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Distributions of Rare Mollusks Relative to Reserved Lands in Northern California

Abstract

In 1994 the Northwest Forest Plan identified several hundred relatively rare plant and animal species as "Survey and Manage" based in part on their presumed association with late-successional/old-growth forests. Other such species were given protection from grazing. However, broad-scale surveys for few of these species existed at that time. In 1999-2000 we evaluated the relationship of nine terrestrial mollusks to U. S. Forest Service reserves in four National Forests in northern California. The nine mollusks were well distributed among reserved and non-reserved lands and showed no association with Late Successional Reserves, Congressionally Reserved, Administratively Withdrawn, or Matrix land allocations. However, the mollusks occurred more frequently than expected in Riparian Reserves when all other land allocations were combined. Our results are a step toward evaluating the protection that the Northwest Forest Plan affords these mollusks in northern California.

Introduction

Survey and Manage (S&M) species are thought to be rare, or their geographic ranges or habitat associations were not sufficiently known at the time of the Northwest Forest Plan (NWFP) to determine whether reserved lands would adequately protect their populations (USDA/USDI 1994). Furthermore, other species were given protection from grazing under the NWFP; some of these have subsequently been put on the S&M list. In northern California, all or part of six National Forests exist within the range of the northern spotted owl (*Strix occidentalis caurina*), which delineates the boundaries of the NWFP. Within four of these forests (Shasta-Trinity, Klamath, Six Rivers, and Mendocino), nine terrestrial mollusks were selected for study because of their protection under the NWFP. They were selected on the basis of three criteria: (1) the belief that they existed on more than one of the four forests; (2) the requirement to survey them prior to timber harvest or other land-disturbing activities; and (3) the implications of their discovery for local land management planning (e.g., interference with scheduled applications of prescribed fire or fuel reduction activities). The subset of species selected included: the hooded lancetooth (*Ancotrema voyanum*), Oregon shoulderband (*Helminthoglypta herleini*), Klamath shoulderband (*H. talmadgei*), chace sideband (*Monadenia chaceana*), Church's sideband (*M. churchi*), Klamath sideband (*M. fidelis klamathica*), yellow-based sideband (*M. f. ochromphalus*), pappilose tail-dropper (*Prophysaon dubium*), and Tehama chapparal (*Trilobopsis tehamana*). Little published information exists on the habitat relationships or geographic range of any of these species. Roth and Pressley (1986)

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mentioned the range of *M. churchi* along with general habitat associations and Cameron (1986) evaluated associations between mollusks and environmental variation in British Columbia. *Monadenia fidelis* occurred in Cameron's study area, but not the subspecies with which we were concerned.

The NWFP incorporated seven land allocations, five of which we evaluated. Congressionally Reserved Areas (CR) were lands set aside for specific purposes by Congress, such as National Parks, Wilderness Areas, and Wild and Scenic Rivers. The NWFP did not alter any pre-existing mandates on these lands. Late Successional Reserves (LSR) were designated in the NWFP to serve as, or become habitat for, late-successional and old-growth related species. Administratively Withdrawn Areas (AWA) were areas identified in National Forest plans to include visual areas, back country, and other areas not scheduled for timber harvest. Riparian Reserves (RR) were designated to protect aquatic species/habitats, and to connect late-successional habitats. RR occur in every other land allocation within a specified distance of streams (see below). Matrix is all land outside of all other categories, and represents the land in which the majority of timber harvest and silviculture activities occur (USDA/USDI 1994). The two allocations we did not evaluate, Adaptive Management Areas (AMA) and Managed Late Successional Reserves (MLSR), were not conducive to this analysis owing to their overlying other land allocations (AMA) or their small size (MLSR; <1% of the land area).

The degree to which currently reserved lands support long-term persistence of these mollusk species is of considerable interest. For instance, if the majority of the mollusk species are associated with LSR, one might conclude that the existing habitat for such species occurs only in LSR or that these reserves are adequately protecting such species. If the species are found in LSR and Matrix lands, however, we might conclude that the species are broadly distributed and do not need protections they are currently afforded, or that their habitat needs are not provided by LSR and additional habitat protection in Matrix lands may be warranted. For the second interpretation, it could be that rare habitat features required by a species are not primarily found in LSR.

Our project objectives were to 1) evaluate the distribution of these mollusks relative to reserved lands; 2) estimate the geographic range of each species; and 3) attempt to develop empirical models to predict each species' presence-absence throughout the study area. Herein we present our findings for the first objective.

We tested the null hypothesis that one or more of the selected mollusks occurred proportionately among land allocation types against the alternate hypothesis that these mollusks were represented disproportionately in one or more land allocations. We were especially interested in the degree of association of the mollusks to reserved lands relative to non-reserved lands.

Methods

The study area included the Klamath, Mendocino, Shasta-Trinity, and Six Rivers National Forests in northern California (Figure 1). These forests encompass >2.2 million ha of primarily forested habitat. Mollusk surveys were conducted at Forest Inventory and Analysis (FIA) plots during 1999 and 2000. The FIA program is national in scope and is designed to inventory and monitor change in forest composition and structure (White et al. 1992, USDA 2000). FIA plots occur on a grid with 5.4 km between points. Each plot is ~1 ha and contains five 0.1-ha subplots where detailed information on live and dead vegetation is collected (USDA 2000). Mollusks were surveyed at 307 FIA points randomly selected from 1055 plots on the 5.4 km grid available on the four National Forests.

Owing to the paucity of existing information on the selected mollusks, we stratified our sampling by allocating plots proportionate to each National Forest's area so we would not randomly under-sample any forest. Because of a keen interest in the association of the selected species with RR, we ensured that the number of points that occurred in RR was proportionate to the area of RR. This required the addition of four RR plots on the Six Rivers and six RR plots on the Shasta Trinity National Forests. Riparian Reserves were identified using a geographic information system that used USGS cartographic feature files from the US Forest Service Remote Sensing Laboratory in Sacramento, California. Fish-bearing streams were identified by state and federal fisheries biologists in 1995. Fish-bearing streams were buffered 90 m on each side and non-fish bearing streams were buffered 45 m on each side as required by the USDA/USDI (1994).

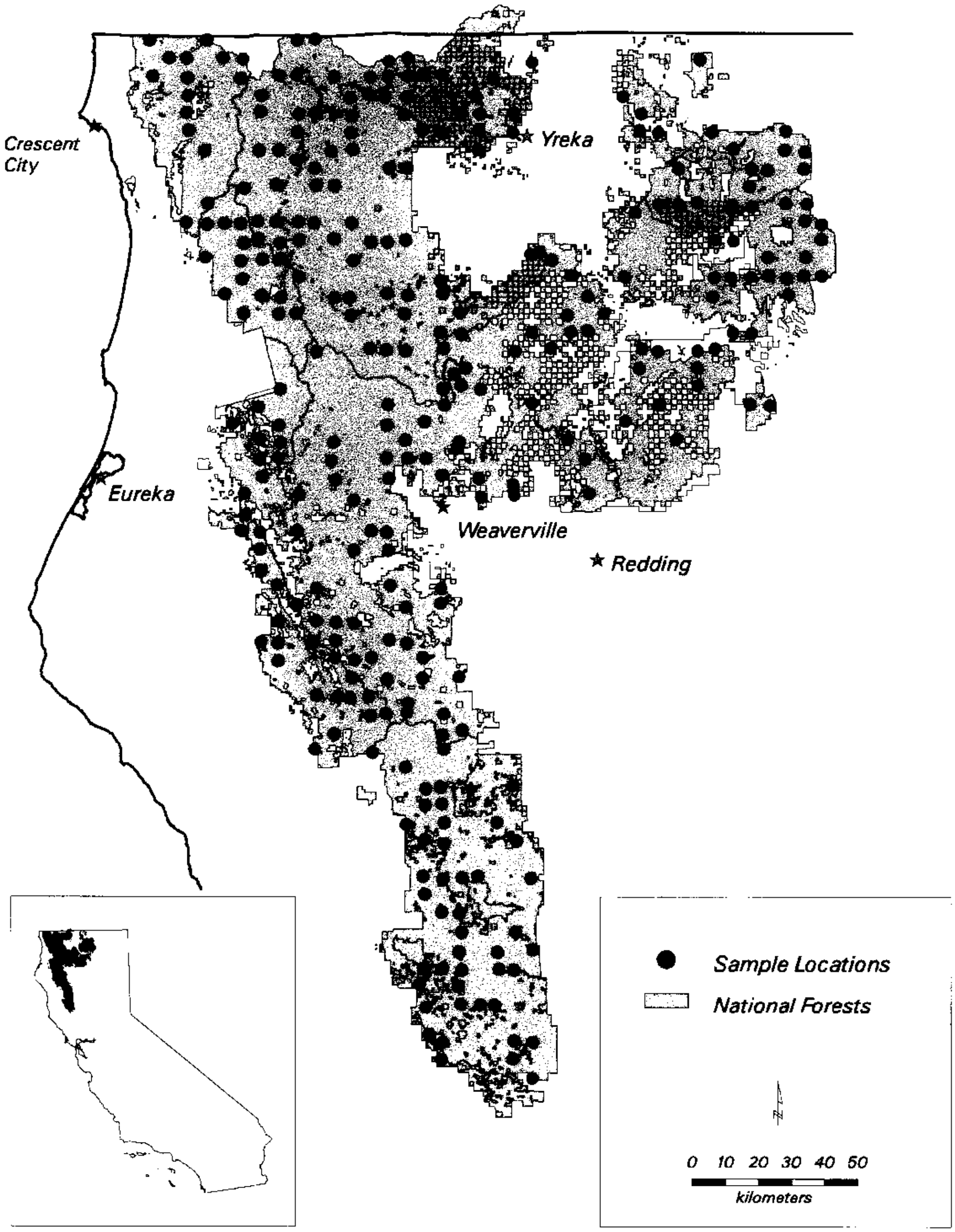

Figure 1. Study area location and distribution of sampling locations.

Mollusks were sampled between March 1999 and September 2000 on the Klamath National Forest, and between 10 April 2000 and 1 July 2000 on the other three National Forests. Each selected FIA point was sampled twice, with a minimum of 10 days between the first and second surveys. Our survey protocol was modified from the protocol currently used for pre-project surveys. We collected many more micro- and macro-habitat variables (for future development of habitat models) than the standard protocol and we also increased the survey effort from one person-hr/4 ha to one person-hr/1 ha.

Surveys were conducted only if the daytime temperature was >5° C and soil was moist as determined by touch. Surveys began with crews walking through the plot and identifying structural features that were likely to provide mollusk habitat (e.g., downed wood), after which two types of focused searches were conducted. Area searches targeted the most likely mollusk habitat by thoroughly inspecting all features and the area likely to conceal them within a radius of 5 m (i.e., 80 m^2) surrounding that feature. One 20-min time-constrained area search was conducted. Point searches were 40-min time-constrained searches, but unlike area searches they were opportunistic searches not constrained to a small area. Surveyors went from one point to another, but were limited to a maximum of 3 min at any one point before moving on to another point. We did not estimate the abundance of each species.

Because of the difficulty of distinguishing species in the field, a single specimen of each putative species (live if available, shell if that was all that was found) was collected from each plot for laboratory identification. Field collected specimens were given to staff experienced in mollusk identification at the Klamath, Mendocino, and Six Rivers National Forests and to one independent contractor, called Second Level Identification staff. If the Second Level Identification staff could not confidently identify a specimen, the specimen was forwarded to Dr. Barry Roth, an expert in mollusk taxonomy, for identification.

We used chi-square tests to evaluate the relationships of mollusk presence to land allocation type. If, as under the null hypothesis, no association between land allocation and the presence of one or more of the mollusks exists, the expected number of detections of mollusks in each land allocation category should be equal to the total number of plots in which mollusks were found multiplied by the proportion of sampled plots within each land allocation category. Recall that the response at each FIA plot is binary (0, 1): either none (0) or one or more (1) of the selected mollusks was found, regardless of the number of species or the number of individuals of each species that were observed. Chi-square tests should not be conducted using the χ^2 distribution approximation when more than 20% of the categories contain expected frequencies ≤5 (Zar 1999). For this reason, and because the detection of any one species at a proposed project area calls for additional review of the management activity, we treated our set of species as a group. However, for descriptive purposes we also provide data for individual species.

Each crew, usually composed of two people, received similar training. Nonetheless, we were interested in evaluating among-crew variation in detecting one or more of the selected species. To do so, we randomly selected 30 plots that would be sampled by a second crew that was unaware of the results of the initial crew. We compared the proportion of plots in which the two different crews arrived at the same conclusion regarding the presence or absence of any of the nine species. We used McNemar's test for paired-sample nominal scale data (Zar 1999) to compare the results of the two initial visits to the same plots by separate crews. The individual species were not of interest in this evaluation, only whether there was agreement in the detection (or lack of detection) of one or more of the selected mollusk species. Our evaluation of the among-crew sampling variation revealed that different crews achieved the same overall proportion of presence (McNemar's χ^2 test statistic = 0.14286—with no continuity correction), but 23% (7) of the 30 test plots differed in the assessment of presence, thus there appears to be no crew bias for the overall proportion of presence.

Results

Of the 307 plots sampled, 153 were in Matrix (49.8%), 76 in LSR (24.8%), 58 in CR (18.9%), 20 in AWA (6.5%). Forty sample plots (13.0%) occurred within RR. One or more of the nine mollusks were found at 113 of the 307 plots (36.8%) (Figure 2). Individual species were detected at

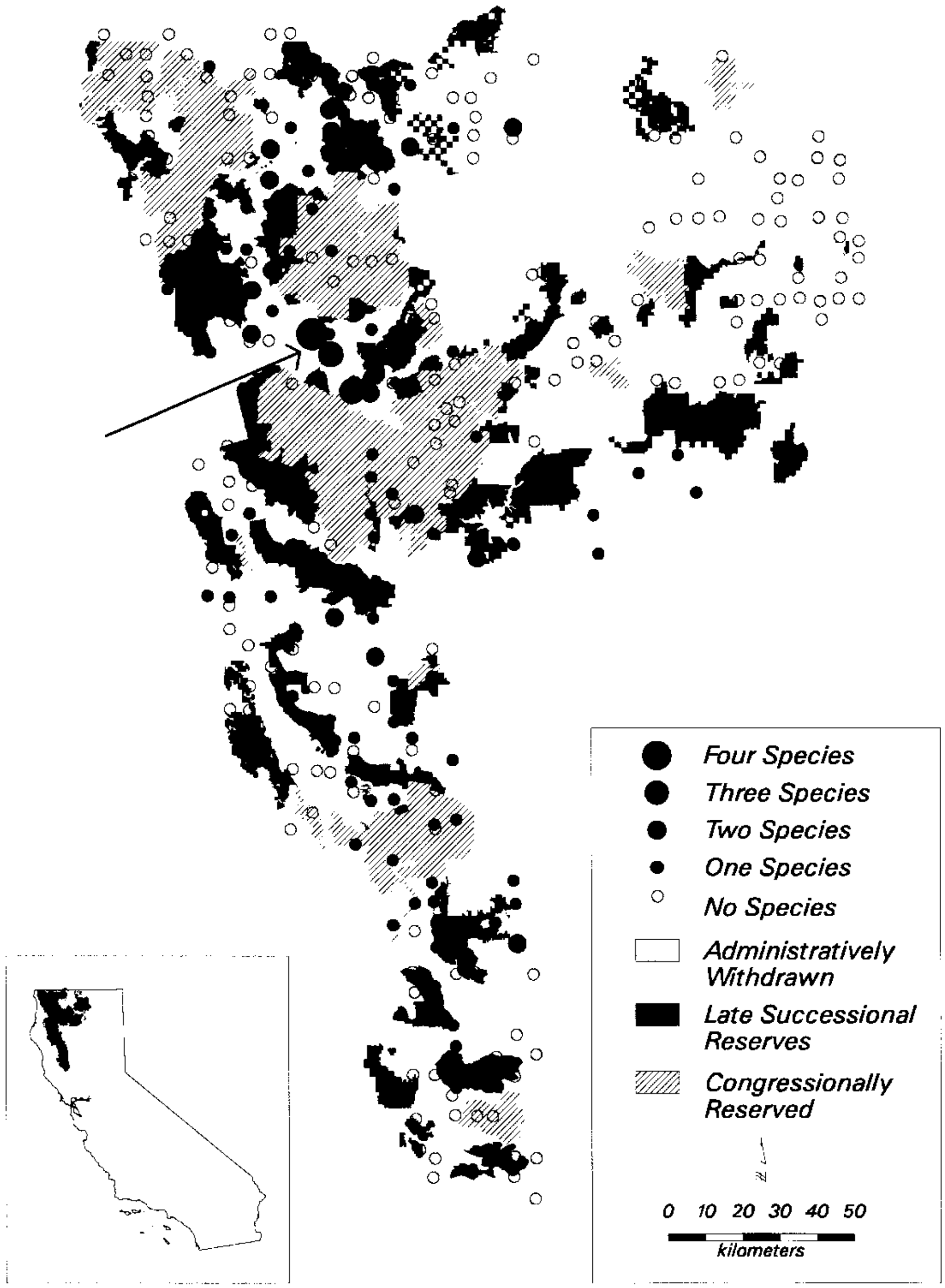

Figure 2. Sampling locations and the presence of the selected mollusk species relative to land allocation status. The arrow points toward the area with high rare mollusk species richness.

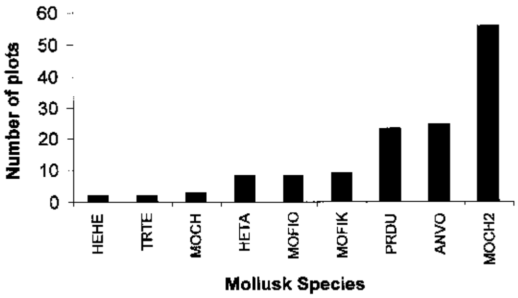

Figure 3. Number of sampling locations at which each of the selected mollusk species was detected. Four letter acronyms refer to the following species: ANVO = *Ancotrema voyanum*, HEHE = *Helminthoglypta herleini*, HETA = *H. talmadgei*, MOCH = *Monadenia chaceana*, MOCH2 = *M. churchii*, MOFIK = *M. fidelis klamathica*, MOFIO = *M.f. ochromphalus*, PRDU = *Prophysaon dubim*, and TRTE = *Trilobopsis tehamana*.

from 2-55 plots (Figure 3, Table 1) and six of the nine species were detected at less than 10 plots.

We failed to reject the hypotheses that the proportion of samples with at least one focal mollusk species detection was equal among the four forests ($\chi^2 = 1.811$), and thus did not further subdivide analyses by forest/strata. When evaluating the association of mollusks with Matrix, LSR, CR, and AWA land allocations, no significant association was found (Table 2, Figure 3). This analysis, however, did not consider RR as a separate land allocation because this allocation is often viewed as an overlay over all other land allocations, effectively superseding other more liberal land use practices that might exist. When we included RR as a separate land allocation, we found

TABLE 1. Detections of individual selected mollusk species by land allocation status. LSR = Late Successional Reserves; CR = Congressionally Reserved; AWA = Administratively Withdrawn Areas.

	Matrix	LSR	CR	AWA	Total
FIA plots sampled	153	76	58	20	307
Proportion of total	0.50	0.25	0.19	0.07	
Ancotrema voyanum					
Number	10	9	3	2	24
Proportion	0.42	0.38	0.13	0.08	
Helminthoglypta herleini					
Number	0	1	0	1	2
Proportion	0.00	0.50	0.00	0.50	
Helminthoglypta talmadgei					
Number	6	0	1	1	8
Proportion	0.75	0.00	0.13	0.13	
Monadenia chaceana					
Number	2	1	0	0	3
Proportion	0.67	0.33	0.00	0.00	
Monadenia churchii					
Number	26	14	11	4	55
Proportion	0.48	0.26	0.20	0.07	
Monadenia fidelis klamathica					
Number	6	3	0	0	9
Proportion	0.67	0.33	0.00	0.00	
Monadenia fidelis ochromphalus					
Number	5	2	0	1	8
Proportion	0.63	0.25	0.00	0.13	
Prophysaon dubium					
Number	12	6	3	2	23
Proportion	0.52	0.26	0.13	0.09	
Trilobopsis tehamana					
Number	2	0	0	0	2
Proportion	1.00	0.00	0.00	0.00	

TABLE 2. Results of χ^2 analysis of associations between mollusks and land allocations. LSR = Late Successional Reserves; CR = Congressionally Reserved; AWA = Administratively Withdrawn Areas; RR = Riparian Reserves.

	Matrix	LSR	CR	AWA	RR	χ^2	*P*
Selected mollusks by four land allocations							
Observed number	54	33	17	9			
Expected number	56.3	28.0	21.3	7.4		2.249	0.522
Distribution of sample locations among five land allocations							
Observed number (307)	139	62	51	15	40		
Observed proportion	0.453	0.202	0.166	0.049	0.130		
Selected mollusks by five land allocations							
Observed number	46	25	12	8	22		
Expected number	51.2	22.8	18.6	5.5	14.7	7.88	0.096

TABLE 3. Results of χ^2 analysis comparing mollusks on Riparian Reserves (RR) and Late Successional Reserves (LSR) against other land allocations.

	RR	LSR	Other	χ^2	P
Riparian Reserves vs. Other land allocations					
Observed number	22		91		
Expected number	14.7		98.3	4.202	0.040
Late Successional Reserves vs. Other land allocations					
Observed number		33	80		
Expected number		28.0	85.5	1.198	0.274

a stronger association between presence of the mollusks and land allocation status (Table 2). We also compared the association of one or more of the mollusk species with RR versus all other land allocations as a group. Mollusks were found at 22 of the 40 RR plots (55%). Under the null hypothesis of no association with RR, the expected number of plots with mollusks in RR was 14.7, which resulted in a significant association with RR (Table 3). We found no association between the presence of one or more of the mollusks in LSR versus other land allocations (Table 3) or when comparing reserved (i.e., LSR, CR, AWA, and RR) versus Matrix lands. Analyses were also conducted excluding *Prophysaon dubium* (detected at 23 plots) because this slug may be a habitat generalist and not need S&M protection (USDA/USDI 2001). However, excluding *P. dubium* did not appreciably alter the results.

Discussion

As a group, the selected mollusks in our study only showed an association with RR. This conclusion should be moderated, however, by the knowledge that one less observation of presence would have yielded a non-significant P-value of 0.076 (using the conventional alpha level of 0.05); and two fewer observations would have yielded a P-value of 0.136. In addition to the purpose of providing protection to aquatic organisms/habitats (USDA/USDI 1994), RR were also envisioned to provide connectivity among habitat patches. We believe that it is premature to draw any conclusions about the need for more or less protection, or about the importance of any habitat feature for this group. This requires species-by-species habitat analyses, which we plan to conduct, before a more complete picture of the distribution and habitat associations of each species will be possible. The general lack of association of the selected species with reserved lands, however, suggests that the conservation of these species will require careful management of Matrix lands. For example, the geographic ranges of *M. f. klamathica* and *M. f. ochromphalus* are extremely small and most of the detections were in Matrix. When appropriate habitats are identified for each species, especially those with small geographic ranges, evaluating distributions of habitat by land allocations will be of great interest. Furthermore, the relative concentration of high species richness of the selected species (Figure 2) occurs primarily in Matrix lands. Until individual species distributions are evaluated relative to their habitat associations and reserve status, we recommend continuing pre-project surveys.

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