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Analysis of the diets of the Northern Spotted Owl and Barred Owl

By: Valeria Briones



Barred Owl (*Strix varia*)

Northern Spotted Owl (*Strix occidentalis caurina*)

Abstract: The purpose of this research paper is to review existing literature on the diets of the Northern Spotted Owl and Barred Owl individually as well as in areas in which they occur sympatrically. By reviewing this literature, the reader can gain an understanding of the characteristics and requirements each owl acquires separately and note similarities between the two. Dietary overlap between the two species in areas in which they occur sympatrically can indicate that there exists food competition between the two. Literature has shown that there is a dietary overlap between the two species ranges anywhere between 28-76% in areas of Washington and Oregon (Weins, 2012, Hamter et al. 1997). Studies show that at times the habitat of each species overlaps more than their diets due to different foraging strategies and habitat partitioning such as selection of terrestrial or arboreal prey varied between both species. Understanding the degree to which the species compete for food can provide scientists with more detail as to how these two species interact and will continue to interact in future years. Because the Northern Spotted Owl is now a federally listed as a threatened species, it is important to understand the role food competition plays in the recent and rapid decline of Northern Spotted Owls throughout their natural range.

INTRODUCTION

The Northern Spotted Owl (*Strix occidentalis caurina*) occurs in the mountains of Marin County in northwestern California north through western Oregon, western Washington, and southwestern British Columbia (Fig. 1). The eastern extent of its range occurs along the eastern periphery of the Cascade Range and the Central Valley in California (Gutiérrez 1996)

They have been detected in forest types such as: Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*) and Shasta red fir (*Abies magnifica*) (Foresman 1976). Studies have shown that northern spotted owl most commonly selects old and mature-growth forests along the Pacific Northwest and select roosts that have more complex vegetation structure. These forests in which the owls select their roosts tend to be multi-

layered with a high canopy closure and large diameter trees. Research has also shown that within these mature old growth forests, Northern Spotted Owls do not build their own nests, but instead rely on tree cavities or broken tree tops, abandoned raptor nests, and accumulated debris to serve as their nesting and roosting sites (Verner et. al. 1992).

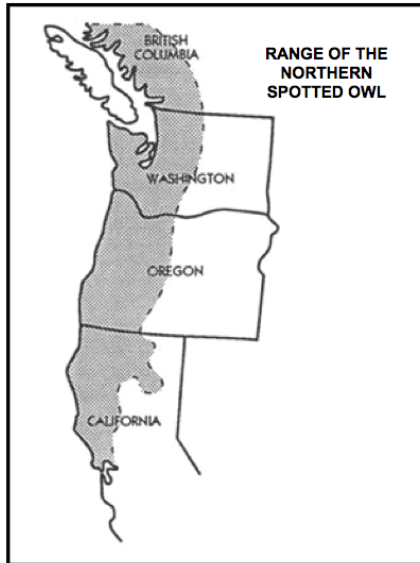


Figure C1—Range of the northern spotted owl.

Figure 1: Range of the Northern Spotted Owl from British Columbia to southernmost end of its range, San Francisco Bay Area (Ward et al. 1990).

Unlike the Northern Spotted Owl, the Barred Owl (*Strix varia*) occupies a much larger range predominantly in the south and northeastern regions of the United States (Fig.2). They are most common in eastern United States west to Texas and their territory ranges from southern Canada down to Mexico. The Barred Owl's preferred habitat is thick mature forest with nearby open land for foraging (Mazur et al. 1996) . They are found in upland woods to lowland swamps usually near creeks, lakes or river valleys. The area generally includes densely foliated trees for daytime roosts, conifers or deciduous trees with year around leaves and are generally found in large blocks of dense, old-growth forests and woodlands near bodies of water or wetland areas, such as wooded swamps; and always near open country for hunting (mt.gov). One of their main habitat requirements are large trees with dense foliage for daytime roosting and cavities for nesting.

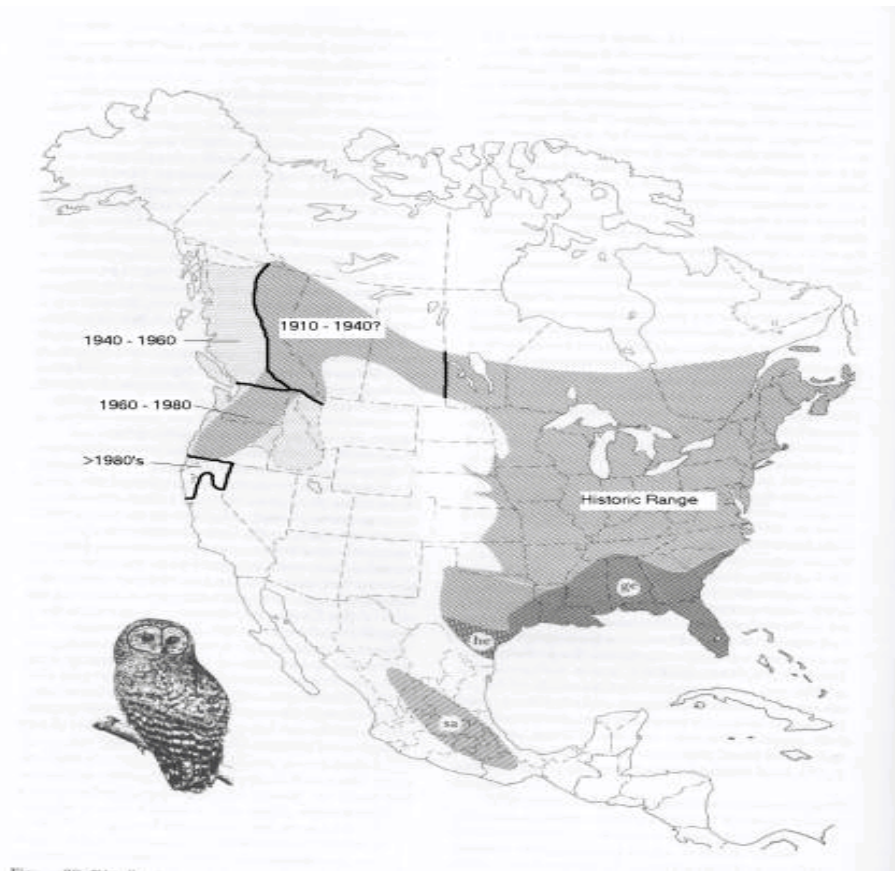


Figure 2: Shows the natural and expanded range of the Barred Owl throughout the United States, including dates (Johnsgaurd, 1988).

The Barred Owl has expanded its range westward within the last 100 years (U.S.F.W.S). Over the last 2 decades this expansion has been more rapid. The Barred Owl and Northern Spotted Owl now occur sympatrically in western Washington, California and Oregon (Fig. 3). The decline in Northern Spotted Owl populations where the two species occur sympatrically has been attributed to the Barred Owl's higher level of aggression, competitiveness and higher reproductive capacity (Van Lanen et. al. 2011). This paper is a review of the literature of the diets of Northern Spotted Owls and Barred Owls and the possible role of food competition on recent decline in Northern Spotted Owl populations throughout its range.

FOOD PREFERENE OF NORTHERN SPOTTED OWL

Northern Spotted Owls use broader landscapes and specialize on larger bodied arboreal prey (Beviset 1997). Spotted owls are known to be "perch and pounce" predators and although most hunting occurs at night they will opportunistically take prey during daylight hours (Gutriérrez 1996). In the wet coastal regions from British Columbia to Oregon the main prey is the Northern Flying Squirrel (*Glaucomys sabrinus*), which tends to be most abundant in old-growth forests. Additional common prey in majority of the areas in which they reside include deer mice (*Peromyscus maniculatus*), wood rats (*Neotoma floridana*), voles, moles and hares. In drier areas, the primary prey shifts from the Northern flying squirrel to the wood rat. The diet of the spotted owl varies regionally, but is generally dominated by the two or three species of the Northern flying squirrel and wood rats in mixed Douglas-fir and dry mixed conifer forests (USFWS 1992).

Canada

While the Northern Spotted owl's range does include Canada, there is insufficient data on their diets within different area. While information on the Northern Spotted Owls diet in Canada may be scarce, there do exist other studies and other sources of information on the owl's habitat populations such as A Framework to Support Landscape Analyses of Habitat Supply and Effects on Populations of Forest-dwelling Species: A Case Study Based on the Northern Spotted Owl (Sutherland et. Al. 2007), In Trouble in Canada- The Northern Spotted Owl (Cooper 2006), Logging to extinction: the last stand of the Spotted Owl in Canada, Vancouver (Sierra Legal Defence Fund, 2002) and others related which tend to focus more on the status and endangerment of the Northern Spotted Owl in various regions. However I was unsuccessful in recovering literature that dealt specifically on the diet of the Northern Spotted Owl therefore was unable to include such data into my report.

Washington

(Forsman et al 2001), studied the diets of northern spotted owls from three areas in Washington: Olympic Peninsula; western Cascades and the eastern Cascades. Northern flying squirrels were the most important prey item in most areas, comprising 29-54% of prey biomass. Other important prey included snowshoe hare, bushy-tailed woodrat, boreal red-backed vole (*Clethrionomys gapperi*), and mice (*Peromyscus maniculatus*, *P. oreas*). Regional variation in Northern Spotted Owl prey species is often due to regional

differences in prey distribution. For example, gophers, which are a common prey item of spotted owl from eastern and western Cascades study areas, are rare in the diet on the



Fig. 3: This figure shows the range expansion of the Barred Owl, and the areas in which both the Barred Owl and Northern Spotted Owl occur sympatrically: Washington, Oregon and California (Monohan, 2007).

Olympic Peninsula. Similarly, wood rats were fairly uncommon from pellet samples taken on the Olympic Peninsula, except in steep, rocky canyons on the east side of the Peninsula. Large crickets and beetles comprised a larger proportion of the spotted owl diet in the eastern Cascades compared to the Olympic Peninsula where they are much less abundant (Forsman et al. 1984). Scientists studied diets of Northern Spotted Owls (*Strix occidentalis aurina*) in three different regions of Washington State during 1983-96. Northern flying squirrels (*Glaucomys sabrinus*) were the most important prey in most areas, comprising 29-54% of prey numbers and 45-59% of prey biomass. Other important prey included snow shoshares (*Lepus americanus*) bushy-tailed woodrats (*Neotomaci- nerea*), boreal red-backed voles (*Clethrionomys sapperi*), and mice (*Peromyscus maniculatus*, *P. aureus*). Non-mammalian prey generally comprised less than 15% of prey numbers and biomass (Foresman et. al. 2001).

Oregon

In a study conducted by Forsman, northern flying squirrels (*Glaucomys sabrinus*) and dusky-footed and bushy-tailed wood rats (*Neuroma forcipes* and *N. cindered*, respectively) are the most common prey of the Northern Spotted Owl throughout its range, constituting the majority of the biomass consumed by owls (man et al. 1984). Red tree voles (*Arborimus longicaudus*) represented as much as 10.3% of the biomass of northern spotted owl diets in Douglas-fir and western hemlock forests of Oregon. In a later study conducted by Foresman, in river valley forests where Douglas-fir was mixed with grand fir (*Abies grandis*) and Oregon white oak (*Quercus garryana*), flying squirrels and wood rats were roughly equally found in the diet, accounting for 29 and 24% of the biomass. Similar studies from over 2 years and roughly 1369 pellets collected (Forsman et al. 1991) revealed that the northern flying squirrel was the primary prey of the Spotted Owl on the western Olympic Peninsula (61% of the biomass) and that bushy-tailed wood rats and flying squirrels were equally represented (39 and 38% of the biomass). In the same study, the pellets of Northern Spotted Owls in the rocky areas on the eastern Peninsula of Oregon were collected and analyzed. Spotted Owl diets on the Olympic Peninsula consisted predominately of flying squirrels; bushy-tailed wood rats were consumed only in a few locales and juvenile snowshoe hares are preyed upon in the spring and early summer (Forsman et al. 1991). Southern red-backed voles and deer mice were present in 20% of owl pellets, but only constituted less than 10% of the biomass consumed by the owls (Forsman et al. 1991). Lagomorphs (snowshoe hares and brush rabbits), occurred in the diet in spring and early summer (Forsman et al. 1984, 1991). Minor prey included the red tree vole, western redbacked vole, and deer mouse. These averaged 10% of the biomass consumed but composed 50% of the prey ingested in particular years (Forsman et al. 1984, 1991).

Older forests provide the highest quality foraging habitats for spotted owls in the western Oregon coast ranges and cascades (Forsman 1984). Composition of Northern Spotted Owl's diet on the western slope of the Cascade Mountains, Blue River and McKenzie Districts all within Oregon between 1987 and 1996 show Northern Flying squirrels consisted of the largest biomass at 48%, followed by Leporids 10.7%, Bushy-tailed wood rat 10.5%, Mazama pocket gopher 7.3%, Western red-backed vole 5.5%, Red tree vole 3.7%, Deer mouse 1.6%, Douglas squirrel 1.1% and the Coast mole

1.2%(Forsman 2001). This study found that Flying squirrels, bushy-tailed wood rats, and dusky-footed wood rats (*Neotoma fuscipes*) were primary prey in mixed-conifer forests. In a later study by Forsman, 2004, the local, regional, and annual variation in diets of northern Spotted Owls in Oregon were studied based on 24497 prey collected at 1118 owl territories between 1970-2003. The sample included 91.5% mammals, 4.3% birds, 4.1% insects, and 0.1% other prey. The diet included 2131 species, including 49 mammals, 41 birds, 3 reptiles, 1 frog, 1 crayfish, 1 scorpion, 2 snails, and 33 species of insects. Diets varied among owl territories, geographic regions, and years; but were generally dominated by four to six species of nocturnal mammals (Forsman et. al. 2004).

In two forest types within Southwestern Oregon, 47 Northern Spotted Owls were closely monitored over 12 months to study both their roosting/ nesting sites, and their prey selection. Results showed that the most common prey in Oregon was the northern flying squirrel and in areas where the flying squirrel was the primary prey and where predation was intense, flying squirrel populations were depressed. The abundance of smaller mammals such as wood rats, seemed to reduce the amount of old forest used for foraging by the Northern Spotted Owls (Carey et. al. 1992).

California

In California Northern Spotted Owls occur in hardwood, coniferous, and coniferous-hardwood forests. Occupied coniferous habitats include mixed conifer, California red fir, and eastside pine forests, which are comprised of ponderosa pine and/or Jeffrey pine. Redwood/California bay, live oak-big cone Douglas-fir and hardwood-mixed coniferous forests (Meyer 2007). They also occur in hardwood habitats including riparian and oak woodlands. The Northern Spotted Owl relies heavily upon predation on forest dwellers throughout California (Barrows 1980). Data collected within California reveals that Northern Spotted Owls rarely hunt in open meadows, however on the occasion that they do, their primary prey is the meadow mouse (*Microtus californicus*). Northern Spotted Owls prefer to hunt within a closed canopy or forested area where the dusky-footed wood rat, red tree vole, California flying squirrel and deer mouse made up the largest percentage of prey found in owl pellets collected in Peninsula Mountain Ranges of California in 1980. The second largest prey consumption in owl

pellets was arthropods followed by other forest-dwelling mammals and other smaller songbirds. In a similar study conducted by Barrows he found Northern Spotted Owls occupying mixed conifer or mixed evergreen forests in North Western California during spring and summer months commonly consume several species of small mammals. These species include the dusky-footed wood rat, red tree vole, northern flying squirrel, terrestrial voles and white-footed mice. Together, these species comprise 88% to 99% of prey biomass in the owl's diet (Barrows 1987, White 1996).

In a different study, 23 Spotted Owl pellets were collected and analyzed. Pellet contents included: 1 mole, 1 shrew, 1 little California bat, 1 hoary bat, 11 flying squirrels, 2 deer mice, 1 Screech Owl, 1 Saw-whet Owl, 1 Stellar Jay, 1 Red-breasted Nuthatch, 1 Evening Grosbeak, 1 June beetle (Marshall 1942).

In 2002 the diet of the Northern Spotted Owl was studied within the Sierra National Forest in California. 620 pellets were collected in coniferous forests and the remains of 1,344 individual prey were collected with an average of 2.12 prey items per pellet. Excluding insects, pellets averaged 1.48 prey items each. At least 35 species (13 mammals, 11 birds, 10 insects, and 1 lizard) were present. Mammals comprised 57.8% of all prey and 87.2% of the biomass; the remainder consisted of birds, lizards, and insects. Large prey such as flying squirrels (*Glaucomys sabrinus*), woodrats (*Neotoma* spp.), pocket gophers (*Thomomys* spp.), Steller's jays (*Cyanocitta stelleri*), northern flickers (*Colaptes auratus*), a western screech-owl (*Otus kennicottii*), an unidentified quail, and some unidentified mammals accounted for 36.5 %of the individual prey items and 78.3% of the biomass (Munton et. al 2002). In the same study by Munton, the diets of Northern Spotted Owls were collected only in Oak Woodland Habitat. 520 pellets were collected and large prey accounted for 48.5% of the total by frequency and 91.8% by biomass. Species included were wood rats, pocket gophers, western screech-owls, and unidentified mammals and owls. Woodrats appeared to be a consistent dietary component, making up 74.3% of prey biomass during the breeding period and 81.9% during the nonbreeding period. Pocket gophers comprised only 12.9% of the prey biomass over the full year. Other mammal species, each contributing less than 5% of the total biomass, included mice, voles, broad-footed moles, and shrews. Western scrub jays were also the most numerous birds identified, followed by other species of owls (Munton et. al. 2002).

Marin County

According to the National Park Service Northern Spotted owls occupy evergreen forests, old growth and second growth redwood, douglas fir, bishop pine, and mixed hardwood forests within Marin County, California. The healthy population of owls found in Marin County indicates that the parks protect complex and diverse plant life within their boundaries. Based on studies done on Northern Spotted Owl pellets residing within Marin County, it has been found that the majority of their diet included dusky footed wood rat, bush rabbit, deer mice, California vole, pocket gopher and a smaller portion included Virginia opossum, songbirds, shrews, moles, weasels, rats, bats, snakes and insects. What this large diversity in their diets within Marin County shows, is the fact that there is a healthy diversity of habitat available for this population. Another study done by Jenson et al. (2005) shows that the dusky footed wood rat made up 49% of the spotted owls diet and deer mice constituted 32% of their diet in Marin County in 2005. This study confirmed that prey items made up roughly 79-94% of the owls entire biomass diet within Marin County.

During the 2005 breeding season, Northern Spotted Owl pellets were collected from the area of Point Reyes in Marin County. The pellets contained a total of 69 prey of which were made up by 49% dusky-footed woodrat, and 32% deer mouse, 12% Norway rat, 6% California vole and 1% Stellar Jay (Jensen, Adams, Merkle 2005).

FOOD PREFERENCE OF BARRED OWL

Canada

In Alberta Canada the barred owl is associated with old mixed wood forest stands. It selects old mixed wood stands because preferred nesting sites are often most abundant in these habitats. Barred owls nest most often in tree cavities formed by fallen branches and broken tops of balsam poplar and aspen trees. Occurrence of barred owls near wetlands and riparian areas can be explained by abundance of old poplar stands in these areas and, therefore, suitable nesting sites for barred owls.

In some areas in British Columbia Barred Owls are now so abundant they outnumber Spotted Owls (Hamer 1988, Dunbar et al. 1991). Owls in Nova Scotia have been observed sorting through leaf litter with their beaks to prey on earthworms

Washington

Barred Owls in Washington have been observed to forage through grass to find slugs (Livezey et al. 2008). Few animals in the Pacific Northwest prey on slugs, but it has been observed that the Barred Owl is one of the few species that incorporates slugs into their diet. In many studies looking into the diets of owls through pellet dissection, it is often difficult if not impossible to detect soft bodied prey remains in the pellets of the owls. In a study done by Livezey in 2002, he gathered roughly 7077 individual prey items from pellets and concluded that the pellets contained 74.7% mammals, 8.3% birds, 6.4% amphibians, 5.6% insects and spiders, 3% crayfish, 1.5% fish and less than 1% reptiles, snails, slugs and earthworms.

Oregon

The Barred Owl unlike the Northern Spotted Owl, is a much more opportunistic feeder, with a much broader prey selection. In a study done along the coastal range of Western Oregon, scientists R.G Anthony and D. Foresman collected samples from 28 Barred Owls prey on nocturnal rodents such as the flying squirrel, wood rats, mice as well as anything from beetles to snails and fish. Although it could be a possibility that Northern Spotted owls occasionally forage on prey such as these, but it would occur much less frequently in comparison to the Barred Owl. The diets of barred owls include a broad range of terrestrial, aquatic and diurnal prey species, which are either absent or rare in diets of the Northern Spotted Owl. In other studies done within Oregon prey species found in the pellets of Barred Owls also consisted of flying squirrels, lagomorphs, moles, Douglas squirrels, and wood rats. Other prey species such as birds, frogs, salamanders, lizards, snakes, crayfish, snails, fish, millipedes and insects were also found amongst Barred Owls, but making up a smaller total prey biomass of their pellets.

From 2007-2009 in western Corvallis, Oregon mammals, birds, reptiles, gastropods, and three types of arthropods were identified primarily to the species level. Excluding crayfish the owls diets comprised 64.8% mammals, 2.9% birds, 1.0% reptiles, 9.8% amphibians, .3% fish, 6.6% gastropods, .2% diplopods, less than 1%

collembolans, and 14.4% insects. Mammals predominated and contributed the most biomass in the three periods of the breeding season of the Owl. Flying squirrels were the most frequently captured during egg-laying and nestling periods while coast moles, shrews and beetles were the most consumed during post-fledgling period (Graham 2012).

Marin County

Although there is currently no sufficient evidence or data on the diet of the Barred Owl species within Marin County, CA there is in fact information on their status and distribution throughout the County. Barred Owls have been observed at Muir Woods every year since the county's first record there in 2002, and they have been observed yearly since 2004 in the southern Olema Valley. Barred Owls were detected near Point Reyes Station in 2003, 2005, and yearly from 2008 to 2010, and in Mill Valley in 2009 and 2010. They have also been detected at several other locations across the southern and western parts of the county though never in consecutive years (Jennings et al. 2011).

DIETARY OVERLAP BETWEEN NORTHERN SPOTTED OWLS AND BARRED OWLS

In western Oregon, diets of both species were dominated by nocturnal mammals, but diets of barred owls included many terrestrial, aquatic, and diurnal prey species that were rare or absent in diets of spotted owls. Northern flying squirrels, wood rats, and lagomorphs were particularly important prey for both owl species, accounting for 81% and 49% of total dietary biomass for spotted owls and barred owls, respectively. Dietary overlap between pairs of spotted and barred owls in adjacent territories ranged from 28–70% (Fig. 4). Both predators were found to have broadly overlapping home ranges and displayed similar patterns of habitat selection within their shared areas. Spotted owls specialized on arboreal mammals whereas barred owls foraged opportunistically across a broad range of prey sizes and types and both predators relied on a similar set of high-biomass prey species such as the flying squirrel, wood rats lagomorphs, tree voles and deer mice. The data showed was that there was a larger overlap between their habitats in

comparison to their diets (Fig. 5). Both of their selected habitats overlapped by 81% while their diets overlapped by 42% (Weins 2012). This diet overlap was also found to shift according to the seasons and tended to increase in fall and winter months and decrease during spring and summer months. Although their diets did overlap significantly, the percent shared wasn't as large possibly due to the different foraging strategies and habitat partitioning such as selection of terrestrial or arboreal prey varied between both species. In a study done from 1986-1989 the home ranges and habitats of the Northern Spotted Owl and Barred Owl were studied in an area in which they occurred sympatrically, the northern Cascade Ranges of Washington. From this study it was found that the diets of the two owls overlapped by about 76%, but overall the diet of the Barred Owl was broader and more evenly distributed in comparison to the Northern Spotted Owl (Hamer 2007).

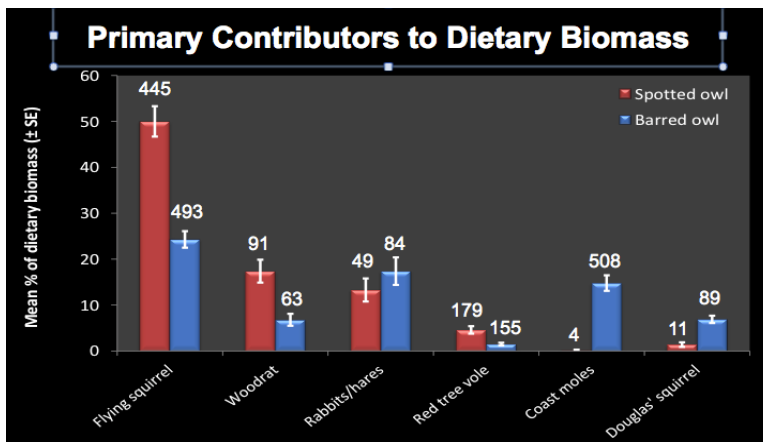


Fig. 4: The dietary overlap between the Northern Spotted Owl and Barred Owl in Western Oregon (Weins,2012).

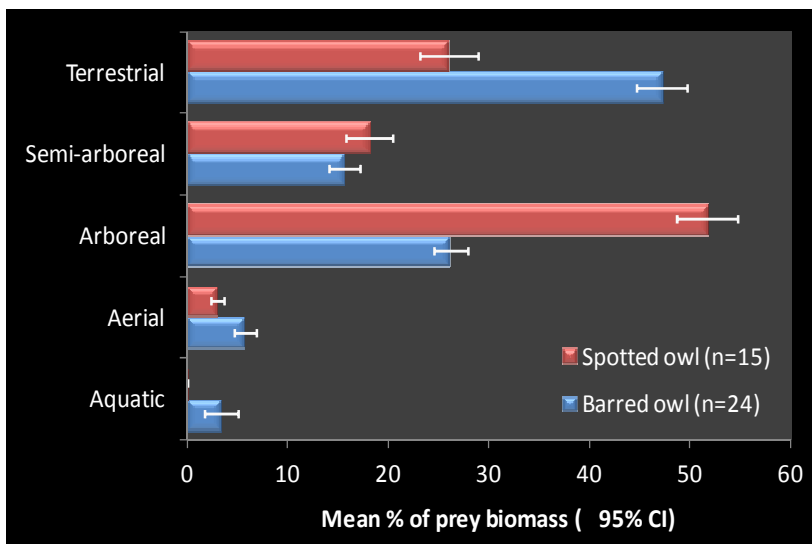


Fig. 5: Shows the Diet Composition between the Northern Spotted Owl and Barred Owl by Prey Activity Zone (Weins, 2012).

FOOD COMPETITION BETWEEN SPECIES

Range expansion of the barred owl has resulted in overlap with the northern spotted owl, as these species have similar habitat requirements and both forage primarily on nocturnal prey (Taylor and Forsman 1976). Interspecific competition and hybridization (Hamer et al. 1994) are jeopardizing spotted owl populations (Kelly et al. 2003). As the Barred Owls continue to displace Northern Spotted Owls in many areas within the Pacific Northwest, it is important to understand the role food competition between the two species has contributed to the decline of the Northern Spotted Owls. Our results indicated that Northern Spotted Owls preyed on a fairly broad range of prey, but primarily focused on a few species of mammals. In contrast, the Barred Owl was more of a generalist, preying on a broader range of species at lower frequencies. This finding agrees with previous studies in which diets of Northern Spotted Owls were generally dominated by a few types of arboreal or semi arboreal forest mammals (Barrows 1980, Forsman et al. 1984, 2001, Ward 1990), where as diets of Barred Owls typically include a diverse mixture of prey (Bent 1938, Hodges 1947, Smith 1952, Sweeny 1959, Korschgen and Stuart 1972, Rhodes 1974).

Interspecific competition between the two owl species over the years could explain the impacts on the Northern Spotted Owl populations along the Western United States. Analyses have shown that the Northern Spotted Owl populations have declined by 20-50% in areas in which Barred Owls are most prevalent and abundant and have been present for an extended period of time (Anthony et al. 2006). Several interactions between Northern Spotted Owls and Barred Owls have resulted in Spotted Owls leaving the area temporarily and/or even permanently (Hamer et al. 1998). These potentially negative interactions between the two species along with loss of suitable habitat for the Northern Spotted Owl have only added to the concern of the Barred Owl's recent and continuing range expansion.

The focus of this paper is to assess and analyze the diets of both owls individually in areas in which they can both be found as well as analyzing their diets in areas in which they occur sympatrically. Through analyzing this data, one can get a better understanding of the effects food competition could have potentially had in the decline in population size of the Northern Spotted Owl over recent years.

The dietary overlap of the two owls may also vary depending on the time of year. For example, Northern Spotted Owls and Barred Owls home ranges tend to both increase during the winter months, therefore their dietary overlap might increase as their home ranges increase. However the home range of the Barred owl on average tends to be smaller than that of the Northern Spotted Owl.

Because Marin County has the densest population of northern spotted owls in the country and Muir Woods represents the southernmost edge of its range, scientists are particularly worried about the impact of the barred owl (Jennings et al. 2011).

DISCUSSION

The goal of this paper was to compare the diets of both the Northern Spotted Owls and Barred Owls individually as well as sympatrically with information gathered from other scientists and researchers and other scientific sources. In doing so, one is able to gain a better understanding of the current issue, which deals with the rapid decline of the Northern Spotted Owl. By reviewing the literature and noting the similar diets and habitat size and use of each owl, it is evident that the competition for food between both species has played and continues to play a major role in the continuing decline of the Northern Spotted Owl species. The objective was to determine the potential for and consequences of competition for space, habitat, and food between these owl species. The study confirms that barred owls not only use similar forest types and prey species as spotted owls, but also that a high density of barred owls can reduce the amount of those resources available to Northern Spotted Owls.

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