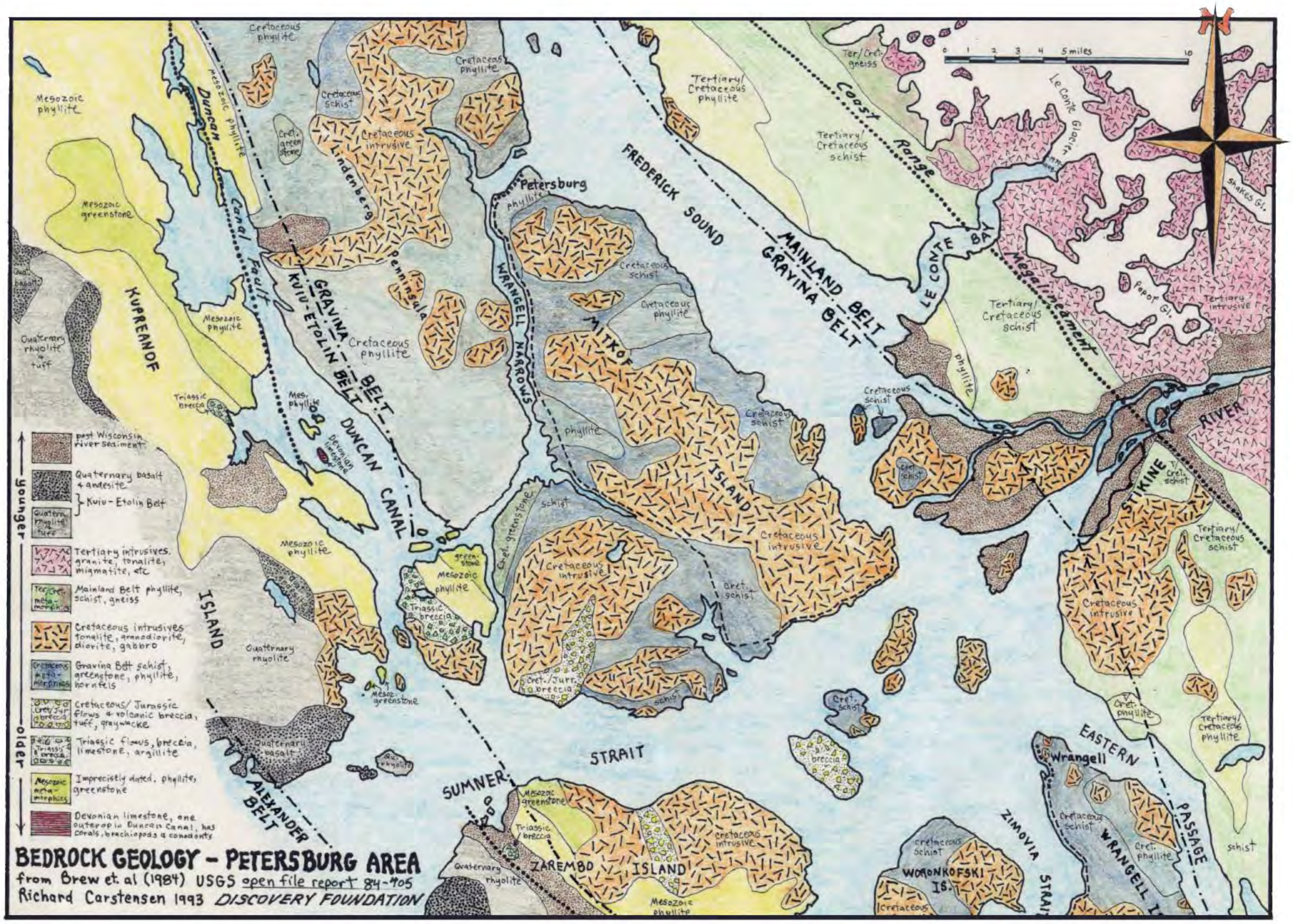
The next series of questions follow naturally: What formed the beaches? The weather patterns? Why are there good fish streams? Good game populations? Attempting to answer these lead us to consideration of soils, nutrients, activities of erosion and deposition .....

Next questions: Where did the materials for the beaches come from? How did the soils form? Where do the nutrients come from? And the topography that dictates local weather?

Eventually almost any line of questioning within the immense field of natural history comes to rest on bedrock, and an understanding of its origins. With young children it may make sense to start with mammals; the cuddlier the better. For adults, the bedrock-first approach makes a lot of sense, for the same reason that we start building houses at the basement, rather than the roof.

Bedrock Geology

Our bedrock map of the Petersburg area comes from D. Brew et al. 1984. *Preliminary reconnaissance geology of the Petersburg and parts of the Port Alexander and Sumdum 1 :250.000 quadrangles, southeastern Alaska*. U.S. Geological Survey Open File Report 84-405. In this one relatively small area, the map shows rocks of many different types and ages. For years, this diversity was bewildering to geologists, but in the last few decades crustal plate theory (which we'll explain in the workshop) has come to the rescue. Workers like Dave Brew have divided Southeast Alaska into several different "terranes," or wandering crustal fragments, each with its own geologic history. To see where the Petersburg area falls within these terranes, study the *Geologic terranes* map on page 3 of our booklet *A naturalist's look at Southeast Alaska*. The modern interpretation places rocks west



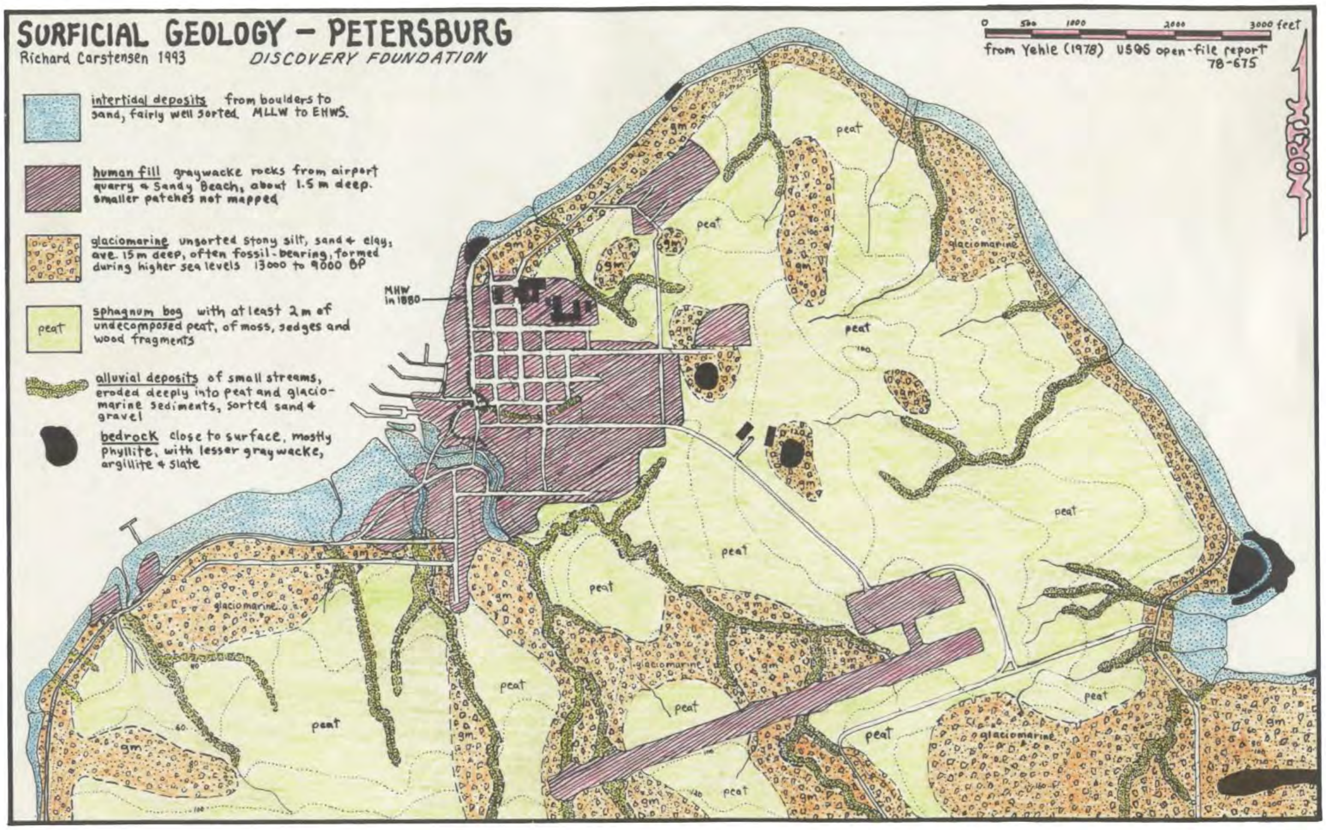
of Duncan Canal and east of Frederick Sound in a complex called the “Wrangellia/Alexander Terrane”, a crustal block that drifted up against North America late in the Age of Dinosaurs. Rocks of Mitkof Island and the Lindenberg Peninsula are part of the “Gravina Belt”, which is thought to be largely formed from sediments washed onto the Wrangellia/Alexander terrane after it had hooked onto North America.

Rocks banging into North America were altered in 2 fundamental ways. first, they were folded and in part thrust down into the earth, where heat and pressure “metamorphosed” them. Thus we got the rock types with exotic names like schist and phyllite. These 2 metamorphic forms of what were once shale (and before that sea-floor mud) now make up a good share of Mitkof and adjacent areas; being easily eroded, they usually form lowlands. Second, large bodies of molten lava were injected up through shatter zones, where they cooled into igneous rocks such as granite and diorite. These rocks are very resistant to erosion, and form most of the area’s highlands.

Glacial History and Surficial Geology

In North America, the last major phase of the Pleistocene ice ages (a 2-million-year period including at least 4 world-wide glacial episodes) is called the “Wisconsin”, or for our purposes in speaking to children, the “Great Ice Age”. As this glacial advance was peaking 20,000 years ago, all of Southeast Alaska was covered by ice, except for the highest peaks and perhaps some seaward-facing headlands, which protruded like islands through a sea of ice. In the Petersburg area the ice was roughly 3500 feet thick, and melted away from the land about 14,000 years ago.

For the next several thousand years the land was still slowly recovering from having been pressed down hundreds of feet under the weight of glacial ice. Today’s lowlands lay under the sea then. Just exactly how high the post-Wisconsin sea level stood against the outer coast is still unclear, but it seems agreed that it stood lower than farther inland where the ice had been thickest In Juneau the ice was about 5000 feet thick, and post-Wisconsin sea level was about 500 feet



higher than today. The best evidence from the Petersburg area suggests maximum sea level was a little under 300 feet.

Resulting surfaces Our surficial geology map comes from Yehle (1978) *Reconnaissance engineering geology of the Petersburg Area*. USGS open-file report 78-675. While the bedrock map lumps all surficial deposits and gives detail to rock types, the surficial geology map lumps bedrock (coded black) and gives details to the unconsolidated deposits which overlie the bedrock. These surficial deposits were laid down either by glaciers, when the Wisconsin ice was receding, or by the ocean at times of higher sea level, or more recently by streams and rivers. On our field trips we'l1 be stopping at roadcuts or streambanks to look at the sediments just below the vegetation and organic mat. Here are the categories of deposits you'll find on the surficial geology map in your packet

Glaciomarine deposits consist mostly of bouldery silt (locally called "blue clay") deposited on the sea floor at a time when there were lots of icebergs to drop rocks down into it, or deposited by glaciers and then re-worked by the sea when it stood higher over the depressed post-glacial landscape than it does now. These deposits are probably much more extensive than mapped, extending under the peats (see below).

Alluvium is a term for any material deposited by moving fresh water. On the surficial map these show as narrow stringers along creeks. On a bigger scale, streams leaving steep bedrock slopes and encountering more level valley floors or marine terraces build fan-shaped deposits. These sites often grow huge Sitka spruce. Similarly, river bottomlands are blanketed with sorted sand, silt and gravel, which also support large-tree forest. On boggy northern-Mitkof, however, productive alluvium is limited to very narrow bands along small streams.

Fill Even in 1978, a large proportion of the Petersburg townsite was covered with human-placed fill.

Peat is the main reason for the fill. These bog deposits, over 10 feet deep in places, blanket much of the north end of Mitkof, especially in the areas below 300 feet, where the formerly higher sea levels resulted in a substratum of compact silt, which impedes drainage and encourages bog formation.

Intertidal deposits These are the modern beaches, as mapped. Not mapped are small sand deposits on the uplands, which are probably beaches from a former time.

Plant communities of the Petersburg area

Our booklet, *A naturalist's look at Southeast Alaska* describes typical northern Southeast Alaskan plant communities as you climb from sea to mountaintop. Here we will only mention some features specific to the Petersburg area.

First, why does our booklet's profile sketch say northern Southeast? The reason may be found on the map of uplift rates in our region. Petersburg is just off the bottom of this map, but you'll note that the 0.17-inch-per-year uplift contour swings between Kake and northern Mitkof. That rebound rate is only about half of the rate experienced by Angoon, which is only half of Hoonah's, which in turn is only half that of Gustavus. Petersburg's uplift rate is just barely rapid enough to produce the distinctive coastal plant communities such as meadows, brush and spruce sapling stands on uplifted former tidelands. The best places to look for these communities is at the top of very gently sloping sand or mudflats. These in turn are most abundant at the mouths of large sediment-laden rivers, which, like uplift rate, increase to the north.

As a result, Petersburg has a very limited amount of recent uplift habitat compared to places like Glacier Bay and Lynn Canal. Inland from the beach though, the profile sketch of community types in our booklet accurately represents the array found near Petersburg. Forests of many sizes and ages and especially bogs are all abundant. To the old-growth and subforest descriptions on the profile, we should add yellow cedar for the Petersburg area. Cedar gives a great deal to the "personality" of the forests here.

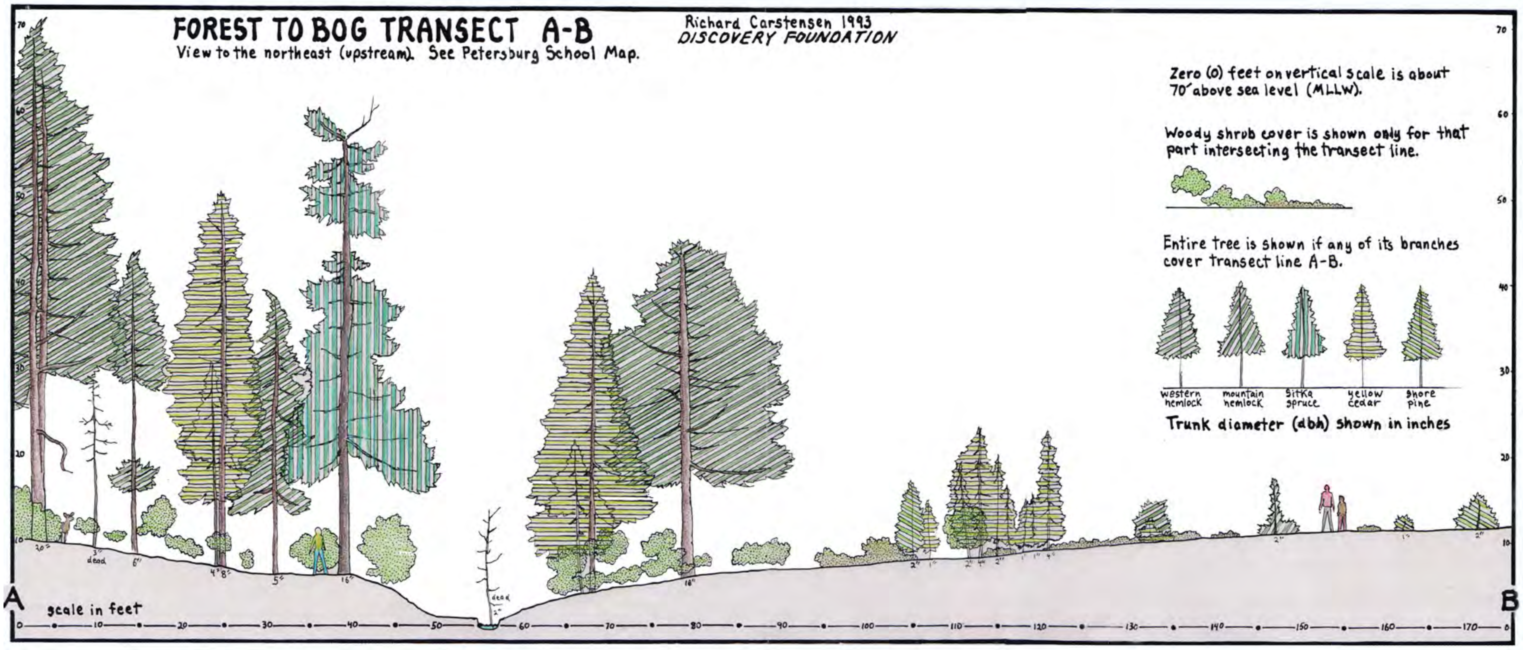
Local variations in forest and bog communities depend on surface type (discussed above), whose main influence on vegetation is drainage, that is, how well or poorly it gets rid of moisture. Other important influences are elevation (which dictates temperature and snow depth), and time since the last major disturbance. Around Petersburg itself, the most important disturbances are selective logging and filling of bogs. Notice on the *Climate and tide data* map in our booklet that Petersburg receives over 100 inches of moisture per year, and gets even more snow on average than Juneau. Kake, by comparison is in the "banana belt", with a warmer climate (compare heating degree days), less rain and less snow.

Land Mammals of Northern Southeast Alaska

Species	Chichagof I	Admiralty I	Glacier Bay	Haines
Insectivores				
masked shrew	X	X	X	X
dusky shrew	X	X	X	X
water shrew	-	-	X	X
Bats				
little brown bat	X	X	X	X
long-legged bat	-	X	-	-
Rabbits				
pika	-	-	-	X
snowshoe hare	-	-	?	X
Rodents				
beaver	X	X	X	X
porcupine	-	-	X	X
hoary marmot	-	-	X	X
northern bog lemming	?	X	?	?
deer mouse	X	X	X	X
long-tailed vole	X	?	X	X
meadow vole	-	-	-	X
red-backed vole	-	-	X	X
tundra vole	X	?	X	X
muskrat	-	-	-	X
bushy-tailed woodrat	-	-	-	?
red squirrel	I	X	X	X
flying squirrel	-	-	X	X
meadow jumping mouse	-	-	-	X
Hoofed Animals				
black-tailed deer	X	X	X	-
moose		—	X	X
mountain goat	-		X	X
Carnivores				
brown bear	X	X	X	X
black bear	-	-	X	X
wolf	-	-	X	X
Coyote	-	-	X	X
red fox	-	-	[X]	X
lynx	-	-	[X]	X
wolverine	-	-	X	X
river otter	X	X	X	X
marten	I	X	X	X

Marine Mammals of Northern Southeast Alaska

Land carnivores	
sea otter	increasingly common on outer coast
Seals and sea lions	
Steller's sea lion	common; breeds mostly on outer coast islands
harbor seal	abundant
fur seal	rare in winter, mostly young individuals
elephant seal	rare
Toothed whales	
killer whale	pods transit area
pilot whale	rare
Dall porpoise	common in straits, less in side bays
harbor porpoise	common in straits and side bays
pacific whitesided dolphin	uncommon
sperm whale	once present; hunted out
Baleen whales	
humpback whale	common in scattered localities, mostly in summer
minke whale	scattered individuals
gray whale	common migrant along outer coast
blue whale	once present on outer coast; hunted out
fin whale	once present on outer coast; hunted out



Transect conducted with teachers in the Petersburg workshop. See line A-B on following Discovery map of the school surroundings. •

Annotated references

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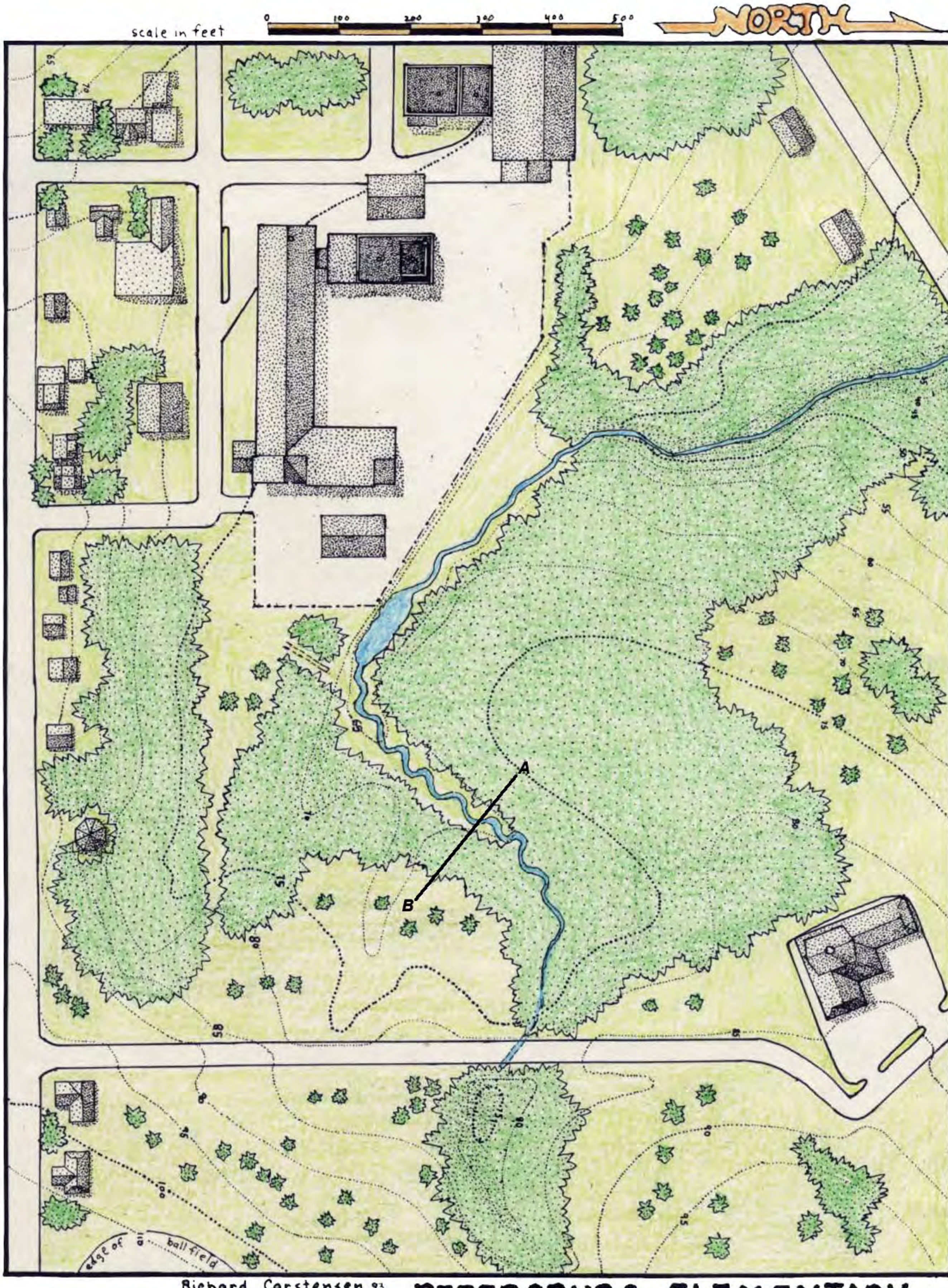
Yehle, L. 1978. *Reconnaissance engineering geology of the Petersburg area, southeastern Alaska, with emphasis on geologic hazards*. U.S. Geological. Survey Open-file Rep. 78-675. 38p. • *Excellent synopsis of the landforms, sedimentary deposits and post Ice-Age historical geology of the immediate Petersburg vicinity.*



PETERSBURG ELEMENTARY

Preface RC 2012: This and other slide shows in our *Nature near the schools* workshop series of course literally were ***slide*** shows in the early 1990s; collections of 35-mm slides were included in notebooks placed in all school libraries. For this re-issue of the workshop notes, I've converted the shows to powerpoint format. You can download *stikine.ppt* from the Discovery website at *www.discovery-southeast.org/xxxxxxxxxxxxxx (needs update)*

Natural History of the Stikine area

Slide show script

Note to Teachers The natural history workshop for the Stikine area encompassed geology, plant communities, local wildlife, marine ecology, human history and many other topics. These slides are exclusively of maps and air photos, chosen to give the "big picture" of Petersburg and its environs.

Notes to you as teacher are included in the script in *italics*, and are not intended to be read out loud. You may wish to present some of the technical words, shown in **boldface**, in a separate class before viewing the slides.

If you've never used air photos before, don't be intimidated. We've discovered that students are fascinated (especially when they find their houses or spots they know well). When time permits, we like to have kids come up and point out features on the screen.

The stereogram sheets in this notebook let the kids see selected views around Petersburg in 3-D. They and the "puzzler" sheet that goes with them make a companion lesson to the slide show. If you have any questions about photo interpretation, or need suggestions on classroom use, contact Discovery, and someone will be glad to help you.

1) title slide

2) USGS topographic map (1:250,000) Petersburg is located on one of the most dramatic landscapes on earth, a mosaic of lush bog (muskeg)& rainforest, deep glacially scoured channels, and on the mainland tall peaks. Maps and air photos help us see the BIG PICTURE. Where do we live? What lives around us? What has shaped this place? What processes are going on today? What will the landscape be like tomorrow?

Using this topographic map, let's look for the major geographic features of the Petersburg area. Can you find the Stikine River? The great river's mouth is on the map. The stippled area is a large delta of deposits it has built out into the water. This delta is rich wildlife country. Another important feature is Frederick Sound. Though the map doesn't show it, the Sound is over 700 feet deep—a great trough carved out by glaciers in the past. It separates Mitkof Island from the mountains and icefields of the mainlandl

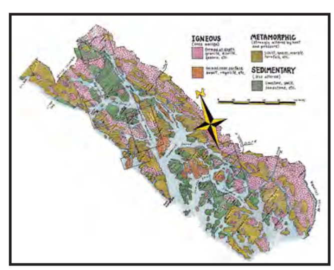
Then find Wrangell Narrows. Though important to people as a waterway, it is a tiny feature compared to Frederick Sound.

(*Four locations of stereograms are indicated: LeConte Bay, Stikine delta, Wrangell and Petersburg. It'd be useful to show your class this slide to orient them before they begin using the stereograms.*)

3) bedrock map of SE Alaska Bedrock is the solid mass of rock making up the earth's crust This is a simplified map of Southeast Alaska's bedrock, lumping together our very complex geology according to the 3 basic rock types: **sedimentary, metamorphic and igneous**.

Sedimentary rocks are sediments (sand, gravel, mud, volcanic ash, etc.) that have been cemented together and thus turned to stone. This process of becoming rock usually happens after more sediments pile on, increasing the heat and pressure. If heat and pressure become great enough that minerals in sediments alter their shape or chemistry, we get **metamorphic** rocks. This greater heat & pressure usually comes from getting buried deeper, or from getting squeezed by mountain-building. Once there is enough heat & pressure (generally after the rock has been pressed down miles into the earth), the rock melts. When it re-solidifies, it will become an **igneous** rock.

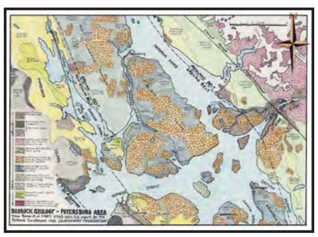
So rocks contain clues about their past history. If an area is made up mostly of sedimentary rock, its history has been relatively calm. But if metamorphic or igneous rocks predominate, there has been a history of more intense burial, erosion and mountain building.



Now look at the area around Petersburg. The rectangle outlines the area covered by the last slide. What kinds of rocks predominate? Yep, the Petersburg area has had an intense history, alright. In fact, geologists estimate that in the last 25 million years, the mountains across from Petersburg have risen 6 to 8 kilometers! But the mountains are less than 2 kilometers high now. Where did the rest of the rock go? That's right, it eroded away. It's mostly sitting out on the continental shelf offshore from the mouth of Chatham Strait, where it is getting buried and turned into sedimentary rock, starting the rock cycle all over again.

4) bedrock geology of Petersburg area Now let's look more closely at Petersburg's rocks. There are very few outcroppings of bedrock downtown, but underneath all that fill and muskeg is a kind of metamorphosed mudstone called phyllite. But then notice on this geology map that there are lots of other types of rocks on Mitkof, Kupreanof and the mainland. They're pretty complicated. (*You have a brief description of them in the Discovery Notebook materials*.)

In fact, geologists puzzled over this complexity for years, until coming up with a sci -fi type hypothesis to explain them. The reason the rocks are so chopped up into different little pieces, geologists think, is because they ran into North America! That's right, they once were at least 2 separate parts of the earth's crust that drifted into North America, and in the process got all jumbled up. (*To take that thought further, see* A naturalist's look at Southeast Alaska *in your packet of materials.*)



5) 1979 aerial infra-red of the upper Wrangell Narrows Some photography is done with film sensitive to a part of the spectrum of sunlight called infrared. That film is particularly able to highlight differences in vegetation. On this photo, the darker red areas that are textured like cauliflower are forest, while the paler red, less textured areas are mostly peatland, brush, alpine meadows or young, second growth forests. The blue-gray areas are mostly unvegetated, like downtown Petersburg and parts of the intertidal zone.

Notice the pattern of forests and peatlands around Petersburg. Using what you see on the slide, can you decide what kinds of places forests are found on? What do they have in common? Hint: what sorts of places drain the best? (*The largest forested areas are on fairly steep bedrock slopes. Smaller stringers of trees follow the creeks, a feature we'll discuss in the following slides.*) This photo was taken before there was much logging on northern Mitkof. What areas along the Mitkof Highway are now clearcuts?

6) color aerial, school vicinity no date We don't have the exact date for this photo but it was taken sometime between the preceding 1979 color infra-red and the next shot in 1985. In this close-up, we've highlighted the creek in blue. This was taken before the school grounds were enlarged, and the creek was undisturbed by placement of fill. Before moving on to 1985, notice the interesting alignment of ponds in the bog on the right, running parallel to the gentle contours. It almost appears as if the peaty margins of these ponds are "oozing" slowly toward the sea.

7) 1985 school after enlargement of fill (*Flip back and forth between this and the previous slide, while students watch for changes*.) Notice that by 1985 the fill for the school grounds came right up against the creek. As a result, the creek was forced into another channel where it trenched down through the soil. If you examine the banks there, you'll find clay and sand in the creek bed. These are deposits the ocean made thousands of years ago when it covered this spot!

The "new" part of the creek trenched down through several feet of these sediments. Where do you think the sediments went? Walk downstream to Andy Mathisen's house, and look for sediments in the creek as you go. They filled up the creek channel in several places. Do you think this had any effect on the fish that live there?

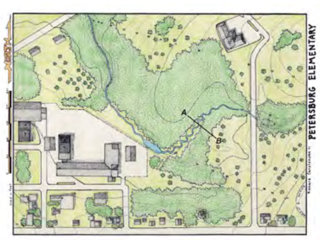
The fill placement attracted beavers, who often home in on such places. In the early 1990s, they built a pond right behind the playground fence, by damming up the

creek. That dam partly washed out by the time of our 1993 workshop, but a remnant of the pond shows on this 1985 photo, where the creek was widest. The former extent of the pond was indicated by the band of dead trees stretching a ways toward the ballpark.

8) school 2005 *[PS 2012: added for the re-issue of Nature near the schools]* Ironically, this most recent aerial photograph is the poorest in quality, but at least it allows us to compare with the earlier aerials. (*toggle with the 1985 view*) What changes can you find? (*new trail through peatlands back to the ballfields & beyond; additional ballfield north of the old one; new school building and parking; associated wetland loss on NW end of school grounds.*)

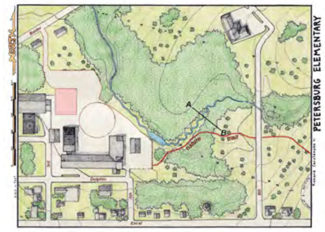
9) 1993 Discovery map of Petersburg school Here's the Discovery map of the school grounds we made in 1993. It shows the remnant beaver pond, since dewatered. Contour lines show the high and low spots of the land. The line by the beaver pond indicates 65 feet above sea level. Find the ones labelled "70", "75" and "80"; they show you which way is uphill from the creek. Imagine you were a drop of water falling on the land uphill from the creek, then flowing downhill toward it. All the land uphill from the creek is part of the creek's **watershed**.

Watersheds are important parts of a creek, because whatever a drop of water picks up on its way to the creek will be poured into it. And since creatures that live in the creek depend on water purity, the watershed has to stay pure, too.

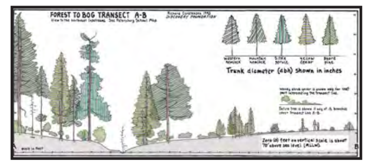


10) Discovery map with updates On this version of the Discovery map we've added subsequent developments. In terms of the watershed, there's good news and bad news. The bad news is that the creek is now rimmed by asphalt and other sources of sediment and toxins. The good news is the new foot trail, making it easy for students to access nature near the school.

Notice line A-B. This is where we measured trees and ground contours during our workshop in 1993. The next slide shows a profile looking northeast through line A-B.

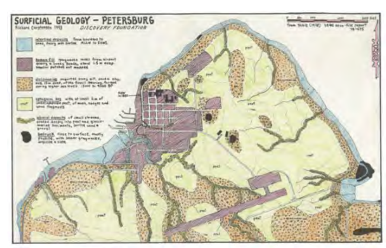


11) forest to bog transect Here's a section through the school ground's creek. The little dead tree in the creek bottom was killed when beaver flooded the valley. Forest grows on the left; sphagnum bog on the right. What other patterns can you find? What trees do best in the bog? (*pine, mountain hemlock, cedar*) What tree needs the best drainage? (*spruce*) Where does brush grow tallest? (*next to the creek, where it gets best light.*)



12) surficial geology of Petersburg We mentioned earlier that the creek behind school had trenched down into old sediments laid down by the sea. The surficial geology map shows these sediments as **glaciomarine**, which means that they were formed in the sea when there were glaciers in the vicinity thousands of years ago. (the land was pressed down by ice from the Great Ice Age, and took a long time to rebound to its present level.)

These glaciomarine sediments are mostly covered by **peat**, which is a mat of undecomposed moss that forms under sphagnum bogs. They probably underlie almost all of the Petersburg vicinity, but the peat hides them. Along the creeks are narrow deposits of sorted sand & gravel laid down by the running water. A large portion of town has been covered by **fill**, because peat makes unstable footing for buildings, roads, etc.

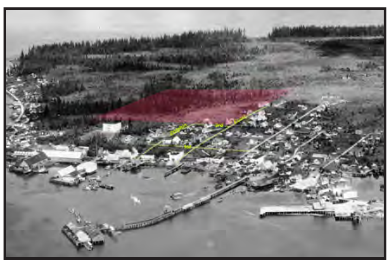


13) 1929 oblique of Petersburg In 1929 the Navy took this oblique view looking northeast over downtown Petersburg and northern Mitkof Island. The grid of streets running east-west and north-south was only half complete. In a moment, we'll zoom in to the area around the school. But first, test yourself and see if you can identify the school grounds area. Where are Dolphin and Excel streets?

And what about your own home? Do you live in one of the historic buildings that were already present

in 1929?

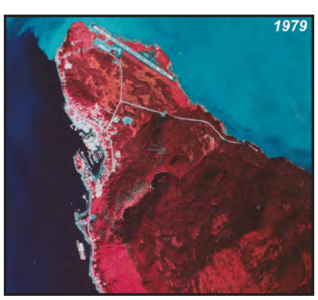
14) 1929 closeup of school area In this close-up view, we've labeled the streets that access today's school grounds, and tinted the grounds pinkish. What were the original habitats on the grounds? (*half forested, half peatland*) Can you trace approximately the course of the creek? (*near edge of the forested portion of the tinted area*) Considering how little well-drained land was initially available near downtown Petersburg—land that supported forest in this scene—we're very fortunate to have the lovely patch that still envelopes the stream running through the school grounds.



15) 1979 aerial infra-red view of Wrangell area Let's now move from Mitkof Island to Wrangell Island's north end. There is a basic similarity; both islands have a town built on a low, boggy foreland with a mountain just behind.

However, clearcuts are more evident in the Wrangell view, especially along the highway leading south out of town. One way to tell them from natural forest patterns is that they cut across drainages and tend to have straighter edges.

The paler blue water in the northeast (upper right) part of the picture is silt at the surface. Where do you think it is coming from? (*This is the Stikine River silt plume. Air photos are taken on clear days, when wind is usually from the north. So the plume drifts south to Wrangell.*) Do you think the silt affects the marine life in the Wrangell area?



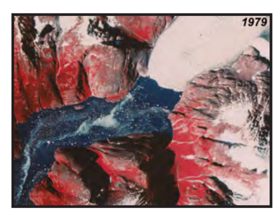
16) 1979 aerial infra-red of Stikine River In this view, we see a lot of the bright red that signifies vegetation other than spruce-hemlock forest. Here it's *not* due to the clearcutting we saw on the Wrangell photo. A lot of it is due to flooding. Notice that some of the islands in the river are scoured bare. Dry winds blasting down the river valley from the continental interior have an effect as well.These are some of the only places in Southeast Alaska where sand dunes can form.

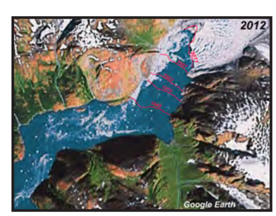
17) 1948 LeConte Glacier LeConte Glacier is the most southerly tidewater glacier in the Northern Hemisphere In 1948, the terminus extended down to the dogleg in the bay. The bay itself was carved by larger glaciers; during the Great Ice Age, they were a mile deep in this area.

Notice there were no forests in the low country near the ice. This was due to an advance of the glacier in recent centuries, followed by rapid retreat

18) 1979 infra-red of LeConte By 1979 the ice front had receded about a third of a mile. Petersburg high school students have been mapping this retreat since 1983 with teacher Paul Bowen.

19) 2012 google earth of LeConte Here's how that recession looks on a low-resolution satellite image from Google Earth in 2012. The glacier did not back up steadily throughout that period. In fact there was a strong re-advance in the early years of mapping, between 1983 and 1991.





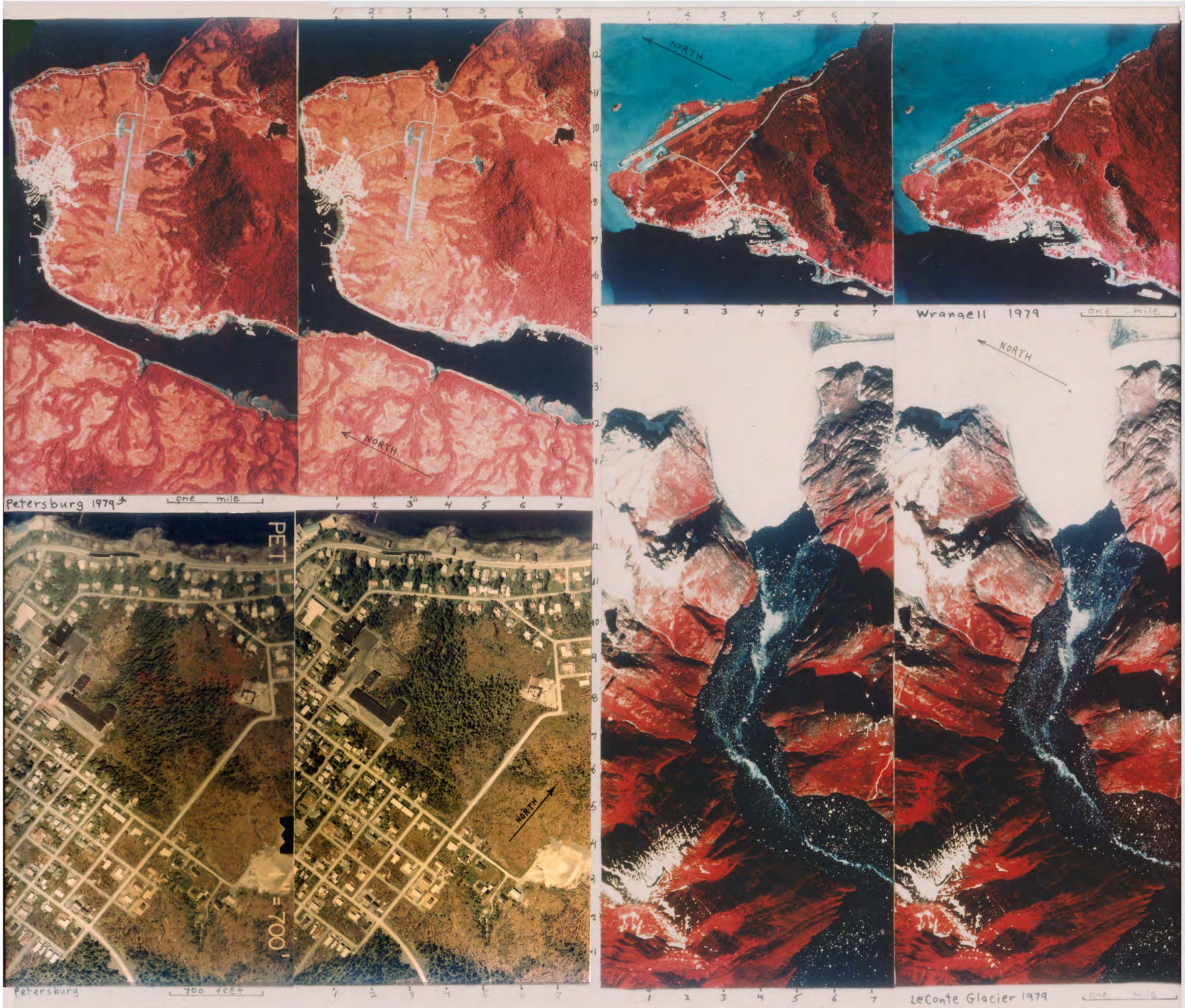
Stikine stereogram puzzlers

Locations of these photos are shown as pink rectangles on the above shaded relief map.

First, let's look quickly through the collection of 6 Petersburg area stereograms. We've included images of town, as well as nearby wilderness areas important to residents of Petersburg and Wrangell. On one side of the sheet there are 4 stereograms. In the lower left is a true-color closeup view of the Petersburg Schools. Proceeding clockwise around the page, we move up to a color infra-red pair of northern Mitkof Island. The scale bar covers one mile, compared to only 700 feet for the true-color closeup; buildings are barely visible. In the upper right is a stereogram for the town of Wrangell, and in the lower right the LeConte Glacier. All CIRs were taken in July 1979. Note that the north arrows for the CIRs point to the upper left, but that on the true color stereogram, the arrow points to the upper right.

Now flip to the backside, where there are 2 more images. The color infra-red pair shows the mouth of the Stikine River, and the true-color one shows Hammer Slough, in downtown Petersburg. This last photo is a single image, not a stereogram, and cannot be seen in 3-D with your stereoscope.

1) Begin with the stereogram of the Petersburg Schools. We don't have the exact date of these photos, but they were taken before 1983 when the playground area was filled. Before trying to interpret air photos, it helps to consider location, compass direction, and scale.

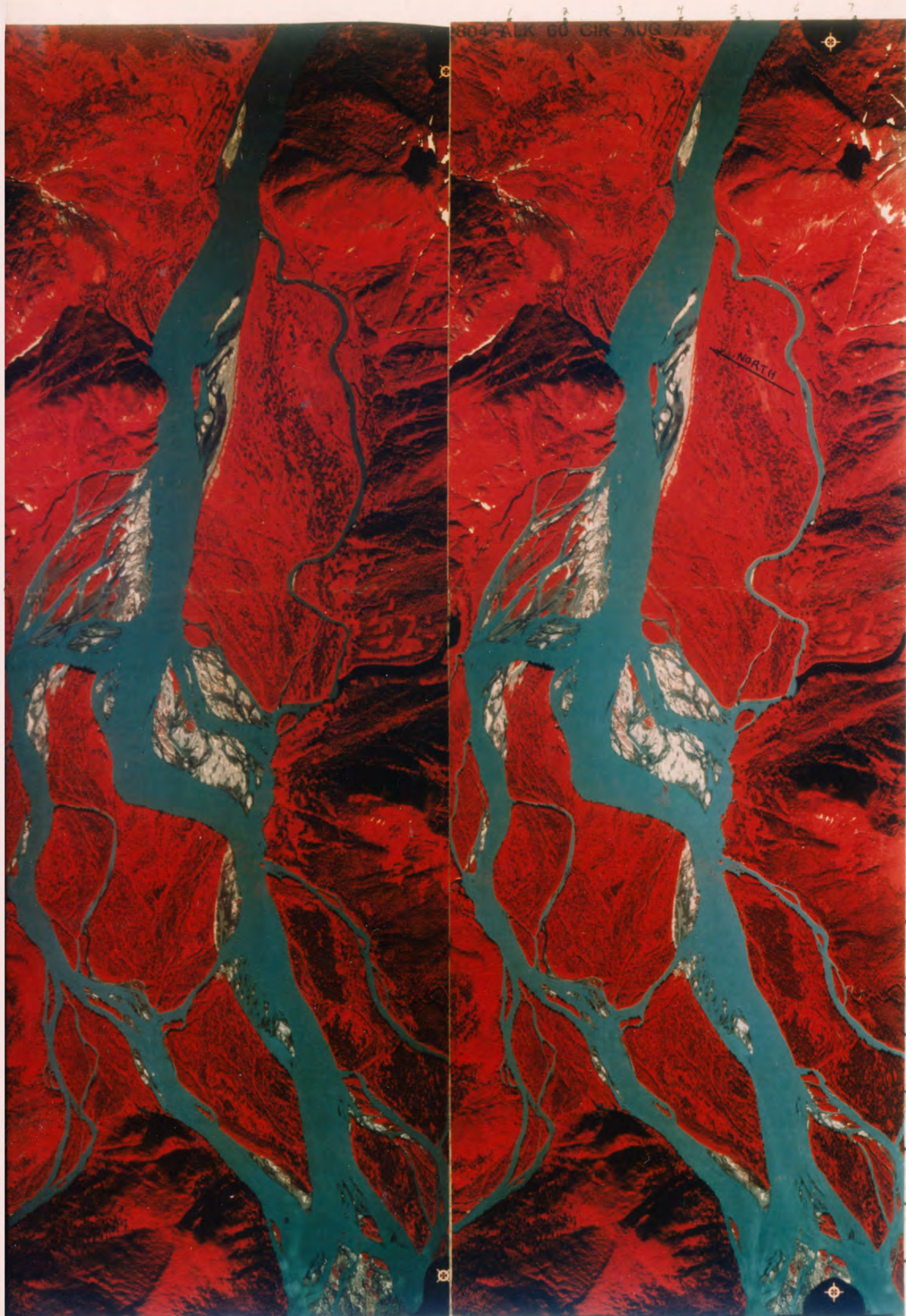


Stereograms for Stikine area For instructions, see *Using the stereoscopes and stereograms* in the introduction to this manual. You can either print this page, or else scale the stereograms on your monitor and hold a stereoscope to the screen. Note the north arrows point in different directions on these photo-pairs. Layout of stereograms is constrained by flight-line direction. Locations of these photos are shown as pink rectangles on the preceding Stikine-area topographic map.

a) What are the coordinates of the Elementary School? Temporarily close your left eye so numbers on the edges of the right photo are easier to read. Starting at the lower left, count over, then up to the school. It's over about 2, and up about 8. We write this as 2—8. What are the coordinates of the old high school?

b) If you take Nordic Drive away from town (left to right, at the top of the photos), which direction are you going? Was that question too easy? Okay, here's a tougher one. Find a tree or building who's shadow can be clearly seen. Were these pictures taken before or after noon?

c) How long (measured east to west) is the elementary school building? One way to measure it is to hold the edge of a piece of paper against the building, mark off its length, and then slide the paper down to compare with the scale bar. Now try this same method using your Discovery map of Petersburg Elementary. Do your measurements agree?



Stikine River 1979 one mile

Hammer Slough 700 feet

d) In the undeveloped land to the northeast of the school, where are the tallest trees? Give coordinates. Study the ups and downs of the land (the topography). Can you make any generalizations about which surfaces will be forested and which will be bog?

2) Move up to the color infrared stereogram of Petersburg and northern Mitkof. Dark red areas are forests; the rougher-appearing the bigger the trees. Peach-colored open areas are wet sphagnum bogs. The pink areas (eg. 3—8, crossing the runway) were forested but have been clearcut.

a) Here's a chance to ask the same questions about forest and bog on the landscape (see 1d above). In what places (give coordinates) do you find the largest trees? Why? There are no simple answers. In many cases foresters are still scratching their heads ...

b) Deltas, or deposits left by streams at their mouths, show bluish-gray on color infrared photos. The largest is at 7—2 1/2, on Kupreanof Island. What are the coordinates of the Sandy Beach delta? From what you've just learned about the relation of creeks to stringers of trees, trace Sandy Beach's largest feeder stream upslope. Where does it come from?

3) To the right of the Petersburg CIRs is a smaller pair for Wrangell.

a) Give coordinates for the following: a recent clearcut, the largest muskeg patch, a tidal mudflat.

During our workshop visit in April 1993 I photographed this pair of very relaxed male yearlings grazing large-leaved avens at Sandy Beach. Deer populations had been low on Mitkof and adjacent islands since the early 1970s, resulting in closed hunting seasons, and habituated deer.

b) The water suddenly changes color from light blue to black at 1/2—7. What's going on here?

4) Below the Wrangell stereograms is a view of LeConte Glacier and Bay.

a) In the lower (SW) part of the bay, conifer forests extend right down to the water. Why isn't this true in the upper bay?

b) Compare the stereogram to the bedrock geology map. What major change in bedrock type occurs at about 2—8?

5) Flip over the page and go to the color infra-red stereogram of the Stikine River. As on the previous color infra-reds, conifer forests show dark red. The level area is the active flood plain of the Stikine. Paler red forests on Limb Island (centered at 3—7, see preceding topographic map) are deciduous. The tallest trees are cottonwoods. The river flows from top to bottom. Cold water with glacial silt shows blue; warmer clearwater tributaries show black.

a) Why are conifer forests confined mostly to the valley walls? An exception occurs at 5 1/2—6 1/2. What does this suggest about that particular island?

b) The pale gray island in the center (4—10) is called The Desert (see map). Which are the oldest and youngest parts of the island? Can you explain this using the concepts of erosion and deposition?

6) The last image is a true color air photo of Hammer and Mill Sloughs, and downtown Petersburg. Remember, single photos like this can't be viewed in stereo. North is to the upper left (we forgot the arrow, but remember that Petersburg's streets mostly run N-S and E-W.)

a) Give coordinates for: extreme low tide, the biggest forest, the most poorly drained surface.

b) Hammer Slough used to fork at 9—4, with one branch coming from the south (biggest forest), and another east branch coming down across the photos from 9 1/2—8. The fork shows clearly on the surficial geology map at 6—3. Just above the fork, at 8—5, is a new patch of bare fill (not there on the 1978 geology map) for the city maintenance buildings. Do you see any evidence that the fill has interrupted the drainage of the east fork?

Answers to the puzzlers

1) school close-up

a) The old high school is at 1/2—10.

b) Nordic Drive runs northeast out of town. Shadows of trees and buildings point slightly to the west of north, so the sun was to the east of south. This occurs just before noon.

c) The school is just over one half the length of the scale bar, or slightly more than 350 feet. This agrees closely with the length as measured on the school map, which we produced in part by enlarging the 1982 *Transportation and Utility Networks* map, made for the Coastal Zone Management Program.

d) The tallest trees are at 4—10. In this closeup (and in the big picture, see 2a), flat areas become poorly drained and steeper slopes become forested. There are 2 situations resulting in steeper slopes on this stereogram: where streams cut down through the peat to the underlying sediments, and where bedrock knobs are trying to poke up through the peat blanket. An example is at 5—2, south of the ballfield. On the surficial geology map this is 7 1/2—5, and the bedrock is shown as a black oval.

2) Petersburg color infra-red

a) This seems to us to be THE ecological question about Petersburg! One good approach is to compare forest distribution on the stereogram to the areas labelled "*gm*" or glaciomarine deposits on the surficial geology map. These deposits, left by a combination of sea and ice also underlie much of the mapped peat areas, but where shown they are less than 2 meters from the surface. Another location of big forests on this stereogram is steep mountainsides, like at 6—8 and 7—12. Trees here.are probably growing on glacial till or *colluvium* (landslide deposits), which are better-drained surfaces than the flat glaciomarine types with a higher percent of fine materials.

b) Sandy Beach is at 4—11. Although the actual streams can't usually be seen at this scale, it's easy to trace them from their associated forests. The line of trees extending to the south from Sandy Beach are growing along slightly better-drained streamside slopes. On the surficial geology map, the creek (and its alluvium) shows as an upside-down "Y" centered at 12 1/2—1. On the stereogram you can see that both forks of the Y drain the area of the landfIll, the white patch at 5—10 1/2.

3) Wrangell CIRs

a) Recent clearcuts are at 1/2—8 1/2, 7—6 1/2, and the runway margins. The largest bog patch is centered at 2 1/2—8 1/2. The harbor (4—7) contains the biggest tidal mudflats.

b) At 1/2—7 is the edge of the Stikine River silt plume. On CIRs cold water with glacial silt shows pale blue, while clear (and warmer) water shows black. On clear days when the wind is from the north, the river sediments often carry as far as Wrangell.

4) LeConte Glacier

a) Conifer forests indicate that the LeConte Glacier did not advance to the lower bay in recent times. In the upper bay, Little Ice Age advance may have wiped out conifer forests on the lower slopes.

b) At 2—8, going up bay, the rock type switches from metamorphic (schist and gneiss) to igneous.

5) Stikine River

a) Conifer forests are confined mostly to the valley walls because on the floodplain, frequent high water buries tree roots in fine silts, smothering them. Cottonwood can tolerate this more than spruce (and spruce more than hemlock). At 5 1/2—6 1/2, spruces indicate that this part of the island is no longer on the active floodplain.

b) Red patches on the upstream end of The Desert are probably mostly willow scrub. This is the oldest part of the island, which is being attacked anleaten away by river currents, but enlarged by deposition on the relatively calmer downstream end. Bar islands often migrate downriver in this way.

6) Hammer Slough

a) Extreme low tide shows at the lower left, 1/2—1. The biggest forest is on the south fork of Hammer Slough, at 12—3. The most poorly drained surface is the bog, either at 13—6 or the one at 12—1 (by the way, the white patches there are not snow, but reflections off bog ponds.

b) At 8 1/2—6 1/2 is a newly formed pond, created where the east fork meets the fill.