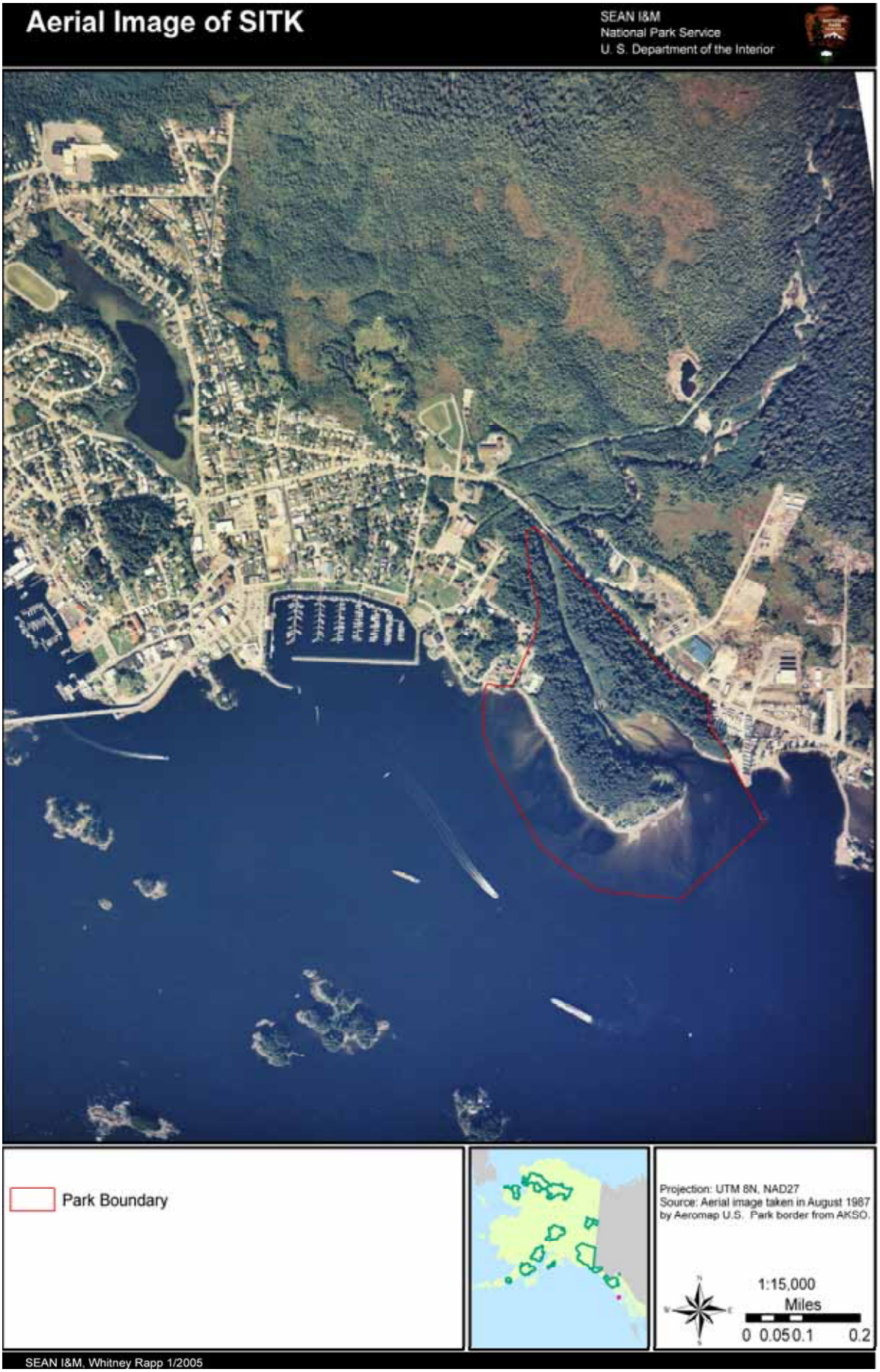
Aerial Image of SITK
SEAN I&M
National Park Service
U. S. Department of the Interior
Park Boundary
Projection: UTM 8N, NAD27
Source: Aerial image taken in August 1987
by Aeromap U.S. Park border from AKSO.
1:15,000
Miles
0 0.05 0.1 0.2
SEAN I&M, Whitney Rapp 1/2005

stream. These energy sources provide a food base for a wide variety of macroinvertebrates, including a diverse complement of mayflies, caddisflies, and stoneflies. Indian River studies have inventoried over 60 species of aquatic macroinvertebrates, 34 species of freshwater diatoms, one cyanobacteria, and three species of aquatic mosses. These in turn provide a food source for juvenile fish, particularly salmon, trout, and char. Anadromous salmonids that inhabit the Indian River include pink, chum, chinook, and coho salmon; Dolly Varden char; and steelhead trout. Eggs are laid in the gravel and hatch to alevins, which develop as fry. Several species remain in the river as juveniles. Eventually juveniles transform to smolts and migrate to the sea, where they put on most of their body mass. After several years in the ocean, adults return to their natal stream to spawn. Salmon die after spawning, leaving nutrient-rich carcasses that stimulate production of the freshwater aquatic ecosystem, as well as providing food for eagles, bears, otters, and many other species (Wipfli et al. 1998). Trout and char return to their natal rivers to spawn but may recover, go back to the ocean, and return to spawn again. Resident stream fish living their entire life cycle in the river include some trout and char, threespine stickleback, and coastrange sculpin.

Aquatic Habitats

The Indian River

The Indian River is cold, clear, and swift. It receives no glacial input. Past glaciers have left glacial till in the drainage and the river's cobble delta deposits are probably the result of flows from receding glaciers in the Pleistocene. The river is low in nutrients, high in dissolved oxygen (O_2), exhibits low conductivity (40 to 50 µS/cm) and alkalinity (11 to 17 mg/L as $CaCO_3$), and generally has a pH around 7 (Paustian and Hardy 1995, Neal et al. 2004). The two main energy pathways in the Indian River ecosystem are:

1. Autochthonous input: The primary production referred to as a polysaccharide matrix or biofilm that grows on all exposed surfaces in the river of which diatoms and cyanobacteria are most important (Neal et al. 2004, Borchardt 1996).
2. Allochthonous input: organic matter from outside the system (e.g., leaves, sticks, cones, catkins, etc.), mostly from mature coniferous and alder forests for the Indian River (Allen 1995).

A considerable amount of material ends up in the river from these sources, which may distinguish it from rivers closer to glaciation. Salmonid fish production in the river is tied to the presence of large woody debris (LWD) contributed by mature riparian forests. The river also receives a massive influx of marine-derived nutrients (MDN) in the fall as salmon return in large numbers to spawn.

Heavily Shaded, Intermittent Tributary that Drains Muskeg Swamp (Tannic)

This tributary exhibits warmer water temperatures, higher organic matter, and lower pH than the river. The ecosystem is driven by allochthonous input from the surrounding forest and primary production by shade-tolerant diatoms and cyanobacteria (Murphy 2001).

Temporary Ponds

Temporary or ephemeral ponds are found in the forested area on the Indian River flood plain within the park. Their presence is totally dependant on rainfall. Most are without standing water during summers with low precipitation. As these ponds develop, aquatic invertebrates quickly colonize them. Most notable are the caddisflies in the family Limnephilidae, which can grow to over 25 mm during the fall and winter months. *Lenarchus vastus* is most abundant followed by species of *Limnephilus* (Smith 2004). These genera have adaptations to take advantage of temporary pond habitats, including diapause that delays sexual maturity in adults until late summer when rains increase; eggs which are deposited in damp substrates; larvae that remain within a thick dissociation-resistant gelatinous egg-matrix for several months until ponds refill; rapid larval development; and wide dispersal of adults (Wiggins 1996, Wiggins and Parker 1997). This ecosystem depends primarily on allochthonous input of broad leaves, coniferous needles, and wood on which the caddisflies feed and which they use to construct their cases.

Sitka National Historical Park

Hydrology

One of the primary natural resources in Sitka National Historical Park is the Indian River and the estuary that it forms as it enters into the ocean. The river flows through a large U-shaped post-glacial valley watershed that encompasses 12.3 square miles, with an elevation range of sea level to 3,800 feet (Neal et al. 2004). The river originates in the rugged mountains of central Baranof Island north of the park and enters Sitka Sound between Crescent Bay and Jamestown Bay. A large portion of the upper basin drains alpine regions while the valley floor is relatively wide, flat, and covered by muskeg and Sitka spruce/western hemlock forests.

The Indian River watershed is characterized by steep topography, well-drained shallow soils, and high drainage density. It exhibits a rapid response to rainstorms, which often cause rather large daily fluctuations in stream flow. Hydrologic calculations indicate that peak runoff occurs within six hours of a storm center passing over, with nearly all rainfall running off in 12 to 24 hours (Paustian and Hardy 1995, Neal et al. 2004). River flow ranges from approximately 20 cfs to 6400 cfs (100-year flood). River discharge generally peaks in September and October and gradually declines throughout winter and early spring. Snowmelt at high elevations results in moderate flow increases in May and June. Minimum flows are most common in December, March, and July. The hyporheic zone (saturated zone under a river or stream) of the Indian River has not been studied but is thought to provide habitat for a diverse meiofaunal (invertebrates < 0.5 mm) community. It also provides a refuge for macroinvertebrates during high flow periods in heavy precipitation events and during drought-induced low flow periods. The substrate of the Indian River bed is generally a silt-free gravel bottom with good interstitial space, ideal for spawning fish and macroinvertebrate production. This provides salmonid eggs and fry with shelter from the current and predators and flowing water that brings oxygen and removes wastes.

The approximate 0.6-mile length of the lower river that flows through the park area is characterized as a low-gradient gravel-cobble bed alluvial channel. An aquatic resource survey completed in 1995 revealed that in general, fish habitat suitability in the lower reaches of the Indian River is limited by a lack of pool habitat, few deep pools, and lack of cover. These habitat conditions were directly related to the paucity of large woody debris (LWD), the major pool-forming agent in southeast Alaska watersheds, which has an important function in providing habitat cover and density (Paustian and Hardy 1995). Nonetheless, this river section is a primary spawning area for returning salmon.

Biological Resources

The convergence of the Indian River, the coastal rainforest, and the Pacific Ocean provides a biologically rich environment for a variety of aquatic resources. The Indian River's clear, oxygen-rich waters are ideal for primary production from microscopic algae that live on most exposed underwater surfaces. Its riparian forests dump additional organic nutrients into the

Southeast Alaska Inventory and Monitoring Network
National Park Service - U.S. Department of the Interior

Freshwater Ecosystems Monitoring Scoping Workshop Notebook

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