

The Holocene Biogeographic History of Elk (*Cervus elaphus*) in Western Washington

Abstract

Many mammalian species found today in Washington state experienced a dynamic biogeographic history during the Holocene epoch (last 10,000 years). The elk (*Cervus elaphus*) was one of those species. Seventy archaeological sites in Washington west of the crest of the Cascade Mountains have produced eighty-eight assemblages of elk remains. The oldest assemblage dates between 6000 and 7000 years ago, but most date to the last 2000 years. Documented assemblages are not a representative sample of the spatial and temporal distribution of elk as a result of how the archaeological record in western Washington has been sampled and the poor preservation of faunal materials in many sites. Available data indicate, however, that elk were widespread between 2000 and 150 years ago. Comparison of the distribution of elk between 2000 and 150 years ago to their late nineteenth and early twentieth century distribution indicates a shift in geographic range over the past 150 years. This shift is attributable to land modification and increased human predation after the middle of the nineteenth century.

Introduction

Late Pleistocene remains of bison (*Bison* sp.) and caribou (*Rangifer tarandus*) have been recovered from the northeastern portion of the Olympic Peninsula of Washington (Gustafson 1985). Remains of grizzly bear (*Ursus arctos*) apparently dating to the late Pleistocene have also been recovered from an island in the northern Puget Sound (Mustoe and Carlstad 1995). Together, these remains suggest the mammals of western Washington experienced a dynamic biogeographic history because there are no historic-period (last 200 years, as documented by Euroamerican explorers, settlers, and scientists) records for these taxa in the area (e.g., Scheffer 1946, 1995). We sought details of that history and here focus on the North American elk (*Cervus elaphus*) or wapiti.

We compiled data for the prehistoric period (> 200 years old) in an attempt to establish where elk were found in western Washington during the Holocene (last 10,000 years), to determine where they were not found, to document changes in their distribution over time, and to examine why those changes might have occurred. Although available data are insufficient to show conclusively where elk were not found prehistorically, those data indicate that elk were widespread over western Washington between about 2000 years ago and 150 years ago.

Study Area

We define western Washington as being west of the crest of the Cascade Mountains (Figure 1). Seasonally fluctuating moisture content of sediment and the acidity of sediment created by coniferous forests characteristic of the area (Franklin and Dyness 1973) combine to speed bone disintegration. Only sediments buffered from these environmental factors tend to contain well preserved remains of prehistoric animals (Lyman 1994). Such sediments are found in caves where they are constantly dry, or in coastal shell middens in which the calcium of the shell neutralizes sediment acidity.

Locally, climates were not stable during the Holocene and floras (e.g., Rochefort et al. 1994) and faunas (e.g., Lyman 1998 and references therein) responded to fluctuating climatic conditions throughout this epoch. During the mid-Holocene climatic interval known as the altithermal, subalpine forests in what is now Olympic National Park were more closed and timberline was higher than at present (Gallison 1994). During the early Holocene, approximately 10,000 to 5000 years ago, prairie vegetation expanded its range in the Puget Lowlands (Whitlock 1992:17). After this period, summer droughts became less intense and vegetation and climate began to take on more modern appearances (Whitlock 1992).

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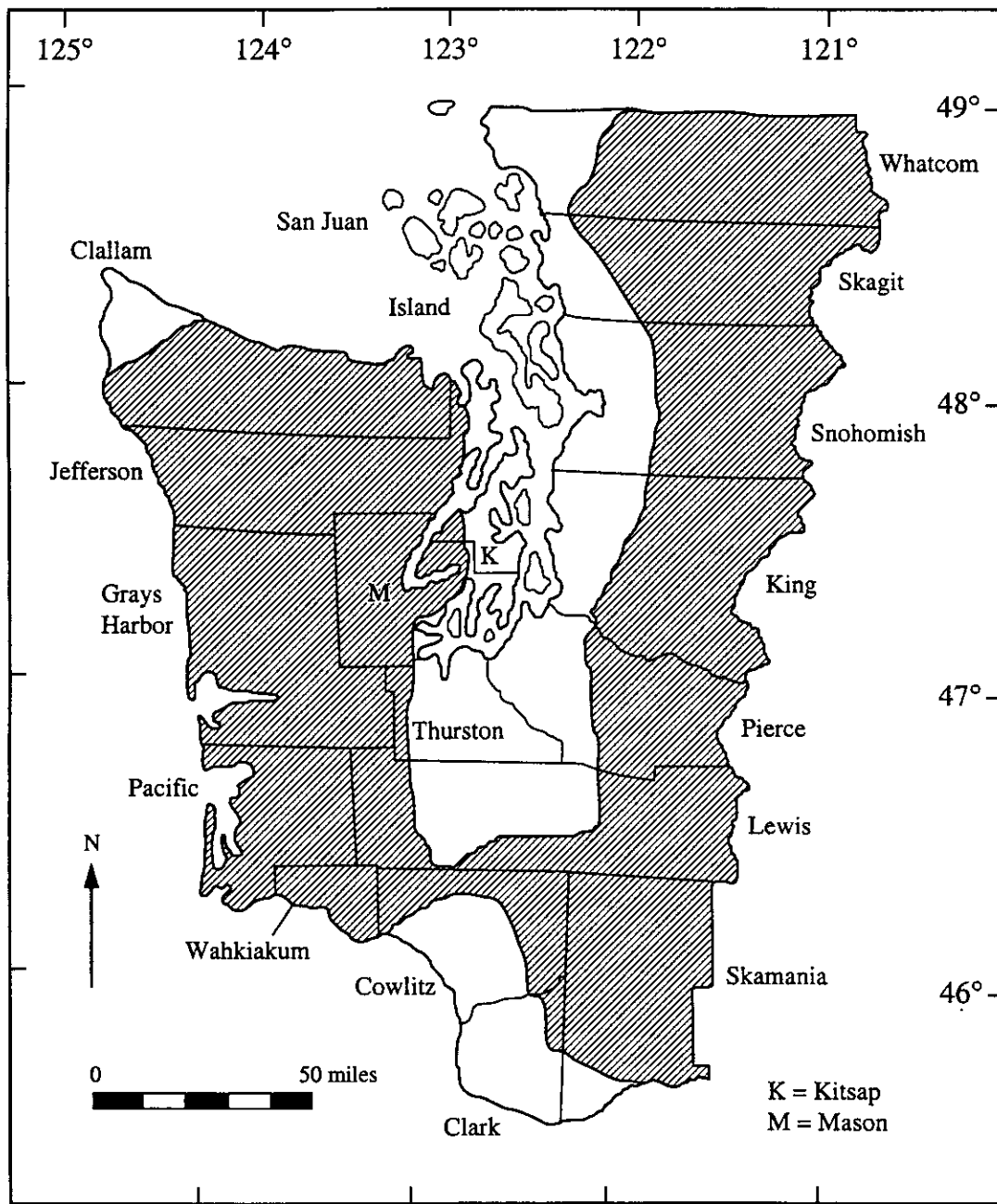


Figure 1. Modern elk distribution (shaded) in western Washington (after Booth 1947, with modifications after Ingles 1965). County lines and names shown for reference.

Studies of western Washington elk indicate this large cervid is most often found in patchy environments. The forest canopy provides thermal and escape cover, forest openings provide forage. Windstorms, landslides, and fires create openings

in otherwise closed forests, creating more elk habitat (Starkey et al. 1982). Early Euroamerican explorers and settlers and late nineteenth and early twentieth century anthropologists report that Native Americans burned portions of forests to improve

production of berries, deer (*Odocoileus hemionus*), elk, and other resources (e.g., Gustafson 1983; McClure 1989; Mierendorf 1997). In conjunction with climatic change, these factors lead us to expect that elk experienced a dynamic biogeographic history during the Holocene. Climatic shifts and well-documented fire histories might be used to predict particular spatio-temporal changes in elk range, but climatic history varies across space (Mock and Bartlein 1995), as does fire history (Cwynar 1987; Dunwiddie 1986; Hemstrom and Franklin 1982). Therefore, we do not attempt to predict changes in elk distribution here and instead simply consider what the prehistoric record reveals.

Elk were distributed along both the eastern and western sides of the Cascade Mountains prior to firearm-enhanced hunting by Native Americans and European settlers. Eyewitness accounts describe an early historic abundance of elk in western Washington, and a late nineteenth and early twentieth century decline (Dalquest 1948; Scheffer 1946, 1995; Starkey et al. 1982). The approximate distribution of elk during the early twentieth century is shown in Figure 1 (Booth 1947, with modifications after Ingles 1965).

Methods

Data for this study were compiled from all known published and unpublished archaeological and paleontological reports on sites excavated in western Washington. The number of identified bones and teeth of elk per site and radiocarbon dates associated with elk remains were recorded, as were instances of stratigraphic associations of elk remains with temporally diagnostic artifacts. Elk remains modified into artifacts were not recorded as these might have been transported significant distances by prehistoric human foragers (Lyman 1994). *Assemblages* of elk remains were defined as site-specific sets of remains that were stratigraphically associated; many, but not all, of these assemblages had associated radiocarbon dates. Given the paucity of elk remains in pre-2000 yr B.P. (before present) contexts and the absence of such remains from many geographic areas, correction and calibration of dates in calendar years (Taylor 1996 and references therein) was deemed unnecessary. Several assemblages were assigned an approximate age based on associated artifact styles when those styles were of known age.

We followed Dixon and Lyman's (1996) lead and plotted elk assemblages on separate maps, one map for every 1000-year period beginning with 100–1000 yr B.P. and every thousand years prior to that period (Figure 2). The purpose of the mapping was to reveal biogeographic dynamics. This exercise was unsuccessful due to the paucity of elk remains older than 2000 years, a result of both how the zooarchaeological record has been sampled and reported and the preservational history of that record. It is therefore important to understand those factors prior to rendering interpretations of the Holocene biogeographic history of elk as indicated by prehistoric remains.

Results and Discussion

Seventy sites produced eighty-eight assemblages of elk remains. Fifty-seven assemblages from forty-six sites were assigned to a particular 1000-year period. Thirty-one assemblages with no associated styles of artifacts of known age, no associated radiocarbon dates, or multiple dates spanning multiple 1000-year periods were tallied and mapped as undated. Most assemblages date to the last 2000 years. The oldest assemblage, from Laysier Cave (45LE223) in Lewis County, dates between 6000 and 7000 B.P. (Gustafson 1987). The second oldest assemblage, from the Dupont Southwest site (45PI72) in Pierce County, dates between 5000 and 6000 B.P. (Wessen 1989) (Figure 2).

The spatial distribution of sites that have produced elk remains exists not because elk were prehistorically rare in some areas and abundant in others. Rather, it is likely a function of how the archaeological record of western Washington has been sampled and preservational biases. The sample of sites producing elk remains is not spatially representative of the area as a whole because of the history of excavation. Many of the sites comprising the cluster in San Juan and Island counties were archaeologically tested in the 1950s to understand local prehistory (Bryan 1963). Many of the sites comprising the cluster in northwestern Whatcom County were excavated in the late 1960s through the early 1980s to understand local prehistory (e.g., Grabert and Griffin 1983). Sites comprising the cluster in western Clallam and Jefferson counties were excavated between 1960 and 1990 as part of a single project (Samuels and Daugherty 1991). These three clusters of sites

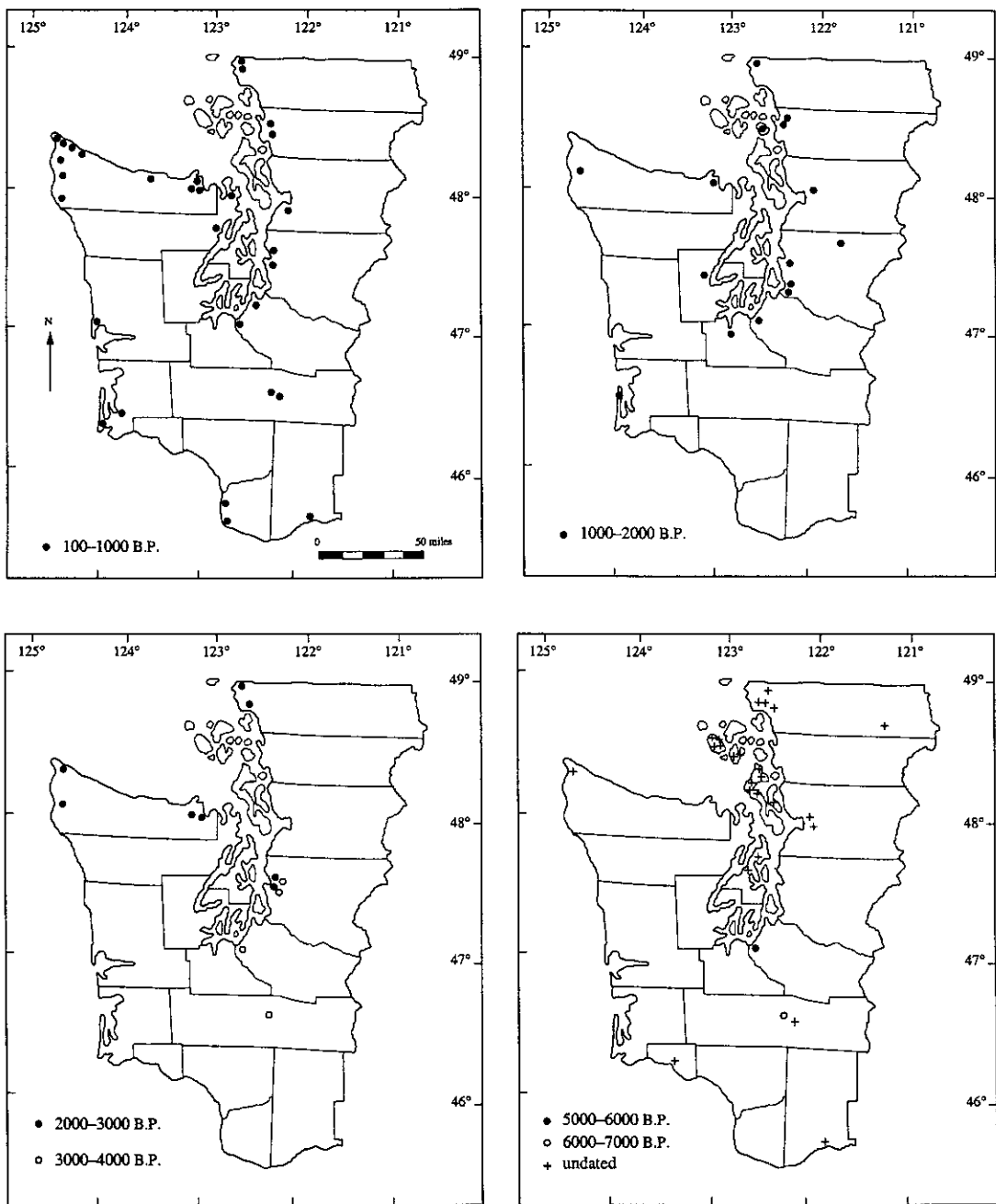


Figure 2. Distribution of archaeological sites containing elk remains per thousand-year period.

represent relatively intensive but geographically limited efforts that are not necessarily representative of western Washington. With few exceptions, the majority of the sites producing elk remains were excavated out of legal necessity rather than as the result of a research design directed toward deriving a spatially representative sample of artifacts or faunal remains.

Finally, western Washington is dominated by coniferous forest that increases the acidity of the sediment, resulting in very poor preservation of faunal remains (Lyman 1994). Poor preservation is exacerbated by seasonal fluctuations in precipitation. Sites in the interior contain elk remains if their sediments are inside caves where they are not subjected to the acid produced by conifers or to seasonal fluctuations in moisture content. Sites not in caves—typically referred to as open sites—have very poor preservational conditions precisely because they are subjected to these processes. For example, fifty-six archaeological sites within about 70 km of Mount Rainier National Park had been excavated as of mid-1994 (Lyman 1995). Twelve of these fifty-six are in caves or rockshelters, and all twelve produced faunal remains; only four of the twelve included elk remains. The other forty-four sites are open sites, and only eight of them produced faunal remains; the remains from only one of these have been reported but do not include elk remains.

In contrast to the poor preservation of faunal remains typical of open sites in interior locations, numerous mammal remains have been recovered from open coastal sites due to the presence of large amounts of mollusc shell in the site matrix. The shells provide sufficient calcium to neutralize sediment acidity and create favorable environments for the preservation of bones and teeth. This, plus the typically more intensive and extensive development and modification of the coast for human use has resulted in more coastal locations producing elk remains than interior locations.

The sample of elk assemblages is not representative of temporal patterns. In the 1950s and early 1960s, radiocarbon dating was a new procedure (Libby 1955), only a few radiocarbon dating laboratories existed, and the general consensus was that the time depth of the archaeological record in Washington state was not extensive enough to warrant such dating (Osborne 1956). For these

reasons few radiocarbon dates were assayed prior to the 1970s. For example, only one of the fifteen sites sampled and reported in the 1950s and 1960s that produced elk remains was dated via radiocarbon in the 1960s. Work undertaken in the 1980s at two of those fifteen sites (45KP2 [Schalk and Rhode 1985] and 45SK7 [Robinson and Thompson 1981]) produced radiocarbon dates, but, given the published record, it is impossible to determine if the dates are stratigraphically associated with the elk remains recovered from these sites.

The Holocene archaeological record of elk in western Washington is a reasonable reflection of where elk occurred prehistorically (Figure 2), but may be a poor reflection of where elk were not found prehistorically. Recognizing these limitations, three things stand out. First, the farther back in time one goes, the less we know about the distribution of elk in western Washington. Second, elk occupied the islands of the Puget Sound, mainland coastal areas, the foothills of the Olympic Mountains and Cascade Range, and also some of the higher elevations of the interior during the last 1000 to 2000 years. And third, the distribution of elk seems to have remained relatively stable in some areas during the last several thousand years. Elk remains regularly occur in sites in western Clallam County, eastern Clallam County, western Whatcom County, and western portions of King and Pierce counties over the last 3000 to 4000 years.

Significance of Results

Comparison of Figures 1 and 2 suggests that the distribution of elk during the early twentieth century was different from that between 2000 and about 150 years ago. In fact, the two are virtually exact opposites of one another. Most prehistoric remains of elk have been recovered from coastal contexts. Undated elk remains recovered from eastern Whatcom County (Mierendorf 1997) and dated (Gustafson 1987) and undated (Lyman, unpublished data) remains from central Lewis County and north-central King County (Lyman 1988) suggest that elk inhabited these areas of the mountains prehistorically. In conjunction with what is known about bone preservation and the history of archaeological research in the area, such records suggest that the absence of elk remains in many upland or montane contexts is not a result

of the absence of elk from those areas in the past but rather is attributable to sampling and preservational biases.

Why might the historic and late prehistoric records be so different? Seventy years ago Edson (1930, 1931) and Brooks (1930) debated the cause of the lack of big game in the Mount Baker area of western Whatcom County. Brooks believed the absence of elk was part of a more general pattern as he found big game scarce over the entire region, and implied the paucity of big game was the result of hunting by Native Americans. Edson argued the rarity of big game was a result of intensive hunting by Euroamerican settlers. Similar debates, in other areas, go on today (e.g., Kay 1994; Schullery 1997). Data summarized in Figures 1 and 2 suggest a solution to such debates for the area mapped.

If Native American hunters were responsible for depletion of the elk population during the prehistoric period, then we should find progressively fewer and fewer sites plotted in Figure 2 as the maps progress from the distant to the recent past—as progressively more local populations were extirpated and hunting areas not recolonized—if *the sample is representative of the population of sites in which elk remains were deposited*. Given sample limitations for the pre-2000 B.P. periods, such cannot be perceived in the maps. But if elk populations were depleted and their range shifted accordingly as a result of hunting by Native Americans, then elk might be found historically in those areas where they were not found prehistorically. However, the available prehistoric sample indicates elk occurred virtually everywhere—recalling sampling and preservation biases—in western Washington prior to 100–150 years ago. If depletion of elk populations and concomitant range changes occurred after the arrival of Euroamerican settlers, then we should find elk historically absent from some areas where they occurred prehistorically. This is precisely what is indicated by Figures 1 and 2. And, there is a corollary that is fulfilled as well.

Elk should be historically absent from areas that were settled early by Euroamericans yet present in areas that were not densely inhabited by these early settlers. Washington (and Oregon) became a territory in 1853, just when settlements were beginning to grow quickly in number and size (Dryden 1968). Early settlers lived off the land and modified habitats with their agricultural and,

particularly, logging practices. Note in particular in Figures 1 and 2 the western edge of the easternmost tier of counties. This was one of the earliest densely populated areas in the state; Bellingham (in western Whatcom County) was established in 1852, Everett (in western Snohomish County) in 1862, and Seattle (in western King County) in 1851. Numerous prehistoric occurrences of elk are known in these areas, but Booth (1947) listed no historic records of elk there. Western Clallam County and the Portland Basin, including Clark County, historically lack elk where they were found prehistorically. The last, too, was settled early and densely; Portland (south of and across the Columbia River from Clark County) was established in 1844 and Fort Vancouver (in southwestern Clark County) in 1825. In his journals of 1825, David Douglas (1914:155) wrote of the Portland Basin that elk were “plentiful in all the wooded parts of the country.” Apparently this was not the case one hundred years later when Booth (1947) compiled his data.

Logging was a major industry throughout the settled portions of western Washington, and although this may have produced more elk habitat, subsistence hunting by early Euroamerican settlers seems to have outweighed the benefits and resident elk populations were decimated. Schullery (1984) suggests some firearms made their way over the crest of the Cascade Range prior to the first major waves of Euroamerican settlers. The impact of firearm-equipped Native Americans on local elk populations is impossible to estimate, but such may have initiated decreases in some local populations prior to the arrival of Euroamericans and contributed to their demise afterwards. We suggest it is doubtful that the impact was geographically universal because local Native American populations were, in the middle of the nineteenth century, less than half the size they had been a century earlier as a result of the introduction of European diseases for which Native Americans had no natural immunity (e.g., Black 1992; Meltzer 1992). Finer temporal resolution in conjunction with more and larger samples of elk remains can be used to test this suggestion.

Conclusions

Prehistoric remains of elk have been reported in areas of western Washington where numerous archaeological sites have been excavated but not in areas where little excavation has been undertaken.

This bias is exacerbated by the general lack of preservation of faunal remains in archaeological sediments underlying local coniferous forests and the paucity of radiocarbon dates associated with those remains. Nonetheless, the available data suggest elk were widespread over much of western Washington at least during the last half of the Holocene, particularly between 2000 and about 150 years ago. Comparison of the prehistoric record of elk in western Washington with the historic record for this species suggests that during the last half of the nineteenth century the distribution of elk shifted as a result of land modification associated with Euroamerican settlement and depletion by human predation.

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Acknowledgements

For help in obtaining obscure reports, we thank Kenneth M. Ames, Sarah K. Campbell, Laura S. Phillips, Julie K. Stein, and Rob Whitlam. Information on various sites and excavations was provided by Astrida Blukis Onat, Gail Thompson, Robert Mierendorf, and Linda N. Goetz. We thank Steve Wolverton and three anonymous reviewers for comments on an early draft, and Dan Glover for preparing the figures. This research was funded in part by the McNair Scholars Program at the University of Missouri.

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Received 18 May 1998

Accepted 12 March 1999