Veiled Polypore (*Cryptoporus volvatus*) as a Foraging Substrate for the White-Headed Woodpecker (*Picoides albolarvatus*)

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GENERAL NOTES

VEILED POLYPORE (*CRYPTOPORUS VOLVATUS*) AS A FORAGING SUBSTRATE FOR THE WHITE-HEADED WOODPECKER (*PICOIDES ALBOLARVATUS*)

David M Watson and David Shaw

Abstract—In the northwest, White-headed Woodpeckers (*Picoides albolarvatus*) are an uncommon species restricted to interior, dry coniferous forests. This species forages primarily by probing in bark crevices, surface gleaning, and excavating below the bark. Here we report on an observation from Mt. Ashland in southern Oregon of a White-headed Woodpecker feeding on insects in and around the sporophores of Veiled Polypore (*Cryptoporus volvatus*). Inspection of other sporophores with signs of woodpecker feeding revealed abundant fly larvae and beetles (adults and larvae). This widespread decay fungus colonizes the sapwood of recently dead trees where it is frequently associated with bark beetles. A suite of other insects is attracted to the sporophore, many using the enclosed pouch as a pupation chamber. In addition to exploring the significance of *C. volvatus* as a foraging substrate for White-headed Woodpeckers, we discuss the potential role of White-headed Woodpeckers as dispersal agents for *C. volvatus* and the possible interplay between *C. volvatus*-induced decay, insect availability, and habitat selection by White-headed Woodpeckers.

Key words: Ashland, bark beetle, *Cryptoporus volvatus*, decay, habitat selection, Oregon, *Picoides albolarvatus*, Veiled Polypore, White-headed Woodpecker

White-headed Woodpeckers (*Picoides albolarvatus*) are an uncommon resident of the montane coniferous forests of the western United States and southern British Columbia. In addition to their restricted range, this species depends on forests dominated by Ponderosa Pine (*Pinus ponderosa*) and is variously listed as endangered (Canada), of conservation concern (USA), and imperiled and vulnerable to extirpation (Washington and Oregon; Mellen-McLean and others 2013). Previous research on this species has focused on habitat preferences and nesting ecology (Lorenz and others 2015). In addition to excavating into trees (alive or dead) for prey (Kozma and Kroll 2013; Lorenz and others 2016), White-headed Woodpeckers exhibit a high foraging versatility; flaking bark and gleaning from trunks, probing needle clusters, prying insects from crevices in bark, sap sucking, and extracting seed from cones of conifers (Lorenz and others 2016). Here, we describe observations of a White-headed Woodpecker foraging for insects found within the sporophores (fruiting bodies) of the Veiled Polypore, or Pouch Fungus (*Cyptoporus volvatus* [Peck] Shear [Basidiomycete: Polyporaceae]), a sapwood decay fungus of conifers in the North Temperate regions of the world (Gilbertson and Ryvarden 1987).

On 22 July 2016, DMW observed a White-headed Woodpecker (adult male by plumage) at 15:50 beside the Pacific Crest Trail on the southern slope of Mt. Ashland in southern Oregon (42.07389 N; 122.71056W; 1940 m elevation). For a period of approximately 15 min, DMW observed the bird with 10X binoculars from a distance of 8 to 10 m as it foraged on the trunk of a dead Red Fir (*Abies magnifica*). The bird repeatedly pecked around the brown sporophores of *C. volvatus*, working up and down the north side of the tree, moving from sporophore to sporophore (Fig. 1 A, B). The bird foraged primarily around the sporophore margins, pecking at the fruiting body itself and the surrounding bark. Afterwards, closer inspection revealed that it was making 12 to 18 mm holes on the lower surface of the sporophores (Fig. 1C).

On 23 July 2016, DMW observed White-headed Woodpeckers (adult males, females, and 1 immature bird) on 5 more occasions in stands of Red Fir, White Fir (*Abies concolor*), and Port Orford Cedar (*Chamaecyparis lawsoniana)* on the southern slope of Mt. Ashland. Inspection of standing dead trees revealed more pecked *C. volvatus* sporophores on a recently dead White Fir (Fig. 1D), with many older (white and brittle) sporophores found beneath the tree, all with obvious peck marks and holes of comparable dimensions.

Then on 24 July 2016 at approximately 2200m elevation, we located more *C. volvatus* sporophores (on White fir and Red Fir) that had been

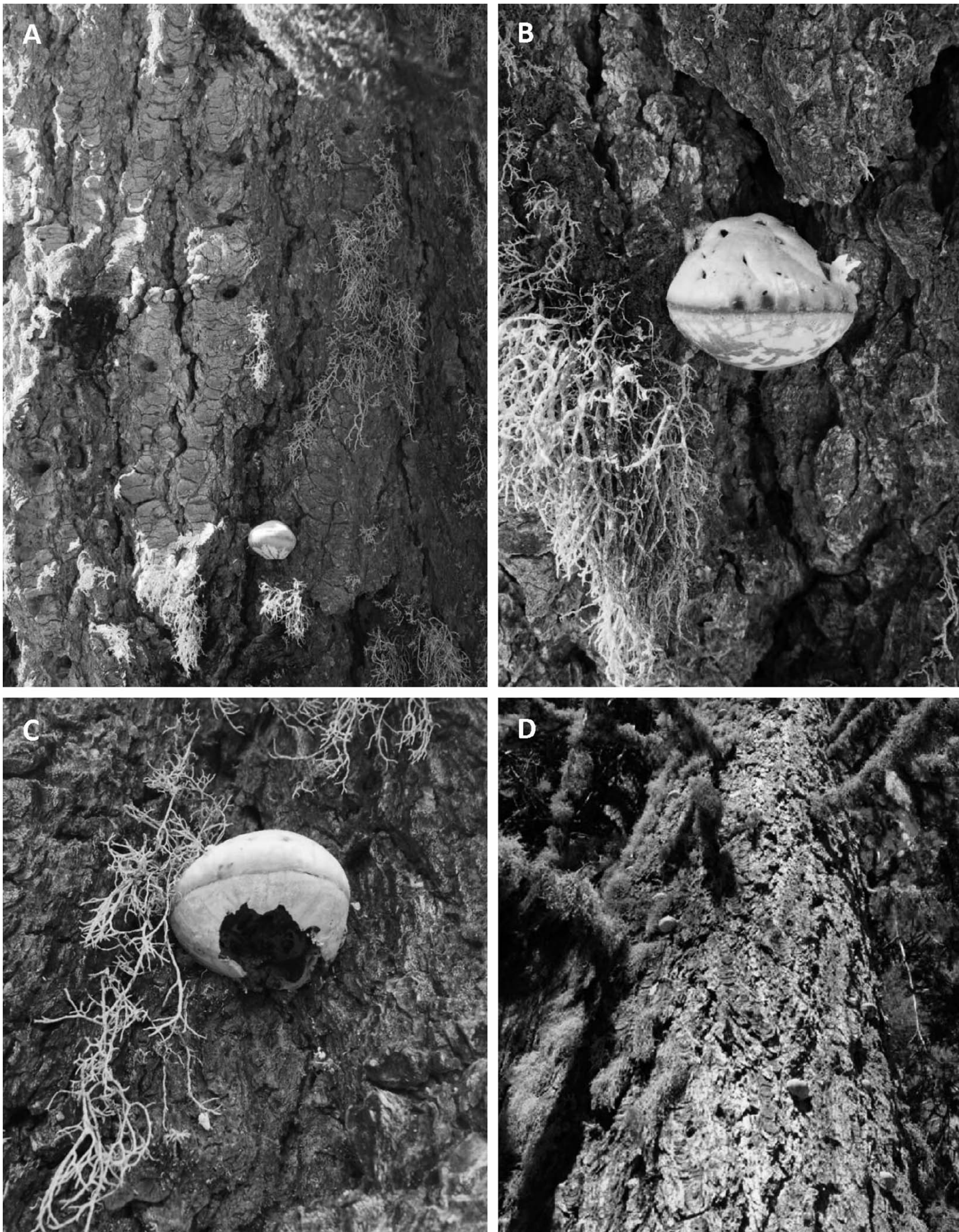

FIGURE 1. (A) The trunk of a Red Fir (*Abies magnifica*) where a White-headed Woodpecker (*Picoides albolarvatus*) was observed pecking around the fruiting bodies of Veiled Polypore (*Cryptoporus volvatus*; Polyporaceae). Note the series of holes and freshly-exposed bark above the polypore; (B) Closer view of one of the Veiled Polypore fruiting bodies; note small holes on the upper surface. This fruiting body was one of several collected, from which small fungus beetles (*Plesiocis cribrum*; Ciidae) emerged; (C) Another fruiting body on the same tree with a large hole on the lower surface, made by a White-headed Woodpecker presumably searching for insects; and (D) Recently dead White Fir (*Abies concolor*) at higher elevation on southern slope of Mt. Ashland with freshly-exposed bark and signs of woodpecker foraging on Veiled Polypore fruiting bodies.

pecked on the upper as well as lower surfaces. We dissected these sporophores and found larvae (approximately 8 mm) of beetles and flies boring within the sporophores, as well as abundant frass from previous occupants that had pupated. Adult beetles (6 to 9 mm) and exuvia were found in the chamber and subcortical area of the sporophore. We also placed fresh sporophores removed from multiple *Abies* spp. into a rearing box from which multiple individuals of a fungus eating beetle, *Plesiocis cribrum* Csy. (Coleoptera: Ciidae; identified by Bill Gerth, Oregon State University Plant Clinic # E17-84), later emerged. These are small fungus beetles known to associate with *C. volvatus* (Borden and McClaren 1972).

Although 5 other woodpecker species (Northern Flicker [*Colaptes auratus*], Hairy Woodpecker [*Picoides villosus*], Williamson's Sapsucker [*Sphyrapicus thyroideus*], Lewis's Woodpecker [*Melanerpes lewis*], and Pileated Woodpecker [*Dryocopus pileatus*]) were observed nearby, we consider it most likely that White-headed Woodpeckers caused the feeding sign; a behavior which has not previously been described. On no occasions did we observe any other woodpecker species feeding on or around *C. volvatus* sporophores and White-headed Woodpeckers were seen or heard at 2 of the 3 separate locations where pecked sporophores were found. Of the other woodpeckers we observed, the Hairy Woodpecker is the most likely to also forage on *C. volvatus* sporophores because it forages on recently dead trees for bark beetles containing *C. volvatus* sporophores, and it has a large dietary overlap with White-headed Woodpeckers during the breeding season (Kozma and Kroll 2013).

In addition to evaluating the significance of *C. volvatus* as a foraging substrate for White-headed Woodpeckers, we also explored the potential role of White-headed woodpeckers as dispersal agents for *C. volvatus* and the possible interplay between *C. volvatus*-induced decay and habitat selection by White-headed Woodpeckers (and woodpeckers in general). *Cryptoporus volvatus* sporophores often grow on recently dead trees in the year following beetle colonization, emerging from the entrance holes created by insects (Waldron 1969; Borden and others 1969). Sporophores typically emerge in early spring and mature in late spring or early summer. The fungus causes a white rot of the sapwood, which Gilbertson and Ryvarden (1987) describe as "superficial" within the 1st year, thought to be readily replaced by succeeding wood-decay fungi. Trees in the genera *Pinus*, *Abies*, and *Pseudotsuga* are the most common hosts. Unlike other polypores, *C. volvatus* is unique in that the pore surface is covered by a veil, creating an enclosed chamber (or pouch) beneath the pore surface. During maturation, an ostiole develops at the base of the veil. Spore dispersal is thought to be associated with insects attracted to the sporophore, which then enter through the ostiole (Borden and McClaren 1970), although airborne dispersal through the pore is also possible (Gilbertson and Ryvarden 1987).

We are unaware of any published observations of birds foraging on this widespread fungus, but the abundant insects we found associated with the sporophore is consistent with previous work. Borden and McClaren (1972) found that in each region studied, over 70% of sporophores investigated had insects or evidence of insect activity, with peak insect activity occurring during and after maturation in June. The predominant insects they found included 3 beetle species: *Plesiocis cribrum*, *Platydema neglectum* Trip. (Coleoptera: Tenebrionidae), and *Aphenolia monogama* Crotch (Coleoptera: Nitidulidae). In addition, they found other Coleoptera and insects in the orders Lepidoptera, Diptera, Hymenoptera, Homoptera, Hemiptera, Neuroptera, and Collembola as well as spiders, mites, and pseudoscorpions. Setsuda (1995) also reported on 5 species of beetles associated with *C. volvatus* sporophores in Japan: 4 were fungus feeding beetles that were specific to *C. volvatus* and 1 was a predator. These insects are found as adults and larvae in the chamber of the sporophore, mining the sporophore and the subcortical area near the sporophore. Waldron (1969) found bark beetles and *P. cribrum*, associated with *C. volvatus* in Ponderosa Pine. Waldron (1969) concluded that *Ips pini* Say (Coleptera: Curculionidae) in *Pinus* spp., *Scolytus ventralis* LeConte (Coleoptera: Curculionidae: Scolytinae) in *Abies* spp., and *P. cribrum* in all tree species, were the primary vectors of *C. volvatus*. Beetles in the families Nitidulidae and Tenebrionidae have also been documented to feed inside *C. volvatus* sporophores on spores and fungal tissues (Gillogly and Gillogly 1954; Borden and others 1969). Borden and McClaren (1970, 1972), documenting the close association with subcortical insects, found that over 25 insect species were associated with *C. volvatus*, and proposed that the fungus was primarily dispersed by the insect predator of subcortical insects and bark beetles, *Temnochila virescens* Mann. (Coleoptera: Ostomidae). This predator was frequently found in the chamber of *C. volvatus* where it apparently feeds on insects and becomes covered with sticky spores. Adults likely vector the spores when they move to newly attacked trees and lay eggs at beetle gallery entrance holes because their larvae were never found in sporophores. Castello and others (1976) also showed that *Dendroctonus pseudotsugae* Hopkins (Coleoptera: Curculionidae: Scolytinae) is a vector of *C. volvatus*, likely from vegetative material transported passively by the beetles. The close association of this fungus with insects makes it a potential food resource for insectivorous birds, especially woodpeckers that forage on standing dead trees. Because the rot induced by *C. volvatus* is restricted to the sapwood, it may play a role in promoting wood boring insects such as flat-headed wood borers (Coleoptera: Buprestidae), round-headed wood borers (Coleoptera: Cerambycidae), and other under-bark inhabiting insects (Borden and McClaren 1970, 1972), which provide further food resources for bark-foraging birds.

When foraging for insects in and around mature sporophores, White-headed woodpeckers likely dislodge spores, facilitating dispersal and potentially effecting directed dispersal to uninfected trees and stands. Woodpeckers have long been presumed to act as dispersal agents for fungi (Warner and French 1970; Cockle and others 2012), with recent research demonstrating a close relationship between occurrence of decay fungi and woodpecker nest site selection (Zahner and others 2012; Jusino and others 2015). Experimental research on Red-cockaded Woodpeckers (*Picoides borealis*) (Jusino and others 2016) has demonstrated a mechanistic link between woodpecker nest excavations and colonization and establishment of decay fungi. By swabbing woodpeckers and inoculating trees with samples retrieved, Jusino and others (2016) recreated the fungal communities associated with Red-cockaded Woodpecker nest cavities, including *Porodaedalea pini* sensu lato, a fungus associated with "pine red heart disease" that characteristically infects trees selected for nesting sites.

Our observations suggest that dispersing fungal spores may be more widespread among woodpeckers, raising the possibility that White-headed Woodpeckers facilitate establishment of *C. volvatus*. Rather than affecting nest-site availability, pouch fungus accelerates sapwood decay of recently dead trees and may enhance availability of saproxylic insect prey within occupied territories. This may be especially important for Ponderosa Pine which has characteristically thick sapwood. Although the lack of previous records of this foraging substrate suggests this behavior is uncommon (Lorenz and others 2016), occasional instances may influence the distribution of *C. volvatus*. In addition to intensifying prevalence of pouch fungi within infected stands, White-headed Woodpeckers may disperse spores to uninfected stands, thereby promoting decay and increasing habitat suitability for saproxylic insects and the species dependent on them.

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