Overview of the Biogeographic Provinces of Southeastern Alaska

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Southeastern Alaska (Southeast) is a coastal ecosystem encompassing the Alexander Archipelago—composed of over 5,000 islands—and a narrow strip of mountainous mainland dissected by glacial fiords and major river systems. Island biogeography is a topic of growing interest among conservation ecologists. During the past century a large percentage of the world's species extinctions have occurred on islands (Diamond 1989, Ceballos and Brown 1995, Cook and MacDonald 2001). Conversely, species and subspecies often *originate* on islands. Scientists are only beginning to understand the implications of island biogeography for long-term species conservation in southeastern Alaska (Cook et al. 2001, 2006).

This chapter provides a brief description of the natural history of each of the 22 biogeographic provinces that make up Southeast as well as a summary of some of the major trends that have occurred relative to the natural variability of focal species and ecological systems. This summary is not intended to be a detailed analysis but rather an overview of some of the key ecological issues that relate to conservation within each province. A watershed matrix (spreadsheet) displays data for selected focal species and resources (including spawning salmon, deer habitat, bear habitat, murrelet nesting habitat, large-tree distribution, and estuary distribution) within each of the 1,030 watersheds distributed across Southeast (Appendix B). The individual watersheds as well as individual focal resources are ranked based on their ecological values within the 22 biogeographic provinces. The total area, amount of timber harvest, and linear distance of roads are also tabulated for each watershed.

A GIS database and detailed map for this conservation assessment of southeastern Alaska and the Tongass National Forest has been packaged on this DVD-Rom (in Appendix C) with project files for viewing in Arc Reader, a share-ware utility for read-only access to GIS functionality. This set of GIS data layers and analyses have been compiled by The Nature Conservancy and Audubon Alaska as part of this conservation assessment.

The descriptions of biogeographic provinces proceed from northwest to southeast along the mainland (Yakutat to South Misty Fiords). Afterward, the same NW-to-SE sequence is applied to the island provinces, beginning with West Chichagof and ending with Dall and Long islands.

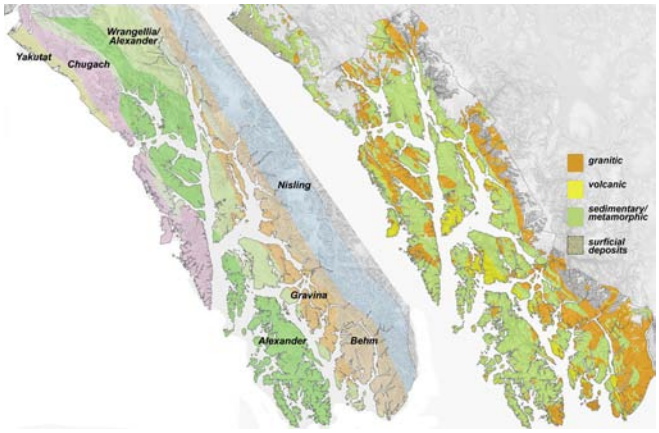

FIG 1. Geological terranes in southeastern Alaska, with bedrock types.

BEDROCK GEOLOGY

Southeast's high-relief topography derives from intense mountain-building energies generated at the suture zone of the North American and Pacific crustal plates. The mosaic of bedrock types is exceptionally

complex, resulting from successive accretions of diverse geologic terranes onto the North American plate over millions of years (Fig 1).

Each of the geologic terranes has its own distinctive assemblage of bedrock types (Fig 1). Many of the sedimentary and metamorphic rocks have origins far away on the floors of ancient tropical seas. In contrast, our igneous rocks such as the Coast Range granitic batholith, and volcanic rocks such as the basalts of southern Admiralty, were created here in Southeast. They result from heat that built up as terrane pieces chafed past each other, melting rock to a liquid state, to later cool either deep in the earth or at the surface.

Particularly significant to Southeast conservation is "karst"–the fascinating topography that results from the dissolution of limestone and marble. Southeast's highest quality (and most vulnerable) karst lies within the Alexander Terrane. Many of the limestones contain fossils of marine mollusks and corals that lived in warm oceans before the earliest amphibians or reptiles. High quality karst landforms generally include widespread cave development. (Caves of another type are also found in some lava flows.) Spelunkers have documented world-class caves, many discovered only in the past decade. Estimates of still-undiscovered Southeast caves range into the thousands. At least 27% of watersheds (or Forest Service Value Comparison Units [VCUs] which are roughly synonymous with watersheds) have high potential for caves and related features. The premier karst region, of international scientific and ecosystem importance, is in the Prince of Wales/Heceta/Dall/Coronation island cluster. Portions of Chichagof, Kuiu and Admiralty Islands also contain distinctive karst landforms (Baichtal & Swanston 1996, Streveler and Brakel 1994).

Bedrock type explains a great deal about the nature and productivity of natural communities. Examples of plant community responses to differences in underlying bedrock are given in Chapter 5. In general, granitic bedrock supports rather unproductive forest communities. Because they are the most resistant of our rock types to glacial erosion, granitic rocks often maintain shear cliff faces, scenically spectacular but biologically impoverished. At low elevations, limestone and marble bedrock often represent the opposite extreme. They once supported Alaska's greatest large-tree forests of Sitka spruce (*Picea sitchensis*), but almost all of these stands have been logged.

GLACIAL HISTORY

During the Pleistocene epoch–a 2-million-year period of successive continental glaciations–the landscape of Southeast was gouged into a fragmented mosaic of islands and deep marine fiords. The last of these episodes was called the Wisconsin Glaciation, which culminated 16,000 to 17,000 years ago. Deglaciation was underway by 14,000 years ago (Fig 2). Slowly, plants and animals and soils returned to the uncovered landscape. Today, complexity of the glacier-carved archipelago and fiord-indented mainland coast is such that no point on land is more than 30 mi (48 km) from a marine beach. The exchange of energy across the great land/sea interface–an important feature of all coastal communities–is intensified in Southeast by these convoluted shorelines. Finally, glaciers in Southeast are not simply historical shapers of the land, but active players in our climate, in ocean dynamics, and as barriers to colonization. The close juxtaposition of glaciers and mature, highly productive forest communities is globally unique. Southeastern Alaska may be the only place in the world where you can see a calving, sea-level glacier while sitting out a rainstorm under the protective canopy of a 500-year old tree.

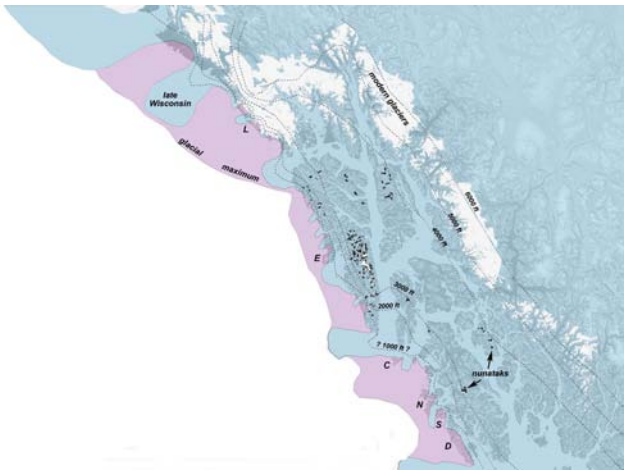

FIG 2. Glacial history of southeastern Alaska.

CLIMATE

Rainfall is heavy but variable within Southeast, ranging from 38 in (91 cm) in rainshadow locations like Angoon to 221 in (530 cm) at Little Port Walter only a short distance away (Fig 3). Snowfall is heaviest on the northern mainland, ranging from 214 in (514 cm) at Yakutat to only 35 in (84 cm) at Sitka (Fig 4). Southeast is strongly influenced by the Alaska Current,

an eddy off the North Pacific Drift. This current buffers sea and air temperatures; both are relatively warm in winter and cool in summer. Although deep cold spells of well below 0°F (-17°C) briefly occur, even the state capitol at Juneau, situated at the foot of extensive perennial icefields, typically hovers around freezing (32°F [0°C]) during the mid-winter months.

Unlike temperate rainforests to the south, our region does not experience prolonged dry periods in summer. This makes Southeast distinctive in several ways: 1) globally significant diversity of bryophytes; 2) relative absence of wildfire, and; 3) consequent replacement of fire by wind as the most important natural forest disturbance in Southeast.

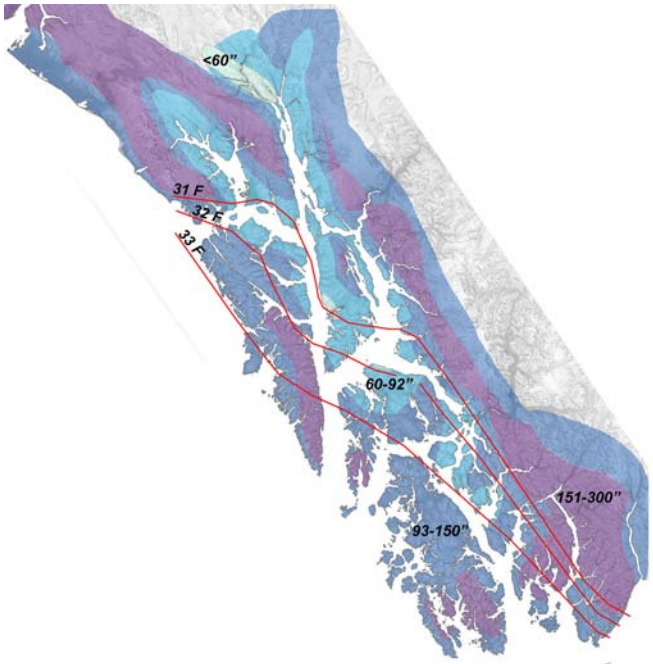

FIG 3. Southeast precipitation zones in inches. Mean winter temperatures in degrees Fahrenheit. Based on Nowacki et al. 2001.

FLORA AND FAUNA

Several cross-regional gradients help to explain some of the variety encountered across the 22 biogeographic provinces (Fig 5). These include northwest-to-southeast (latitudinal) gradients, and mainland-to-island "continentality" gradients. But there are many influences on species distribution; general tendencies implied by these gradients should be interpreted with caution. For example, terrestrial species richness *generally* declines in a northwesterly direction (i.e. increasing latitude). Terrestrial species richness similarly tends to decline along transects from the mainland to outermost islands, with increasing

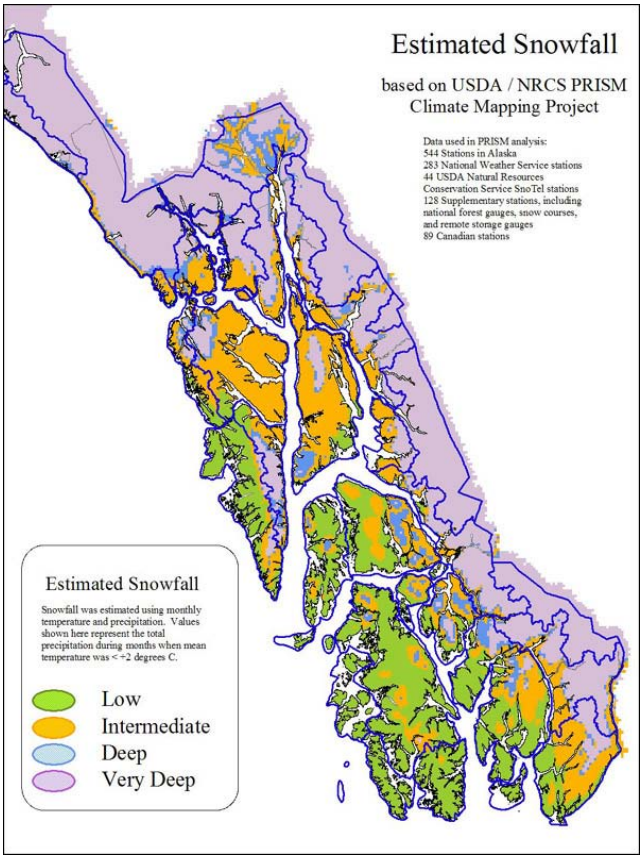

FIG 4. Estimated snowfall zones in southeastern Alaska.

FIG 5. Biodiversity gradients in southeastern Alaska.

isolation. One might therefore predict that Southeast's greatest species richness would occur in the southeastern most quadrant, but there are few lowland transboundary corridors here to encourage the intermingling of boreal interior plants and animals with those of the coast. It's actually in the river-rich Chilkat region that these connections are strongest. Highest species richness for both mammals (MacDonald and Cook 1999) and vascular plants is therefore found in the Chilkat Province in northern Southeast.

Island fragmentation and associated barriers to colonization have also led to distinctive assemblages of plants and animals on the thousands (> 5,000) of islands of varying size, height and isolation. During the roughly 12,000 years since the last great ice age subspeciation (neoendemism) has occurred among mammals (Cook et al. 2001, 2006, also see Chapter 6.7 Alexander Archipelago endemics) and probably other groups such as amphibians. There is also the possibility that older relictual lineages persisted in refugia (paleoendemism). Along with the isolated Haida Gwaii (Queen Charlotte) Island complex in British Columbia, Southeast's Alexander Archipelago could be seen as a sort of fast-track temperate zone version of the Galapagos Islands. In that capacity, Southeast offers a unique temperate rainforest laboratory for the study of island biogeography.