United States Department of the Interior

NATIONAL BIOLOGICAL SURVEY
Olympic National Park
600 East Park Avenue
Port Angeles, Washington 98362

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MEMO

TO: RESEARCH FILES, OLYMPIC NATIONAL PARK

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SUBJECT: SURVEY REPORT, RECRUITMENT OF COTTONWOOD ON THE QUINAULT RIVER, OLYMPIC NATIONAL PARK

Black cottonwood (*Populus balsamifera trichocarpa*) trees occur as components of riparian forests along many rivers in Olympic National Park. The distribution of cottonwood overlaps Roosevelt elk (*Cervus elaphus roosevelti*) range and concern has been expressed that elk herbivory has suppressed cottonwood recruitment along west-side rivers.

In the Pacific Northwest, black cottonwood may reach 200 or more years of age and heights of 25-35 m (Franklin and Dyrness 1973:48). The species is also considered to be very intolerant of shade, i.e., tree establishment does not occur under forest canopies.

Relatively little is known about the ecology of cottonwood in the park. Fonda (1974) studied forest succession on the floodway zone (sensu Bauer 1971, cited by Fonda 1974) of the Hoh River. He considered the valley floor to be composed of terraces of four different ages. Forests on successively older terraces represented components of a long-term sere that culminated in climax forests dominated by western hemlock. Black cottonwood occurred in forests of the two youngest terraces; in "alder flats" (7.9 cottonwood trees/ha) and in *Picea sitchensis-Acer macrophyllum-Populus trichocarpa* communities (65.2 trees/ha). Cottonwood trees were 11-60 cm dbh in the alder flats and 11-120 cm (mostly 11-90 cm) in the *Picea* community. No smaller diameter cottonwoods were recorded, and, unfortunately, no tree ages were reported. Cottonwood did not occur on the older terraces. Fonda believed that the erosion pulses which formed these terraces were associated with regional geologic events. Thus, maximum ages of trees in the alder flat communities (65-75 years) seemed to be associated with an 1800-1850 neoglacial ice advance, as documented on Mount Rainier, and the *Picea-Acer-Populus* communities were associated with a 1540-1635 advance. This limited information suggests that recruitment of cottonwoods in the floodway zone is episodic and may relate to the frequency and magnitude of substrate disturbance.

mosaics, and changes in the floodplain were examined over time. Extensive areas of bare sand and gravel appeared in the 1953 photos, evidently reflecting the effects of floods documented by Gilbertson (1981). Marked lateral shifts in river channels also occurred between 1953 and 1976, and 1976 to 1993, but these changes seemed less extensive than those in the earliest photos. On 30 August and 22, 23 September I walked several accessible reaches of the floodplain that had contained bare-appearing gravel/sand deposits in the 1953 photos (dotted lines in Fig. 1). I described each site (relative age of gravel bar based on the photos, overstory composition, presence of driftwood logs), noted the occurrence of cottonwoods, measured their dbh, and cored one or more trees to determine age. Age determination proved frustrating because most cottonwood--even relatively young trees--had rotted centers, therefore ages are approximate. I described the occurrence of willow and cascara at several sites because there has also been interest in the effects of elk herbivory on these taxa. Most of the 13 sites examined were photographed.

Results and Discussion

Most sites were dominated by red alder, but cottonwood establishment had occurred at 9 of the 13 sites examined (Table 1, Figures 6-12). Cottonwood had escaped browsing and developed into trees at sites that were bare sand/gravel in the 1953 photos, as well as on younger-aged gravel bars. A variety of age classes occurred, including trees just a few years old (Fig. 10). Young trees usually occurred in the proximity of mature "parent stands" of cottonwood; recruitment had not occurred at sites 1-4 on the North Fork where mature cottonwood were essentially absent from the nearby riverbanks. At 3 sites, driftwood logs seemed to have provided refugia from ungulate browsing which allowed escapement of trees into older age classes. Similarly, willow and cascara had become established on different-aged gravel bars. Maturation of willows into tall shrubs was also associated with driftwood at one site (Fig. 3).

Much of the area surveyed was classed by Jack Schwartz as "winter range overpopulated" during the late 1930s elk studies (Schwartz and Mitchell 1945). However, levels of ungulate herbivory may have declined since the 1930s (See Jenkins 1981, Woodward et al 1993). In any event, cottonwood trees are being recruited into riparian forest communities along the Quinault River with present levels of herbivory (elk sign was abundant throughout the areas surveyed). Recruitment *may be* associated with major flood events, the occurrence of mature stands that provide abundant seeds, and perhaps driftwood refugia that inhibit browsing. A more extensive survey would be required to determine if present recruitment levels match those that produced the mature cottonwood stands that occur now along the river. The survey could also be extended to other drainages, but early air photo coverage is limited (1952 photos exist for the Queets River).

The pattern of forest succession reported for the South Fork Hoh differed from the Fonda model (McKee et al 1982). The lower terrace forests on the South Fork lacked cottonwoods (in the limited area of their samples) and the dominant conifers appeared to be of similar ages on both upper and lower terraces, calling into question the sere proposed by Fonda. McKee et al (1982) cautioned that lack of correlation in seres should be expected because the history of disturbance likely differs among valleys.

Roosevelt elk browse cottonwood on the west-side rivers and elsewhere in the Pacific Northwest (Schwartz and Mitchell 1945, Jenkins and Starkey 1991). Concern was expressed earlier that lack of cottonwood recruitment could be attributed to levels of elk browsing (Newmann 1953, 1954).

The abundance and height classes of cottonwood (seedlings, <0.5m; saplings, 0.5-2.0m; small trees, >2.0-15m) were recorded in willow communities during a survey of shrub utilization and condition on lowland elk ranges in 3 west-side river valleys of the park during 1980 (Jenkins 1981). The 88 circular sample plots (radius ca. 30 m) were located "...selectively in uniform and representative stands..." in the 3 valleys (Queets n= 15, Quinault n= 45, Bogachiel n= 28). Cottonwood seedlings occurred in about 50, 75 and 80 percent of the sample plots on the Queets, Quinault, and Bogachiel, respectively (percent frequency estimated here from graphs in the report). Saplings occurred in about 10, 35, and 75% of the plots in the respective valleys. Small trees occurred only in the Bogachiel plots (ca 20%). Thus, within the sample plots, cottonwood recruitment was highest on the Bogachiel range. After considering several grazing indices (including many plots on other shrub species), Jenkins (1981) concluded that overall forage utilization declined in the order Queets, Quinault, Bogachiel, and that herbivory was less intense during 1980 than during the 1930s.

During June 1991, I noted a stand of comparatively small diameter cottonwoods on the East Fork Quinault River, a condition that stood in marked contrast to the large diameter trees in nearby stands. The Quinault is known to be a very dynamic river; an analysis of annual momentary maximum flows from 1911-1978 showed that unusually large floods occurred during the 1940s and 1950s (Gilberston 1981). Floods coincided with a marked reduction in sockeye salmon (*Oncorhynchus nerka*) production, attributed in part to extensive alteration of spawning habitats by the flooding. Notable floods also occurred during December 1979 and November 1990 (Scott Chitwood, Quinault Fisheries Dept., pers. comm. 1994). During 1994, I conducted a preliminary survey of recent cottonwood recruitment along sections of the Quinault River drainage.

Methods

The overall survey area extended from about Graves Creek to near Lake Quinault (Fig. 1). I obtained aerial photographs taken in 1953 (USGS), 1976 (OLYM files) and 1993 (USFS, Quinault Ranger Station, partial coverage). The photos were arrayed into

Table 1. Cottonwood and riparian shrub status at 13 sites on the Quinault River, Olympic Natl. Park, August-September 1994

		Cottonwood[a]			
Site	Location	N	dbh(cm)	Age	Comment
1	N.Fork, 1.4 km North[b]	0	--	--	Willow colonization of gravel bar established >1976.[c] Heavily browsed (Fig. 2)
2	N.Fork, 1.5 km North	0	--	--	Willow, alder on gravel bar established > 1976. Willows to > 3m tall in log refugia (Fig. 3)
3	N.Fork, 0.3 km North	0	--	--	Willows > 5m tall on bar est. >1976 (Fig.4)
4	N.Fork, 0.25 km North	0	--	--	12 Cascara > 6m tall on bar est. > 1976 (Fig. 5)
5	N.Fork, 0.1 km North	4	33±7.0 23-38	24±1.6 22-26?	On gravel bar est.> 1953. Stand present in 1976 air photo. Mostly alder (Fig. 6)
6	Mainstem, S. of Bunch Field	4	28±14.3 11-44	16±2.1 13-18?	C-wood recruited into 19-20 year old alder stand. Seedlings present on gravel bar, but with patchy distribution, heavily browsed (Fig. 7, 8).
7	Mainstem, 0.4 km W. of bridge	7	24±5.4 18-33	19±2.8 17-25?	Established in refugium (Fig 9) "Parent stand" adjacent--trees 26-62 cm (n=5) had ca. 36?-80 growth rings.
8	Mainstem, SW edge Bunch Field	4	43±8.6 33-53	40±5.2 32-43?	"Parent stand" <30 m distant. Heavy elk use.

Table 1. Cottonwood on the Quinault (continued)

9	Mainstem, SW edge Bunch Field	3	18±1.0 17-19	19±2.2 17-20? (n=2)	Primarily alder, with scattered cascara, willow. Bar was newly deposited in 1953. C-wood established in log jam refugium
10	Mainstem, 1.2 km W. of bridge	3	9±1.2 8-10	5±0.6 5-6	Saplings to 3 m recruited in log jam refugium (Fig. 10).
11	Mainstem, 1.5 km upstream from Lake Quinault	4	34±5.6 28-39	38±2.5 35-41?	14-16 C-wood established on bar that was newly deposited in 1953. Stand is mostly alder
12	Finley Cr., 0.8 km upstream of mainstem	4	24±9.6 12-33	21±6.8 13-28	Mostly alder, but dozens of C-wood established on gravel, deposited > 1976. Gravel bars altered to maintain bridge. Park inholdings adjacent, elk sign abundant (Fig.11).
13	East Fork below Graves Creek	31	27±7.3 12-43	20±4.2 16-25? (n=4)	Alder, willow, C-wood establ. on gravel bar deposited < 1976 (Figs. 12a-c).

a. Number trees sampled; mean dbh and age ±SD and range. ? = one or more ages uncertain, trees with rotted centers.

b. Distance from confluence with East Fork.

c. Relative ages of gravel bars determined from 1953 and 1976 aerial photographs.

References Cited

Bauer, W. 1971. Streamway classification, p.3-20. In Interagency Committee for Outdoor Recreation, Wild, scenic and recreational rivers. Olympia Washington.

Fonda, R.W. 1974. Forest succession in relation to river terrace development in Olympic National Park, Washington. Ecology 55:927-942.

Franklin, J.F. and C.T. Dyrness. 1973. The natural vegetation of Oregon and Washington. General Technical Report PNW-8, USDA Forest Service, Portland Oregon.

Gilbertson, L. 1981. Quinault River Sockeye Salmon. pp. 1-60. In, 1981 preseason management report for spring and summer fisheries on the Quinault and Queets Rivers. Quinault Fisheries Department Report.

Jenkins, K. 1981. Status of elk populations and lowland habitats in western Olympic National Park. Unpublished Report 81-1, Cooperative Park Studies Unit, Oregon State University. 53 pp.

Jenkins, K. J. and E.E. Starkey. 1991. Food habits of Roosevelt elk. Rangelands 13:261-265.

McKee, A., G. LaRoi and J.F. Franklin. 1982. Structure, composition, and reproductive behavior of terrace forests, South Fork Hoh River, Olympic National Park. pp 22-29. In, E.E. Starkey, J.F. Franklin, and J.W. Matthews (eds), Ecological research in national parks of the Pacific Northwest. Forest Research Lab. Publication. Oregon State University, Corvallis, Oregon.

Newman, C. 1953. A preliminary report on elk, cougar, bear, coyote, and browse conditions in the Olympic National Park. Unpublished report, Olympic National Park. 40 pp.

Newman, C. 1954. Special report on the Roosevelt elk of Olympic National Park. Unpublished report, Olympic National Park. 58 pp.

Schwartz, J.E. and G.E. Mitchell. 1945. The Roosevelt elk on the Olympic Peninsula, Washington. J. Wildl. Management 9:295-319.

Woodward, A., E. G. Schreiner, D.B. Houston, and B.B. Moorhead. Ungulate-forest relationships in Olympic National Park: Retrospective exclosure studies. National Park Service Technical Report NPS/PNROLYM/NRTR-93/15. 63 pp.

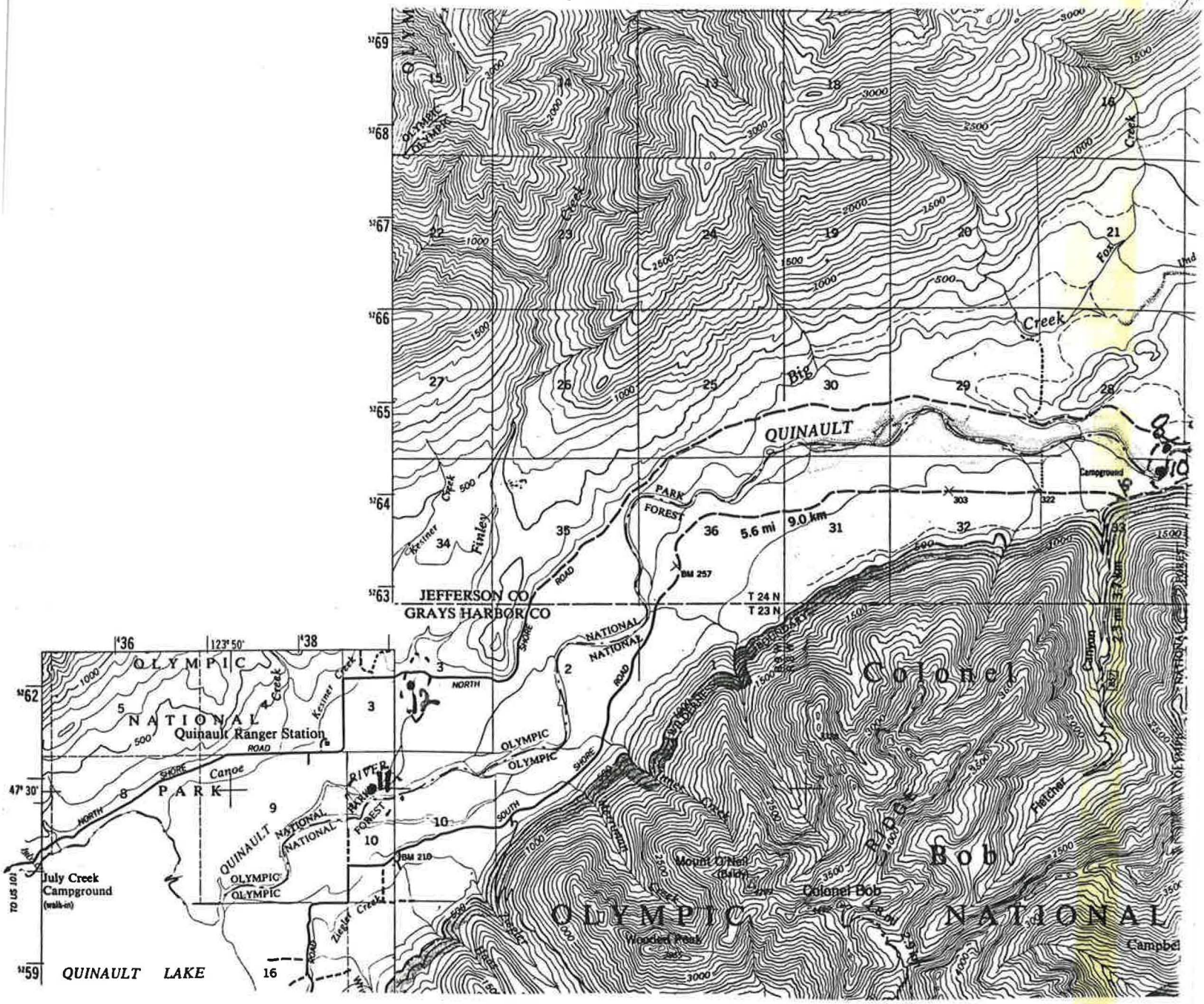
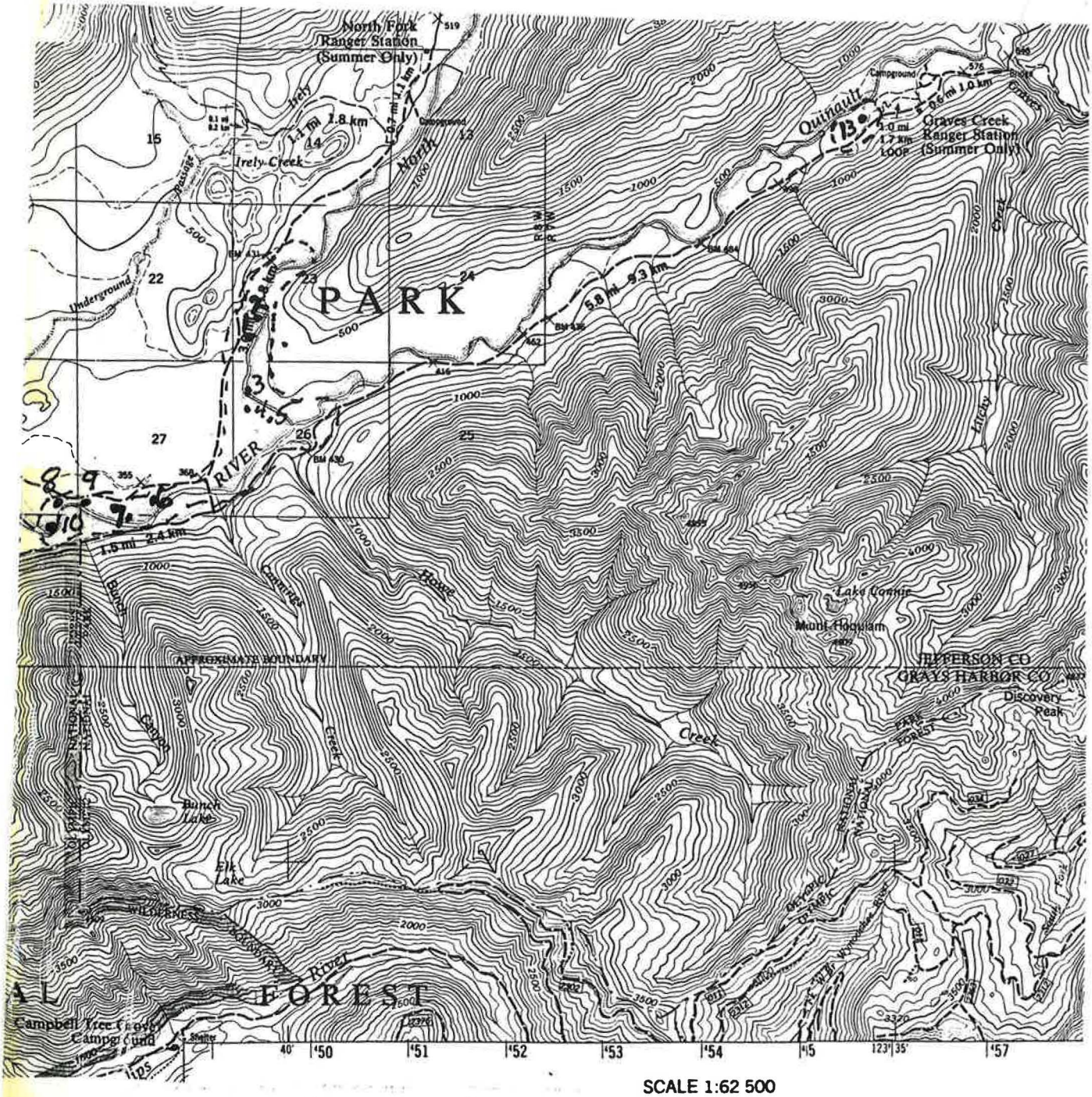


Figure 1. Location of sample sites discussed in text (approximate). Dotted line = approximate survey areas.



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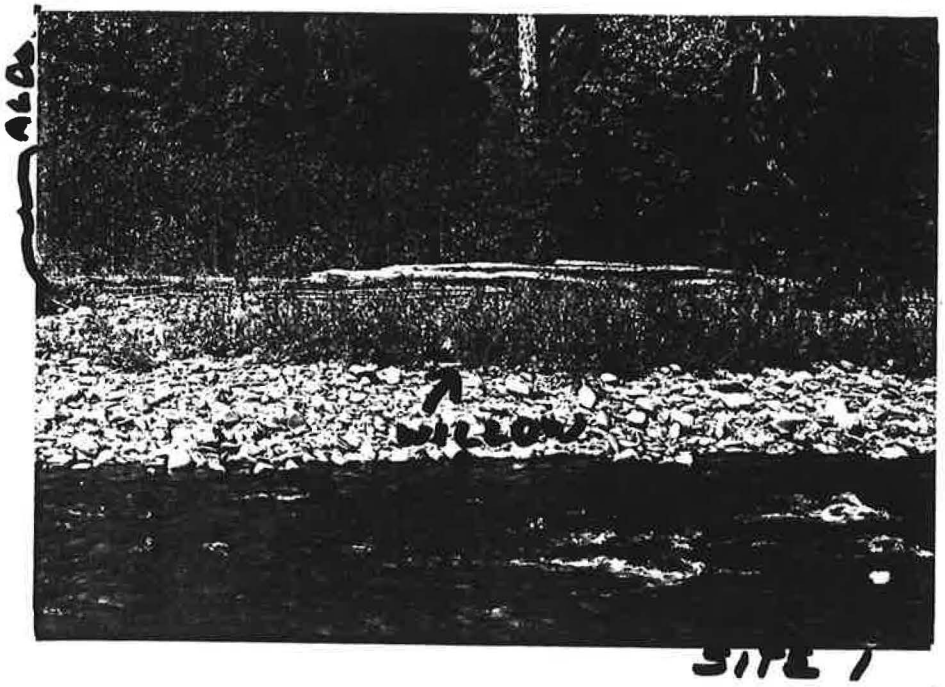

Figure 2. Willow colonization of a gravel bar established after 1976, North Fork Quinault River, 30 August 1994 (Site 1). Willows were up to 1.5 m tall, and had been heavily browsed. A dense stand of red alder had colonized the far edge of the bar.

Figure 3. Willow colonization and recruitment to 3 m in a log refugium on a gravel bar established after 1976 (Site 2). The m-stick is marked in decimeter increments. 30 August 1994.

Figure 4. Willows to 5 m tall occurred in a Sitka spruce-red alder stand on a gravel bar that was deposited before 1976 (Site 3). 30 August 1994.

Figure 5. Cascara recruitment to 6 m tall had occurred on a gravel bar deposited before 1976 (Site 4). 30 August 1994

Figure 6a, 6b. Four cottonwood trees established in a red alder stand on a gravel bar that was formed after 1953 (Site 5). The cottonwoods were considerably taller than the alders established at about the same time (6a). Decaying logs at the base of the trees (6b) suggested that the cottonwoods became established in a log refugium that has since decayed. 8/30/94.

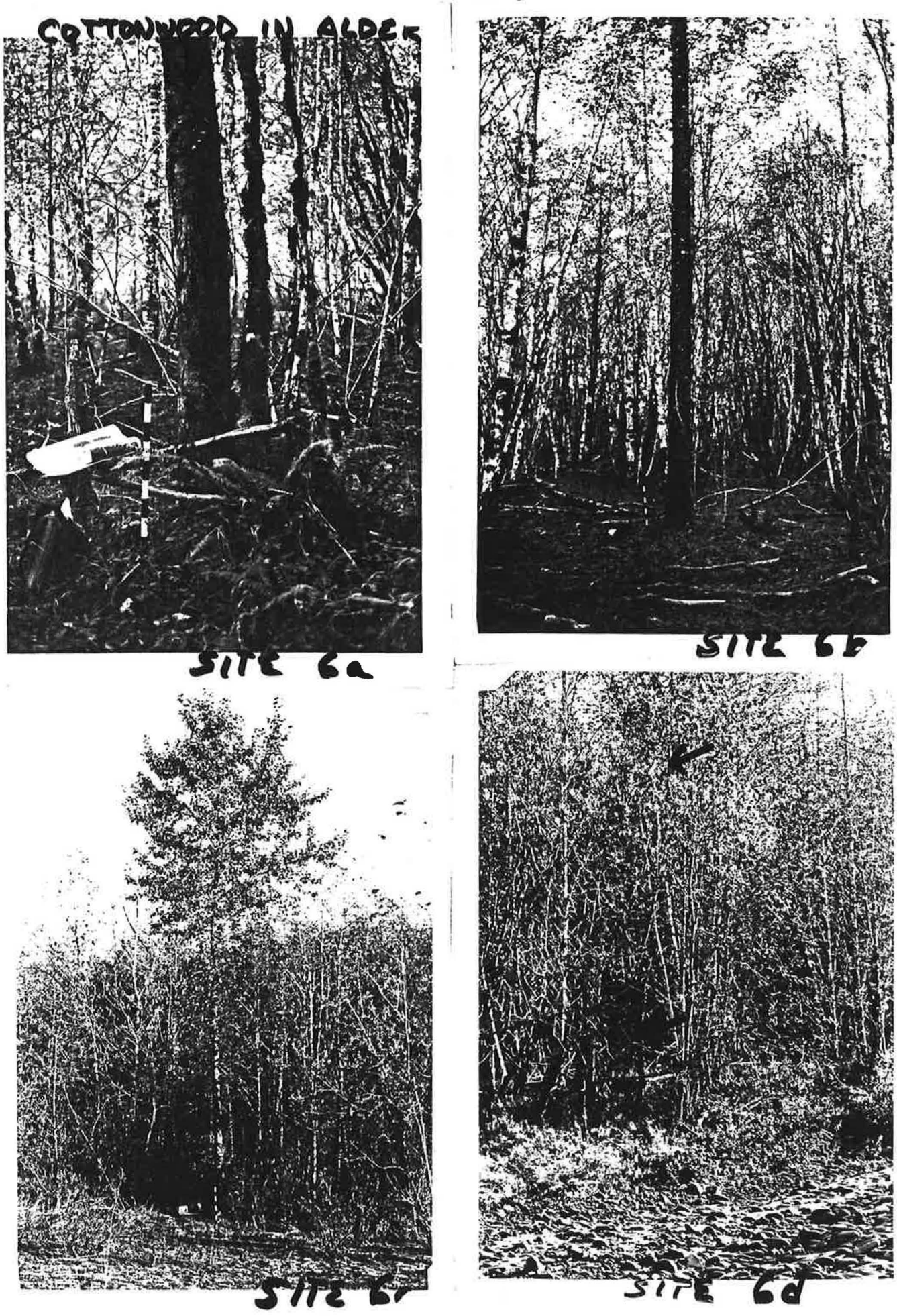

Figure 7a-d. Cottonwoods less than 20 years old that occurred among alder-dominated stands (Site 6). 22 September 1994.

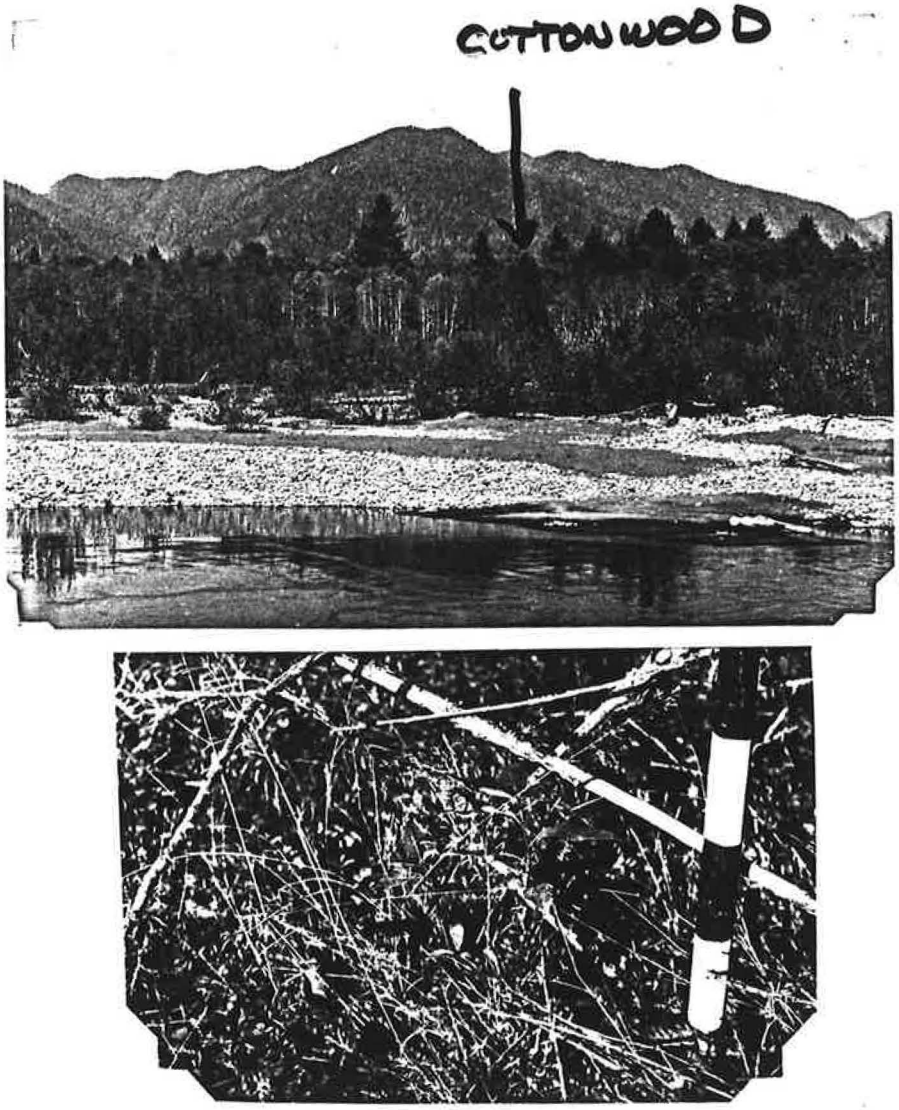

Figure 8. Overview of the sand/gravel bars at Site 6, including the cottonwoods at site 6a. Alder and willow had colonized the youngest bars (foreground). Cottonwood seedlings (inset) occurred sporadically on the newer bars. 9/22/94.

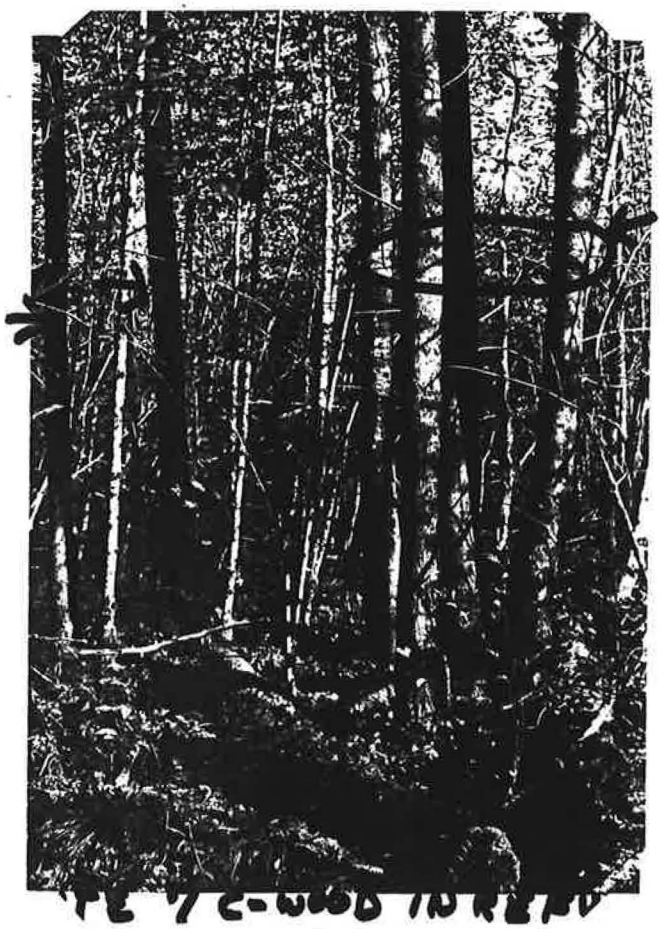

Figure 9. Seven cottonwoods that became established during the past 25 years in a log refugium (Site 7). A stand of older cottonwoods occurred adjacent to the new stand. 9/22/94.

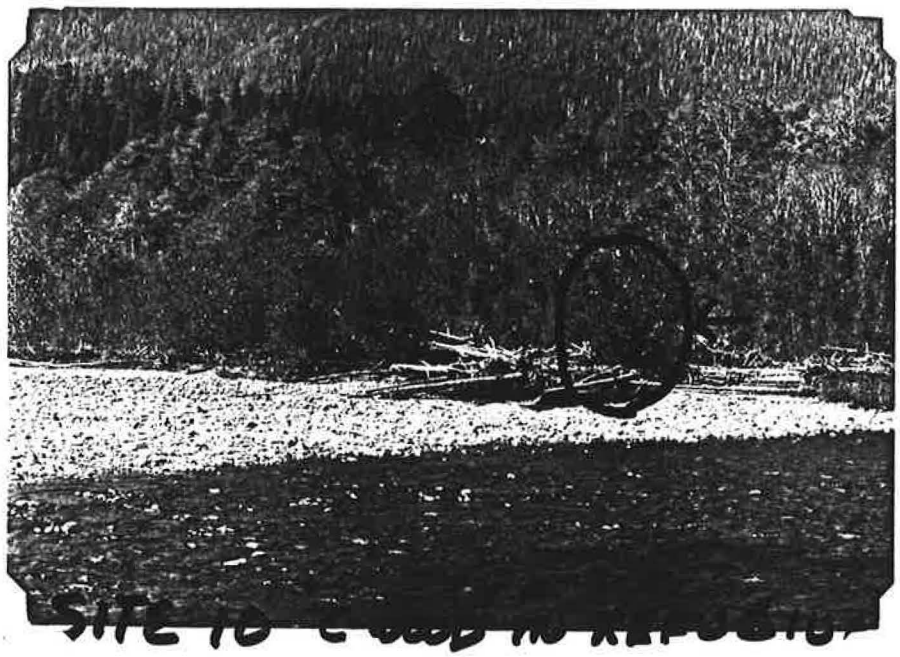

Figure 10. Four cottonwoods saplings that had escaped browsing in a log refugium on the floodplain of the Quinault River. 22 September 1994.

Figure 11. Cottonwood and alder colonization of gravel bars along the west channel of Finley Creek. Many younger age classes of cottonwoods occurred along the streambank. 9/23/94.

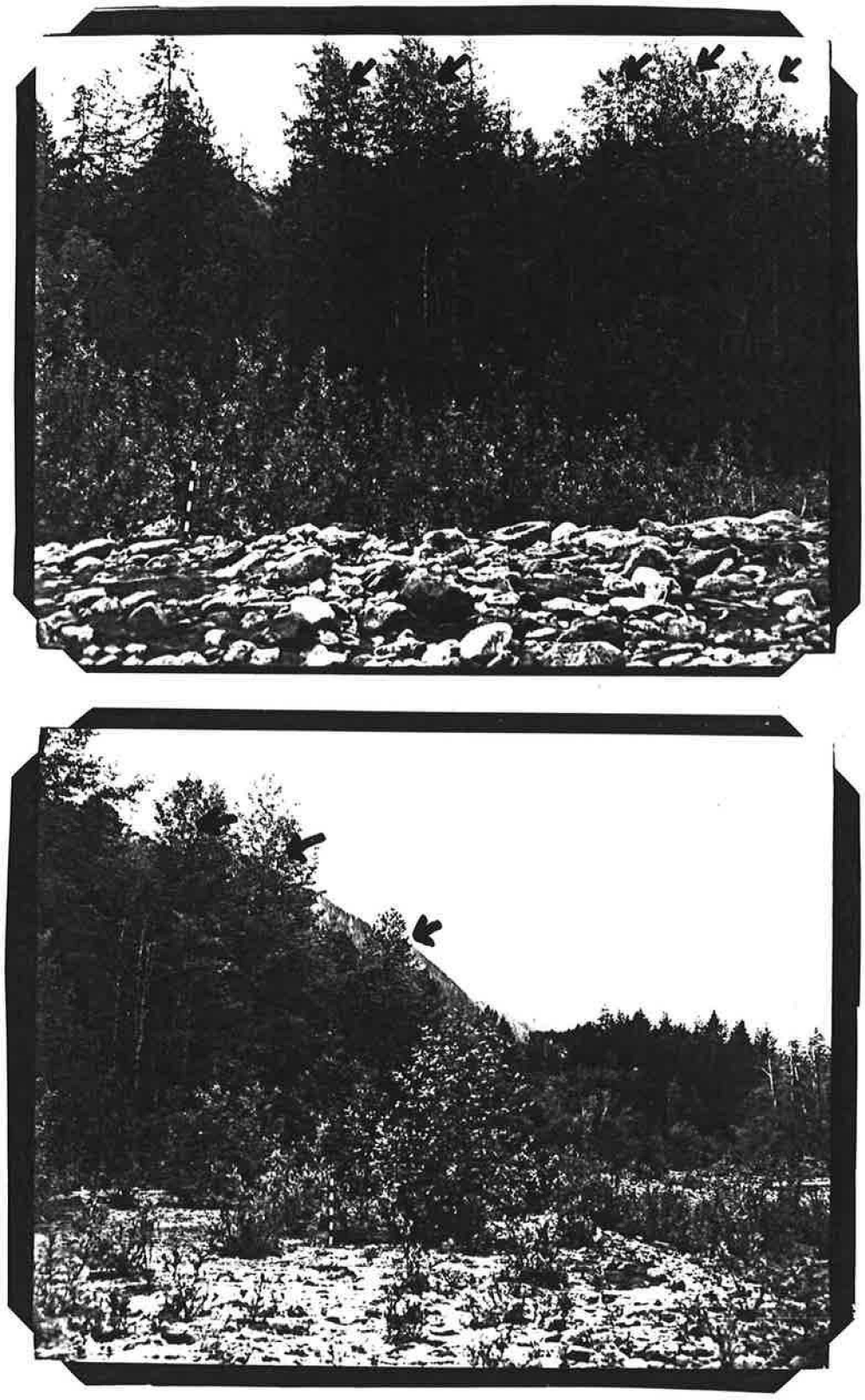

Figure 12a&b. Cottonwood colonization of a gravel bar on the East Fork Quinault River downstream from Graves Creek (Site 13). Photos 12a&b were taken 11 June 1991. Willow and alder had recently colonized the newest bar (foreground); cottonwoods and alders had become established on somewhat older sections (background). A mix of alder and cottonwood occurred in the stand interior (photo 12c, next page, taken 22 September 1994).

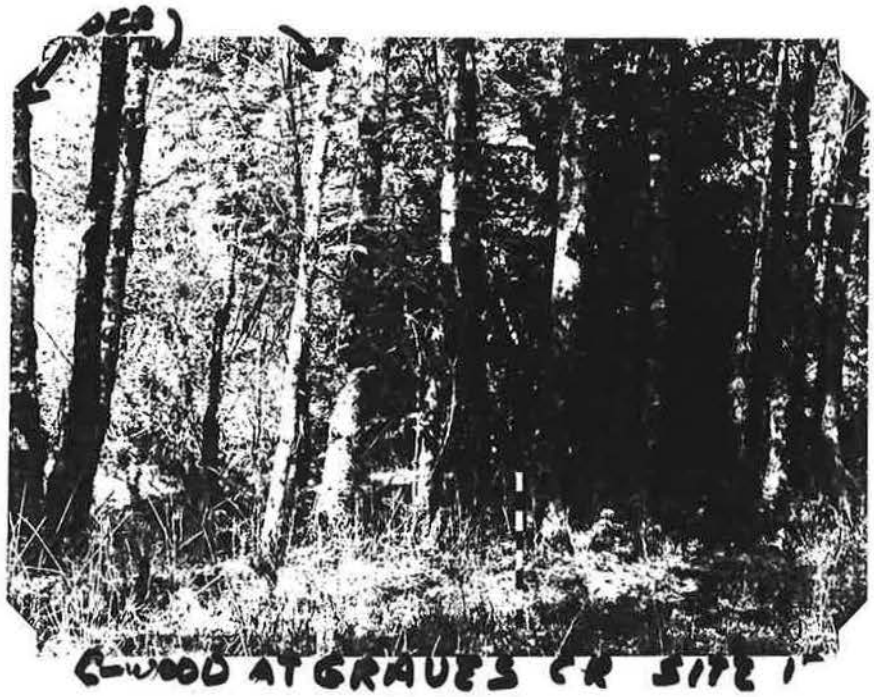

Figure 12c. Cottonwood near Graves Creek (See previous page).