

## Bird Communities in Oak Woodlands of Southcentral Washington

### Abstract

This study was initiated because there was a perception that oak woodlands are unique habitats for birds, particularly Neotropical migrants. The objectives of this study were to determine species composition and relative abundance of bird populations in oak and oak-conifer woodlands; and to evaluate the importance of these habitats to nesting birds. This study was undertaken near the northern limit of the Garry oak habitat in North America. The study design consisted of three replicates each of five upland habitats and three riparian habitats. Seventy-two bird species (53 Neotropical migrants and 19 permanent residents) were found at least twice on the 18 study sites. There were no significant differences in species richness among upland habitats. An average of 12 neotropical migrant species were detected per study site in both upland and riparian areas. Neotropical species comprised 62% of all birds detected. Bird abundance was highest in study sites with large amounts of small oak and small pine; it was lowest in riparian study sites. The most abundant species was the Nashville warbler. Bird species composition in the Washington Garry oak habitat was different from those previously reported from Oregon and California.

### Introduction

Among the factors likely to cause avian or other wildlife population declines, habitat loss and modification are two of the most important. Birds strongly associated with limited habitats have a higher potential for population decline than those affiliated with more widespread habitats. Furthermore, animals at the fringes of their distributions have less stable populations (Caughley and Sinclair 1994). The Garry oak (*Quercus garryana*) habitat has been threatened by encroachment of conifer species, firewood cutting, and livestock grazing. There has been concern that this habitat is critical for birds and other organisms and its loss would cause significant population declines in some oak-dependent birds (DeGroot et al. 2000). In California, tan oak (*Lithocarpus densiflorus*), coast live oak (*Q. agrifolia*), and California black oak (*Q. kelloggii*) have been decimated by a new disease referred to as Sudden Oak Death, an undescribed *Phytophthora* fungus (Svihra et al. 2001), and Garry oak may become a new host. Therefore, understanding the ecology of the Garry oak community is now more important than ever.

This study was initiated, in part, because there was a perception that oak woodlands are unique habitats for birds. Klickitat County contains the most extensive examples of oak woodlands remaining in Washington, where large areas of oaks exist either in pure patches or mixed with conifers. Ornithologically, oak woodland habitat ap-

pears to differ from other habitats in Washington in two ways. First, bird species diversity is high compared with coniferous forests (Manuwal 1991). Second, it provides the primary nesting habitat for oak woodland specialists: the acorn woodpecker (*M. formicivorus*), ash-throated flycatcher (*Myiarchus cinerascens*), and western scrub jay (*Aphelocoma californica*). Of these three species, the western scrub jay may be the most common. The acorn woodpecker is limited to a small colony near Lyle, Washington, at the mouth of the Klickitat River. The ash-throated flycatcher is found in various locations in southern Washington from about Bingen eastward where it is primarily found among oaks (Seavey 1997). Washington represents the northern edge of its breeding distribution since it is accidental in British Columbia (Campbell et al. 1997).

Several papers describe the bird communities of oak woodlands in California (Verner and Ritter 1985, Verner 1987, Avery and Van Ripper 1989, Block et al. 1994, Aigner et al. 1998) and Oregon (Anderson 1970a, 1970b, 1972; Sterns 1995). There are no published accounts of bird communities associated with oaks in Washington.

The Garry oak community, found in Oregon and parts of northern California, extends north into western and south-central Washington. Oak woodlands are patchily distributed in western Washington. Oak woodlands remain in the Fort Lewis area, although they are threatened by human encroachment, invasion by alien plant species

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and a history of fire suppression (Tveten and Fonda 1999). Thus, the extensive oak and oak-conifer forests in south-central Washington represent the largest examples of oak woodland habitat in Washington. The Klickitat and White Salmon drainages are in the heart of this region. Garry oak may be found mixed with either Douglas-fir (*Pseudotsuga menziesii*) or ponderosa pine (*Pinus ponderosa*) in south-central Washington. Of particular importance is the Garry oak woodland community and its ecotone with the ponderosa pine woodland, a habitat characteristic of most of the lower east slope of the Washington Cascades (Franklin and Dyrness 1988). Oak and oak-conifer habitats provide habitat for birds such as the western scrub jay, that are uncommon elsewhere in Washington. Characteristics of the bird communities of oak woodlands in south-central Washington are poorly known, and little is known about the value of these woodlands to Neotropical bird species. The objectives of this study were to (1) determine species composition and relative abundance of bird populations in oak and oak-

conifer woodlands, and (2) evaluate the importance of these habitats to nesting Neotropical migrants.

### Study Area

The study was conducted at three primary geographical locations in south-central Washington: 1) the White Salmon River, 2) the Klickitat River, and 3) areas near Goldendale (Figure 1). The study site represented mixes of oak and conifers and successional age classes. The habitats were selected on their general appearance because they represented the variation that existed within the oak woodlands in south-central Washington. The upland areas were divided into the following general types with three replicates per habitat: large pine-large oak (LP-LO); small pine-small oak (SP-SO); large Douglas-fir-large oak (LF-LO); mostly pure large oak (LO); and mostly pure small oak (SO). The Klickitat Oak Mapping Inventory of the Washington Resource Data System (WRDS), a GIS data bank, provided by the Washington Department of Fish and Wildlife (WDFW), was helpful in selecting some study areas.

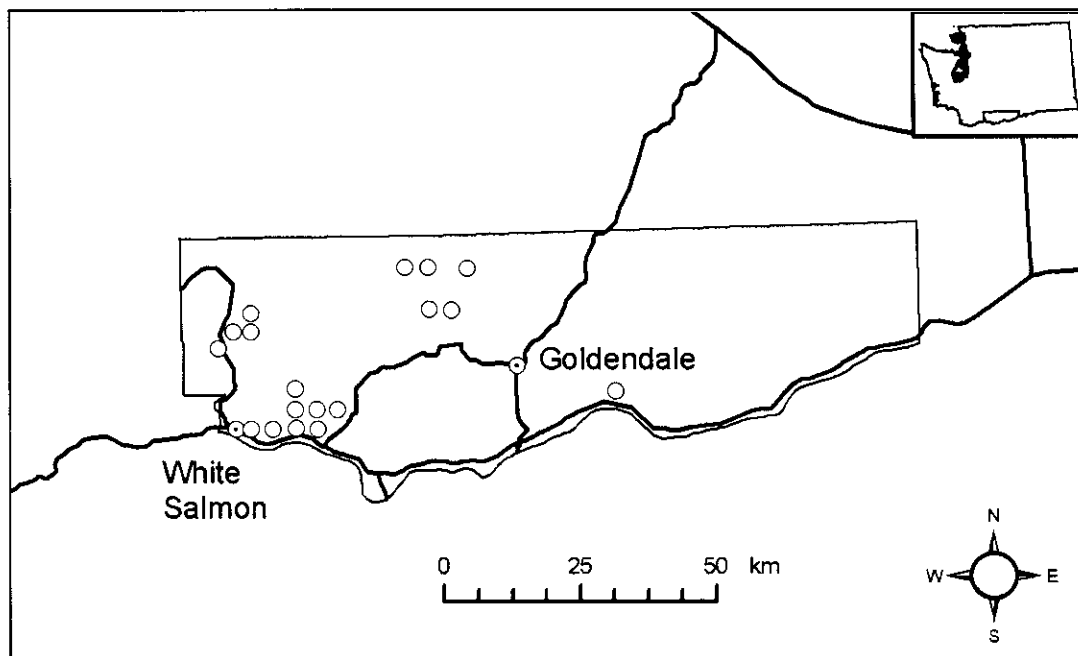


Figure 1. Location of study sites in oak woodland habitat in south-central Washington.

## Methods

### Field

The field crew surveyed five upland habitats with three replicates in each habitat ( $n = 15$ ), and three riparian areas ( $n = 3$ ). The fixed radius point count method (Verner 1985, Manuwal and Carey 1991) was used to obtain an index of bird abundance. In each of the selected study sites, an array of 10 points spaced 100 m apart and at least 50 m from the study site edge (except riparian study sites) was used to determine abundance, species richness, and species composition. We selected the largest accessible study sites that were representative of a particular habitat. Nevertheless, some individual study sites were in habitat patches that did not allow point count stations to be spaced more than 100 m apart. A bird survey consisted of tallying all individual birds heard or seen near each point for 8 min. Surveys usually began within 15-30 min of official dawn. In 1995 and 1996, five surveys were made at each study site, beginning in late April and ending at about 7 July.

All vegetation was sampled at the 10 bird point count locations. At each point, the number and dbh of trees and snags were counted in a 13-m-radius (0.05 ha) circular plot. Tree species composition was determined from the 13-m-radius circular plot data.

### Data Analysis

I calculated the total number of birds detected to compare bird abundance among different habi-

tats. Birds detected in a study site only once were omitted from the analysis since those birds were probably either migrants moving through or vagrant non-breeding birds and therefore were not representative of the study sites. I also calculated the total number and mean number of species detected per study site and then obtained the average for a habitat. One-way Analysis of Variance (ANOVA) was used to compare differences in species richness and total detections among habitats. Square-root transformed mean number of detections and mean number of species were used as the variables. SPSS v11 was used in performing statistical tests. The level of significance for each analysis was  $P = 0.05$ . I used the Jaccard's similarity index ( $I_{js} = \text{species in common/all species} \times 100$ ) (Muller-Dombois and Ellenberg 1974) to compare regional bird communities. By using the percentage tree composition for each study site, I calculated the Shannon-Weaver index  $H' = -\sum p_i \log_e p_i$ , where  $p_i$  is the proportion of individuals in the  $i$ th tree species (Shannon and Weaver 1963) as a simple measure of tree species diversity.

## Results

### Description of Habitats

The LP-LO habitat was characterized by widely-spaced large diameter Garry oak and ponderosa pine, and some bigleaf maple (*Acer macrophyllum*) in the Columbia Gorge area (Table 1). Understory shrubs were also widely scattered, although there

TABLE 1. Percent composition of live trees and mean diameter at breast height (cm) (in parentheses) of live trees and snags in six habitats in south-central Washington in 1995. Snags were treated as a species in calculation of the diversity index.

Tree species	Large pine-large oak ( $n = 553$ )	Small pine-small oak ( $n = 1028$ )	Large fir-large oak ( $n = 388$ )	Pure large oak ( $n = 387$ )	Pure small oak ( $n = 1168$ )	Riparian ( $n = 1092$ )
Garry oak	73.3 (16.5)	80.7 (10.1)	45.6 (21.9)	98.4 (21.4)	95.1 (10.4)	67.0 (18.8)
Ponderosa pine	6.6 (30.5)	18.6 (20.5)		1.3 (34.3)	2.7 (26.3)	4.6 (34.4)
Douglas-fir		0.7 (30.3)	28.3 (25.1)	0.3	2.2 (9.9)	0.3 (37.9)
Grand fir			14.1			
Bigleaf maple	20.1 (7.0)		9.8 (12.3)			2.5 (19.7)
Red alder			2.2			
Cottonwood						1.7 (49.1)
Oregon ash						2.3 (15.9)
Garry oak snag	46.4	15.9	18.8	18.1	8.0	21.5
Ponderosa pine snag						18.5
Cottonwood snag						34.4
Unidentified snag						43.0
Diversity ( $H'$ )	0.81	0.60	1.46	0.17	0.42	1.31

were occasional clumps. The mean height of Garry oak was 9 m, ponderosa pine 10 m, and bigleaf maple 6 m.

The SP-SO habitat had a high density of small diameter, often clumped Garry oak. Larger diameter and taller ponderosa pine were mixed with the oak. Mean tree heights were Garry oak 7 m, ponderosa pine 11 m, and Douglas-fir 13 m.

The LF-LO habitat was only found in the White Salmon drainage west of the other study areas. Mean tree heights were grand fir (*Abies grandis*) 17 m, Douglas-fir 14 m, Garry oak 13 m, bigleaf maple 10 m.

LO study sites were in the White Salmon area and along the Columbia Gorge. The only trees species present were Garry oak (mean height 10 m), ponderosa pine 6 m, and a single Douglas-fir in one study site. These study sites were open with little understory.

Study sites of SO contained high densities of small diameter Garry oak with either Douglas-fir or large ponderosa pine scattered through the study site (Table 1). Mean height for oak was 7 m, ponderosa pine 12 m, and Douglas-fir 8 m.

Riparian vegetation was highly variable and contained more tree species than the upland study sites (Table 1). Garry oak and black cottonwood (*Populus trichocarpa*) were the most common species, making up 80% of all trees. Other tree species included ponderosa pine, Oregon ash (*Fraxinus latifolia*), bigleaf maple, red alder (*Alnus rubra*), cottonwood snags, and oak snags.

Highest tree species richness occurred in LF-LO and riparian areas (Table 1). The LF-LO study sites (in the White Salmon drainage) consisted of 43% Garry oak, 27% Douglas-fir, 13% grand fir, and 9% bigleaf maple. These species made up 92% of all the trees. Riparian areas had more species, but Garry oak constituted 64% of the total trees present. The next most abundant species was cottonwood, which constituted 12% of the total. Lowest tree species richness was found in LO study site (Table 1), which consisted of large widely-spaced oaks making up 97% of the tree species present.

Snags were not a prominent feature of any of the study sites, accounting for only 2% of all trees sampled. The largest percentage of snags occurred in LF-LO study sites (5%) and riparian study sites (4%), but the largest number and largest diam-

eter snags occurred in riparian areas. There was little deadwood on the ground in most study sites. Despite the general lack of snags and forest floor woody debris, dead branches and holes in the trunk were characteristic of most Garry oaks in the study site. These characters increased with the age of the tree.

#### Avian Species Composition and Richness

There were 53 species of Neotropical migrants and 19 species of permanent residents detected in the 18 study sites during 1995 and 1996. Seventy-two bird species were detected more than once in 1995 or 1996 in the 15 upland study sites. Mean number of species detected per study site was  $21 \pm 0.94$  (Figure 2). Species composition varied somewhat among the various study sites. There were no significant differences in species richness among upland habitats. The large amount of variation among study sites probably masked any possible significant differences. The total species detected in each habitat were LP-LO (52), SP-SO (40), LF-LO (48), LO (58), SO (55), and riparian (64).

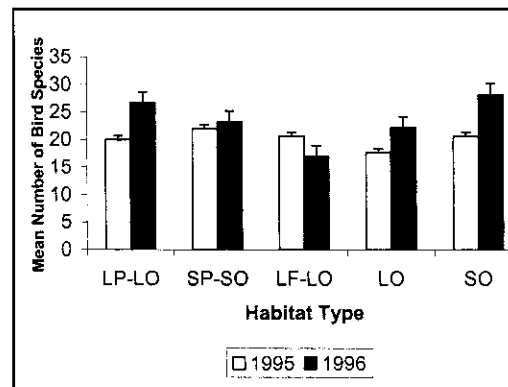


Figure 2. Number of bird species and standard error at upland ( $n = 15$ ) oak woodland study sites in south-central Washington, 1995-1996.

In the three riparian study sites, the mean number of bird species detected per study site was 25 for both years. The warbler (10 species) and flycatcher (6 species) groups contained the largest number of species. A complete summary of relative abundance by species in each habitat is available from the author.

## Avian Abundance

We detected over 6,200 individual birds within the 50 m radius of the point count stations over the 2 yr. Neotropical migrants made up  $64 \pm 2.3\%$  of birds detected in the 15 upland study sites and  $59 \pm 3.5\%$  of birds detected in the 3 riparian areas (Table 2). Highest number of detections were in SP-SO, LF-LO, and SO habitats (Figure 3). Large pine-large oak and riparian areas had the lowest number of detections. There was no significant difference in birds detected between years. The dark-eyed junco (*Junco hyemalis*), Nashville

TABLE 2. Most abundant birds in upland oak, oak-conifer woodlands and riparian areas in 1995 and 1996 in South-central Washington (top 50%). Numbers are number of detections <50 m of point count station. Percent refers to percent of all detections in either upland or riparian habitats.

Species	Mean Total	Percent of Total
<b>Upland Habitats</b>		
Nashville warbler	333	10.6
Chipping sparrow	285	9.0
Dark-eyed junco	240	7.6
Spotted towhee	207	6.6
Yellow-rumped warbler	159	5.1
American robin	147	4.7
Red-breasted nuthatch	141	4.5
Brown-headed cowbird	124	3.9
<b>Riparian Habitat</b>		
Nashville warbler	64	13.5
Spotted towhee	48	10.1
Black-throated gray warbler	45	9.6
American robin	42	8.9
Dark-eyed junco	34	7.2
Vaux's swift	23	4.9

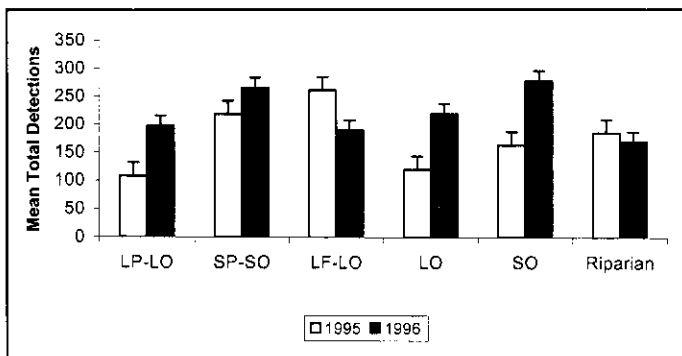


Figure 3. Total mean number of detections of upland ( $n = 15$ ) and riparian ( $n = 3$ ) study sites during 1995 and 1996. Means are for 3 study sites per habitat. Bars are standard error.

warbler (*Vermivora ruficapilla*), and American robin (*Turdus migratorius*) were found at all study sites. The spotted towhee (*Pipilo maculatus*), western tanager (*Piranga ludoviciana*), chipping sparrow (*Spizella passerina*), brown-headed cowbird (*Molothrus ater*), and red-breasted nuthatch (*Sitta canadensis*) were found at 73-97% of all study sites. The yellow warbler (*Dendroica petechia*), song sparrow (*Melospiza melodia*), and olive-sided flycatcher (*Contopus cooperi*) are examples of species that were found at only 1-2 study sites.

Neotropical migrants made up over 62% of all species detected. The highest percentages of Neotropical migrants occurred in LP-LO and SO habitats. Neotropical migrants were represented by 10 species of warblers and 7 species of flycatchers; warblers made up 21% and flycatchers 5% of 6273 detections over the 2 yr. The black-throated gray warbler (*D. nigrescens*) and Nashville warbler were the most common warblers, followed by the yellow-rumped warbler (*D. coronata*) or orange-crowned warbler (*V. celata*). Many of the yellow-rumped warblers were undoubtedly migrants and not nesting birds. The Nashville warbler was by far the most abundant nesting warbler, accounting for almost half the warbler detections.

Seven species of flycatchers were detected during this study, with differences in the number of flycatcher species between habitats and among study sites within a habitat. Flycatcher data for 1995 may contain some misidentifications because field observers were unable to distinguish some of the flycatcher species early in the season. Flycatcher species richness

was lowest in the LF-LO habitat. In 1996 small numbers of Hammond's flycatcher (*Empidonax hammondi*) and Pacific-slope flycatcher (*E. difficilis*) (the most common flycatcher in LF-LO) were detected in LF-LO. The western wood-pewee (*Contopus sordidulus*) was the most common and widely-distributed of the seven species of flycatchers, absent only in LF-LO study sites.

## Discussion

Bird species richness was similar among the 15 upland sites (Figure

2), even though the sites differed in tree heights and average dbh (Table 1). This similarity was likely due to the relative lack of vertical habitat diversity, especially in the large oak stands where there were few shrubs and oak trees were widely scattered. Although species richness was similar, species composition differed, particularly in regard to the species of flycatchers and warblers. Species richness was higher in riparian sites compared with average richness in upland sites (Figure 2). High avian species richness in riparian areas was due to the generally higher habitat structural diversity along riparian areas since there were more shrubs and taller trees, and because the riparian areas we sampled were linear, thus including a substantial amount of edge within the 50-m radius circle of the point count.

Bird abundance was high in study sites dominated by a mixture of small oaks and small pines, and stands of almost pure small oak (Figure 3). These stands had large amounts of edge created by the clumping of trees and past timber harvesting. Species such as the spotted towhee, chipping sparrow, gray flycatcher (*E. wrightii*), and dusky flycatcher (*E. oberholseri*) were common in such areas. Most of these sites had a few scattered large oaks and pines that provided additional structural diversity to the sites. They provided nesting opportunities for cavity-nesting birds such as northern flicker (*Colaptes auratus*) and red-breasted nuthatch, and perch sites and nest sites for American kestrel (*Falco sparverius*).

Our riparian areas had unexpectedly fewer detections than upland sites (Figure 3). Riparian areas reportedly have higher species richness and total abundance than adjacent upland areas (Oakley, et al. 1985). The riparian areas we sampled were

along streams so that the observers may have actually reduced the area they sampled by confining their detections to within the riparian vegetation zone. In many cases, the riparian width was less than the 13-m radius around point count stations. Riparian areas attracted the red-eyed vireo (*V. olivaceus*) and yellow-breasted chat (*Icteria virens*); neither were recorded in upland habitats. Some other species, such as the Vaux's swift (Table 3) and ash-throated flycatcher (Seavey 1997) tended to be more common near riparian areas.

Species richness was considerably higher in virtually all oak woodland habitats compared with any of the age classes of west-side Douglas-fir studied by Manuwal (1991). For example, mean species richness at the study site level in Douglas-fir forests ranged from 13 in mature study sites to 18 in old-growth study sites. In oak woodland upland study sites, mean species richness was 21. Seventy-two species of birds were detected in the oak woodlands study, whereas only 34 species were detected in the Douglas-fir study sites. Raptors were omitted in this comparison.

Although geographical variation complicates comparisons with studies conducted in other parts of the West, nevertheless some notion of the importance of oaks to birds can be gained by making such comparisons (Table 3). Compared to published accounts of bird communities in oak habitats of the Pacific states, only 32% of the bird species in the Washington habitats were the same as the Oregon sites and only 6% were the same as those reported from the oak-pine woodlands of central California.

A much higher percentage of the total bird community consisted of Neotropical migrants in oak woodlands than in west-side Douglas-fir

TABLE 3. Similarity (%) between Garry oak bird communities in south-central Washington and selected oak habitats in Oregon and California.

Comparison	Garry oak south-central Washington This study	Garry oak-conifer western Oregon Anderson 1972	Blue oak-conifer northern California Avery and Van Ripper 1989	Oak-pine woodland central California Verner and Ritter 1985
Bird species comprising top 50% of abundance (see Table 2)	100	12	5.9	0
All bird species in community recorded at least twice.	100	31.5	12.0	18.3

habitat. In Douglas-fir study sites from Mt. Rainier south to the Columbia River, Neotropical migrants made up 33% of the avifauna inhabiting mature Douglas-fir forests, and 45% of young forests (Manuwal 1991). The most abundant Neotropical migrants were the Pacific-slope flycatcher, hermit-Townsend's warbler (*D. occidentalis x townsendi*), and dark-eyed junco. In contrast, Neotropical birds made up nearly 70% of all birds in upland oak habitat I studied. Oak woodlands provide nesting habitat for large numbers of Nashville warblers (Table 2). Densities of this species in oak woodlands may be higher than for any other habitat occupied by this species in its western range.

The oak woodlands of south-central Washington provide a diverse habitat for birds in general and for three species found exclusively or primarily in oaks. These woodlands are substantially different in species composition from other forest habitats (Table 3) and are important for several species of Neotropical birds. Highest overall bird densities and species richness occurred in areas dominated by a mixture of small oaks and pines. Fortunately, this habitat is currently common on state-owned lands, however, certain areas need to be identified and protected as part of a Neotropical bird management plan.

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## Acknowledgements

Funding for this study was provided by John Pierce, Washington Department of Fish and Wildlife; Tara Zimmerman, USDI, Fish and Wildlife Service; and Virginia Kelly and Richard Larson, USDA, Forest Service, National Scenic Area Program, Hood River, Oregon. Without their support, this study would not have been possible. Dave Anderson, Wildlife Biologist, Washington Dept. of Fish and Wildlife was especially helpful with logistics. He also assisted in getting additional funding and provided valuable background information on wildlife of the White Salmon and Klickitat areas. Elizabeth Roderick and Mary Linders assisted in obtaining information on oak habitat distribution. Phil Hurvitz created the study area map. Jennifer Seavey helped select study sites, organized field crews, and assisted in collecting data. Without her assistance, this study would have been much more difficult. I gratefully acknowledge the efforts made by the following field crew members: George Armistead, Jonathan Lee, Edd Paradise and Kirk Prindle. Melinda Knutson, Stephen Bouffara, and Naomi Manuwal were very helpful in reviewing the manuscript.

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*Received 15 February 2002*

*Accepted for publication 24 April 2003*