PETITION TO LIST

Franklin's Bumble Bee
***Bombus franklini* (Frison), 1921**

AS AN ENDANGERED SPECIES
UNDER THE U.S. ENDANGERED SPECIES ACT

Photo of *Bombus franklini* by Pete Schroeder

Submitted by

The Xerces Society for Invertebrate Conservation and Dr. Robbin W. Thorp

Prepared by Dr. Robbin Thorp, Sarina Jepsen, Sarah Foltz Jordan,
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June 23, 2010

Ken Salazar
Secretary of the Interior
Office of the Secretary
Department of the Interior
18th and C Street N.W.
Washington D.C., 20240

Dear Mr. Salazar:

The Xerces Society for Invertebrate Conservation and Dr. Robbin Thorp hereby formally petition to list the Franklin's Bumble Bee (*Bombus franklini*) as endangered under the Endangered Species Act, 16 U.S.C. 1531 *et seq.* This petition is filed under 5 U.S.C. 553(e) and 50 CFR 424.14 (1990), which grants interested parties the right to petition for issue of a rule from the Secretary of the Interior. Petitioners also request that critical habitat be designated concurrent with the listing, as required by 16 U.S.C. § 1533(b)(6)(C) and 50 C.F.R. § 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. § 553).

The Franklin's bumble bee (*Bombus franklini*) has a very limited geographic range and it is under significant and immediate threat. Based on almost a decade of cooperative surveys which were funded by the USDA Forest Service and the USDI Fish and Wildlife Service, and USDI Bureau of Land Management, we believe that the worldwide population may be limited to only a few nests. For these reasons, as further elaborated below, we also appeal for an emergency listing pursuant to 16 U.S.C. § 1533(b)(7) and 50 CFR 424.20 in order to ensure the species' survival. While the species is emergency listed, the U.S. Fish and Wildlife Service should finalize a standard listing rule for Franklin's bumble bee.

We are aware that this petition sets in motion a specific process placing definite response requirements on the U.S. Fish and Wildlife Service and very specific time constraints upon those responses. 16 U.S.C. § 1533(b). We will therefore expect a finding by the Service within 90 days, as to whether our petition contains substantial information to warrant a full status review.

Sincerely,

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I. EXECUTIVE SUMMARY

Franklin's bumble bee (*Bombus franklini*) is in imminent danger of extinction. Extensive surveys from 1998-2009 have demonstrated that there has been a precipitous decline in the number of individuals and localities in the past decade. In 1998, 94 individuals were found at eight sites. In the past four years, only one individual has been observed in surveys.

Threats to Franklin's bumble bee are detailed below and include: 1) Exotic diseases introduced from commercial bumble bees used for greenhouse pollination of tomatoes and field pollination of a variety of crops; 2) Habitat loss due to destruction, degradation, and conversion; 3) Pesticides and pollution; 4) Inadequacy of current rules, regulations and law; and 5) Exotic plant species introduction, increased human use of native habitat, climate change affecting alpine habitat, and alteration of wildfire severity and intensity.

There are currently no regulations or laws that protect Franklin's bumble bee or its habitat. The lack of protection, multiple threats, small number of extant populations, and natural instability of small populations lead us to conclude, unequivocally, that Franklin's bumble bee is immediately threatened with worldwide extinction and must be given protection under the Endangered Species Act.

II. CANDIDATE BACKGROUND, STATUS, AND LISTING HISTORY

Until 1996, the U.S. Fish and Wildlife Service classed *B. franklini* as a "Category 2" Candidate Species which indicates that listing may be warranted, but not enough information was known to federally list the species. This status was based on the recognition of the narrow endemism of the species and the lack of knowledge on the specific biological characteristics, habitat requirements, potential threats to its existence, and other critical parameters that affect the persistence and viability of its populations.

B. franklini is currently considered to be a "Species of Concern" by the U.S. Fish and Wildlife Service (USFWS 2009). "Species of Concern" is defined as "taxa whose conservation status is of concern to the U.S. Fish and Wildlife Service (many previously known as Category 2 candidates), but for which further information is still needed. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing" (ODFW 2010). *B. franklini* is also included on the California Department of Fish and Game special animals list (CDFA 2009) and is listed as an Oregon Sensitive Species by the USDA Forest Service and USDI Bureau of Land Management (Forest Service/BLM 2010). The species has a NatureServe Global Status rank of G1 (Critically Imperiled), an Oregon state status rank of S1 (Critically Imperiled) and a California state status rank of SNR (not ranked) (NatureServe 2010). It is listed as critically endangered on the IUCN Red List (IUCN 2009) and critically imperiled on the *Red List of Pollinator Insects of North America*, produced by the Xerces Society for Invertebrate Conservation (Thorp 2005c).

Franklin's bumble bee has no legal protection under the U.S. Endangered Species Act and neither Oregon nor California allows listing of insects under their respective state endangered species statutes.

III. TAXONOMIC STATUS

Bombus franklini (Frison), 1921.

B. franklini is a valid species and its taxonomic status is uncontested. In 1971, Milliron questioned the taxonomic status of *Bombus franklini* as a valid species. Without presenting any evidence for his taxonomic decision, Milliron (1971) placed *B. franklini* in synonymy under *B. occidentalis* (Greene 1858) and then placed *B. occidentalis* in synonymy as a subspecies of the northern and eastern *B. terricola* (Kirby 1837) on the basis of presumed overlapping color variation. This question has been addressed through studies of morphometrics by Plowright and Stephen (1980), the lack of intergradation (color/morphological) in areas of sympatry with *B. occidentalis* by Thorp *et al.* (1983), structure of the male genitalia by Williams (1991), and genetics (allozymes) by Scholl *et al.* (1992) and Cameron *et al*. (2007). All five studies between 1980 and 2007 concluded that *B. franklini* was indeed a valid species and distinct from *B. occidentalis*. *Bombus franklini* is currently recognized as a valid species in the most recent world list of bumble bee species (Williams 1998).

The original description by Frison (1921) was based on two queens sent to him by a commercial collector, E. J. Oslar and labeled by Oslar as having been collected at Nogales, Arizona in July 1917. Subsequently, Frison (1923) found additional specimens in the collections of the U.S. National Museum from "Oregon" (without more specific locality data) collected by C. F. Baker which he designated as a worker "Morphotype" and a male "Allotype." In 1926, Frison published additional records of one worker each from Roseburg and Gold Hill, Oregon, collected by H. A. Scullen. The same two records were published by Scullen (1927). Subsequently, evidence was marshaled by Thorp (1970) to dispute the putative Arizona records of *B. franklini* and to propose Gold Hill, Jackson County, Oregon the realistic type locality. Evidence included finding specimens of many other west coast bumble bee species labeled by Oslar as having been collected in southern Arizona about the same time, but representing a great disjunction for each of the species. Field studies by R. W. Thorp also failed to turn up *B. franklini* or any of the other dozen species of bumble bees also labeled by Oslar as having been collected in southern Arizona. This is supported by evidence presented on species of *Andrena* by LaBerge (1980, 1986) and the lack of specimens from the area in major bee collections (J. Ascher, personal communication).

IV. SPECIES DESCRIPTION

Bombus franklini is readily distinguished from other bumble bees in its range by the extended yellow on the anterior thorax which extends well beyond the wing bases and forms an inverted U-shape around the central patch of black, lack of yellow on the abdomen, predominantly black face with yellow on top of the head, and white at the tip of the abdomen. Other bumble bees with similar color patterns in the range of *B. franklini* have the yellow extending back to the wing bases or only slightly beyond and usually have one or more bands of yellow on the middle or slightly behind the middle of the abdomen (most on T-4). Females of most species have yellow hair on the face, in contrast to black on *B. franklini*. Females of *B. occidentalis* and *B. californicus* that have black hair on the face also have black hair on the vertex in contrast to the yellow hair on the vertex in *B. franklini*. Females of *B. californicus* have a long face in contrast to the round face of *B. franklini* and *B. occidentalis*.

Queens & workers

Face round with area between bottom of compound eye and base of mandible (= malar space) shorter than wide; hair predominantly black with some shorter light hairs intermixed above and below antennal bases. Hair on top of head (= vertex) yellow. Hair of thorax (= mesosoma) on anterior two-thirds above (= scutum) yellow extending rearward laterally inside and beyond the wing bases (= tegulae) to rear third (= scutellum), but interrupted medioposteriorly by inverted U-shaped patch of black; hair on posterior third above (= scutellum) black; hair of thorax laterally (= mesopleura) black, except for small patch of yellow in upper anterior corner in area of pronotal lobes. Hair of abdomen (= metasoma) black except for whitish or silvery hair at sides and apex of 5th plate above (= tergum 5, = T-5).

Female *B. franklini*. Illustration by Elaine Evans, The Xerces Society.

Males

As for female, except malar space as long as wide, face below antennae with predominantly yellow hair, and T-6 with some pale hair laterally.

Keys to and illustrations of color patterns of *B. franklini* and species that might be confused with it are presented in Thorp *et al*. (1983).

V. POPULATION DISTRIBUTION AND STATUS

See Appendix 1 for a complete table of records of *B. franklini*.

Historic Distribution

Franklin's bumble bee has the most limited geographic distribution of any bumble bee in North America and possibly the world (Williams 1998, see Figure 1). *B. franklni* is known only from southern Oregon and northern California between the Coast and Sierra-Cascade Ranges. Stephen (1957) recorded it from the Umpqua and Rogue River Valleys of Oregon. Thorp *et al*. (1983) also recorded it from northern California and suggested its restriction to the Klamath Mountain region of southern Oregon and northern

California. Its entire distribution, including recent range extensions (Thorp 1999, 2001, 2004) can be covered by an oval of about 190 miles north to south and 70 miles east to west between 122^{o} to 124^{o} west longitude and 40^{o} 58' to 43^{o} 30' north latitude. It is known from Douglas, Jackson, and Josephine counties in Oregon and Siskiyou and Trinity counties in California. Elevations of localities where it has been found range from 540 feet (162 m) in the north to above 7,800 feet (2,340 m) in the south of its historic range. Although the number of populations that existed prior to 1998 is unknown, there are several historic records for this species, both published and in museums, including two in 1925 (Gold Hill and Roseburg, OR), one in 1930 (Roseburg, OR), two in 1950 (Gold Hill and Medford, OR), two in 1958 (Ashland, OR), two in 1968 (Mt. Ashland and near Copper, OR), one in 1980 (Ashland, OR), two in 1988 (Ashland and Merlin, OR), two in 1989 (Hilt and Yreka, CA), four in 1990 (Ashland, Ruch, Central Point, and Gold Hill, OR), one in 1992 (Ashland, OR), two in 1997 (Roxy Ann Peak near Medford and Ashland Pond in Ashland, OR), and four in 1998 (Roca Canyon in Ashland, Lost Creek Reservoir, and Grizzly Peak near Shale City, OR). Additional records with unknown dates and or localities are also available, including the 1917 type specimen whose locality (Nogales, AZ) has been determined to be erroneous.

Present Distribution and Conservation Status

Over the last decade, the number of populations and number of individuals has declined drastically. Evidence for this decline is based on intensive and extensive surveys, primarily by R. W. Thorp (Thorp 1999, 2001, 2004, 2005a, b, 2008) from 1998 through 2009. Surveys for the Bureau of Land Management were also conducted in 2005 (Code and Haney 2006). During each of the past nine years, R.W. Thorp surveyed from nine to seventeen historic sites (average 13.8 sites) per year. Dr. Thorp also surveyed from six to nineteen additional sites (average 12.8 sites) each year, some of which were visited more than once per year and some of which were visited in multiple years (Table 1).

Between 1998 and 2005, the number of sightings of *Bombus franklini* declined precipitously from ninety-four individuals in 1998 to twenty in 1999, nine in 2000 and one in 2001 (Figure 1). Although twenty were found in 2002, only three were sighted in 2003, all at a single locality (Table 1). None were found in 2004 and 2005. A single worker of *B. franklini* was sighted in 2006 at Mt. Ashland, which is the same locality where *B. franklini* were found in 2003 (Table 1). None were found in 2007, 2008 or 2009. During the past four years, Dr. Thorp's visits have focused on sites where *B. franklini* has been observed most recently. However, Thorp continued to survey other historic and potential sites (Table 1).

In 2006, the Bureau of Land Management conducted a survey of sixteen sites that contained optimal habitat for *B. franklini*. Each site was searched twice by trained technicians (Code and Haney 2006). No *B. franklini* were found during this search effort.

Figure 1. Map of the distribution of Franklin's bumble bee. The yellow star indicates the location on Mt. Ashland where the single *B. franklini* worker was observed in 2006.

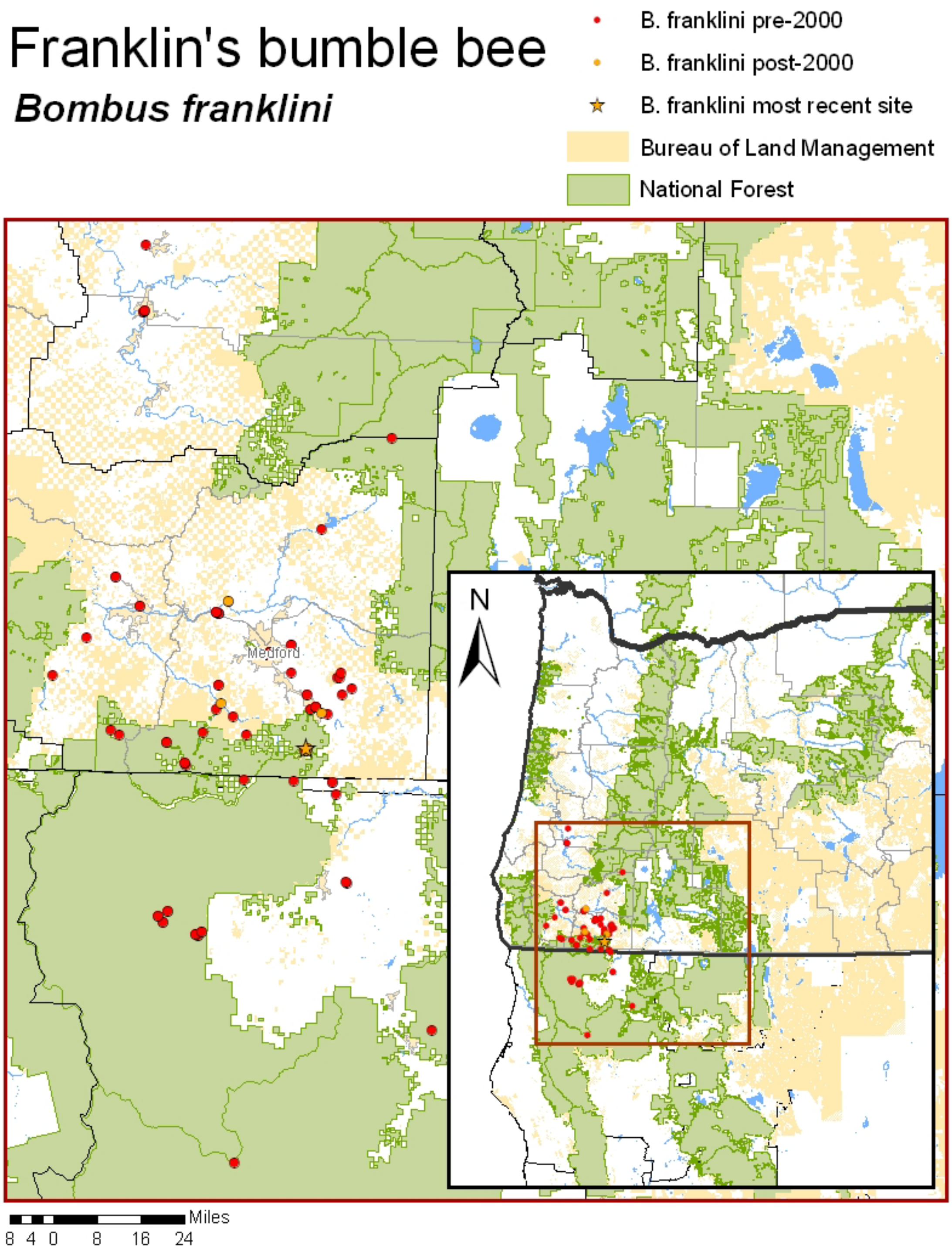
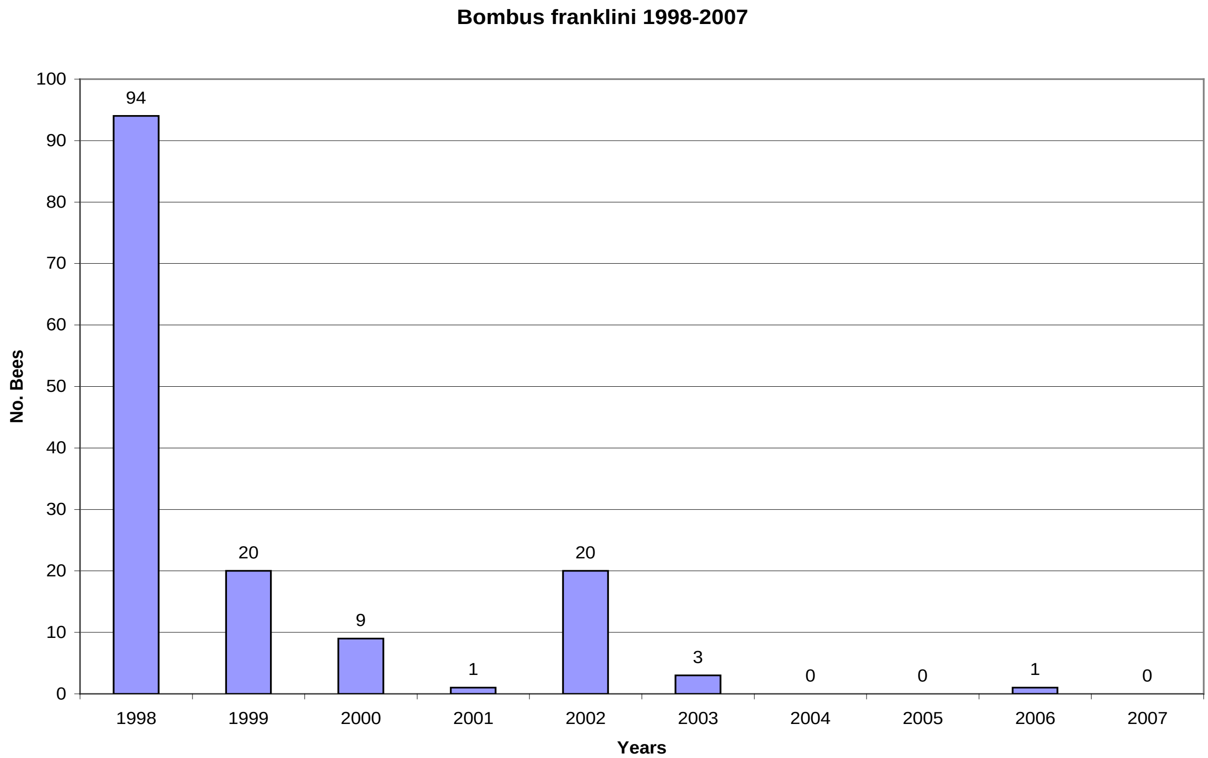


Table 1. Historic and new* localities surveyed for *Bombus franklini* and numbers of *B. franklini* observed from 1998 through 2007 (Thorp 2008). Bolded entries denote that *B. franklini* was observed. Surveys were conducted by Dr. Thorp during 2008 and 2009, but no *B. franklini* were encountered.

			# times visited / # *B. franklini* found									
		Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Site	**ST**	**CO**										
Sutherlin, W of	OR	Douglas	**1/1***	1/0	1/0	2/0	1/0		2/0	3/0		1/0
Ashland	OR	Jackson			1/0	2/0	**3/1**		4/0	7/0	5/0	2/0
Ashland, ENE (3)	OR	Jackson	1/0	1/0	1/0	2/0	5/0	1/0			1/0	1/0
Buncom, E of	OR	Jackson		**1/1***	3/0	1/0	1/0					
Gold Hill, E of	OR	Jackson	**4/44***	2/0	**7/5**	7/0	3/0	4/0	2/0	4/0	2/0	2/0
Grizzly Peak	OR	Jackson	2/0	2/0	1/0	2/0	2/0	2/0	2/0	3/0	1/0	2/0
Jackson Campground	OR	Jackson	**2/2***	2/0	1/0		1/0			1/0		
Kenney Meadows	OR	Jackson	**2/3***	2/0	2/0	2/0	1/0	1/0		1/0		
Lost Creek Reservoir	OR	Jackson		1/0		1/0			1/0	1/0		
Medford	OR	Jackson			3/0	3/0		1/0	1/0			
Mt. Ashland (2)	OR	Jackson	**3/37**	**6/19**	**7/2**	**5/1**	**10/19**	**9/3**	13/0	11/0	**8/1**	7/0
Phoenix, E of	OR	Jackson			1/0	2/0						
Ruch	OR	Jackson	**3/3**	2/0	**2/1**	1/0	2/0		2/0			
Ruch, S of (2)	OR	Jackson	1/0	2/0			1/0	2/0	2/0	1/0		
Ruch, SSE of	OR	Jackson		2/0	**3/1***	2/0	1/0	2/0		1/0		
Union Creek	OR	Jackson		1/0								
Selma, S of	OR	Josephine	**1/2***	1/0	1/0							
Wonder, W of	OR	Josephine			1/0							
Mt. Shasta	CA	Siskiyou	1/0	1/0	1/0		1/0			1/0	2/0	1/0
Hilt	CA	Siskiyou	**2/2**	3/0	3/0	1/0	2/0	1/0	1/0	2/0	2/0	1/0
Montague	CA	Siskiyou		1/0					1/0		1/0	
Total *B. franklini* seen			94	20	9	1	20	3	0	0	1	0
New sites for *franklini*			5	1	1	0	0	0	0	0	0	0
B. franklini site visits			22	32	41	33	36	20	31	36	22	17
Other sites visited			19	23	14	7	6	8	9	19	14	2

Figure 2. Number of *Bombus franklini* observed in surveys from 1998-2007 (Thorp 2008). Surveys were also conducted by Dr. Thorp in 2008 and 2009, but no *B. franklini* were found.



VI. BIOLOGY, HABITAT REQUIREMENTS AND POLLINATION ECOLOGY

Biology

Bombus franklini is a primitively eusocial bumble bee. As with all other bumble bees, they live in colonies consisting of a queen and her offspring, the workers and males. There is a division of labor among these three types of bees. Queens are responsible for initiating colonies and laying eggs. Workers are responsible for most food collection, colony defense, and feeding of the young. Males' sole function is to mate with queens. Bumble bee colonies depend on floral resources for their nutritional needs. Nectar provides them with carbohydrates and pollen provides them with protein.

The nesting biology of *B. franklini* is unknown, but it probably nests in abandoned rodent burrows as is typical for other members of the subgenus *Bombus* sensu stricto (Hobbs 1968). Colonies are annual, starting from colony initiation by solitary queens in the spring, to production of workers, and finally to production of queens and males. Queens produced at the end of the colony cycle mate before entering diapause, a form of hibernation. *B. franklini* queens emerge in spring and begin their search for appropriate nesting sites. The queen collects nectar and pollen from flowers to support the production of her eggs, which are fertilized by sperm she has stored since mating the previous fall. In the early stages of colony development, the queen is responsible for all food collection and care of the young. As the colony grows, workers take over the duties of food collection, colony defense, and care of the young. The queen then remains within the nest and spends most of her time laying eggs. Colonies typically consist of between 50 and 400 workers at their peak (Plath 1927, Thorp *et al.* 1983, Macfarlane *et al.* 1994) along with the queen. During later stages of colony development, new queens will be produced as well as males. Queen production is dependent on access to sufficient quantities of pollen. The amount of pollen available to bumble bee colonies directly affects the number of queens that can be produced (Burns 2004). Since queens are the only bumble bees capable of forming new colonies, pollen availability directly impacts future bumble bee population levels.

The flight season of *B. franklini* is from mid-May to the end of September (Thorp *et al*. 1983).

Habitat requirements

B. franklini require habitat with a rich supply of floral resources that bloom continuously from spring to autumn. Landscape level habitat quality has been shown to influence bumble bee species richness and abundance, indicating that isolated patches of habitat are not sufficient to fully support bumble bee populations (Hatfield and LeBuhn 2007, Öckinger and Smith 2007). Since *B. franklini* nest primarily underground in abandoned rodent burrows, nesting sites may be limited by the abundance of rodents.

Pollination Ecology

Bumble bees play the vital role of pollinators as they transfer pollen between native flowering plants when they are foraging. Bumble bees are generalist foragers, meaning that they do not depend on any one flower type. However, some plants do rely on bumble bees to achieve pollination. The loss of bumble bees can have far ranging ecological impacts due to their role as pollinators. An examination of the theoretical effect of removal of specialist and generalist pollinators on the extinction of plant species concluded that the loss of generalist pollinators poses the greatest threat to pollinator networks (Memmott *et al.* 2004). In Britain and the Netherlands, where multiple bumble bee species, as well as other bees, have gone extinct, there is evidence of decline in the abundance of insect pollinated plants (Biesmeijer *et al.* 2006).

Bumble bees are generalist foragers, meaning that they gather pollen and nectar from a wide variety of flowering plants. Since bumble bee colonies obtain all of their nutrition from pollen and nectar, they need a constant supply of flowers in bloom. Not all flowers are of equal value to bumble bees. Many varietal hybrids do not produce as much pollen and/or nectar as their wild counterparts (Frankie *et al*. 2005). *B. franklini* have been observed collecting pollen from lupine (*Lupinus* spp.) and California poppy (*Eschscholzia californica*), and collecting nectar from horsemint or nettle-leaf giant hyssop (*Agastache urticifolia*) and mountain monardella (*Monardella odoratissima*) (R. Thorp personal observation). They may collect both pollen and nectar from vetch (*Vicia* spp.) as well as rob nectar from it (P. Schroeder personal communication).

VII. CURRENT AND POTENTIAL THREATS – SUMMARY OF FACTORS FOR CONSIDERATION

The U.S. Fish and Wildlife Service utilizes, per § 4(a)(1) of Endangered Species Act (1973 *et seq*., 16 U.S.C. 1531 *et seq*), a five factor analysis of threats to list and delist species. Species may be designated as endangered or threatened *"because of any of the following factors: A) the present or threatened destruction, modification, or curtailment of its habitat or range; B) overutilization for commercial, recreational, scientific, or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; E) other natural or manmade factors affecting its continued existence."* While the primary threat to *B. franklini* is *C) disease or predation*, the authors contend that *B. franklini* is threatened with extinction by all five factors and should be given protection under the U.S. Endangered Species Act.

A) The present or threatened destruction, modification, or curtailment of its habitat or range

Bumble bee populations are subject to threat by many kinds of habitat alterations which may destroy, fragment, degrade, or reduce their food supplies (flowers that produce the nectar and pollen they require), nest sites (e.g. abandoned rodent burrows), and hibernation sites for over-wintering mated queens (e.g. undisturbed ground). Fragmentation of bumble bee populations can result in problems including inbreeding depression (Darvill *et al.* 2006, Ellis *et al.* 2006) and an increased risk of extinction due to demographic stochasticity. Threats that have altered the habitat of *B. franklini* include agricultural intensification, water impoundments, livestock grazing, urban development, fragmentation of landscapes, natural and introduced fire, and invasive species. These threats are even more significant when the range of an animal, such as *B. franklini*, has been reduced to just a few locations. In this case, habitat loss or degradation at any one site has a more pronounced impact on the extinction potential of the species.

<u>Agricultural intensification</u>

Increases in farm size and operating efficiency have led to loss of pollinator friendly hedge rows, weed cover, and legume pastures through more modern practices including more effective land leveling, irrigation, tilling, and pesticide and fertilizer usage. Agricultural intensification has been shown to have a negative impact on species richness, abundance and diversity of wild bees (Le Féon *et al.* 2010). Tilling may directly destroy bumble bee overwintering sites.

One site within *B. franklini*'s historic range near Gold Hill in Jackson County, OR had significant excavation and deposited soil that altered approximately 50% of the bumble bee foraging habitat by 15 June 2004. Hines and Hendrix (2005) found that bumble bee diversity in Iowa prairies was linked to floral abundance and the presence of grasslands in the surrounding landscape. Both floral abundance and grasslands are frequently reduced in agriculturally intensive landscapes. In Ireland, England, and central Europe, agricultural intensification is deemed responsible for recent declines of bumble bee species (Williams 1986, Carvell *et al.* 2006, Diekotter *et al.* 2006, Fitzpatrick *et al*. 2007, Kosior *et al.* 2007, Goulson *et al.* 2008). The decline of bumble bees in Illinois was found to coincide with a period of major agricultural intensification in the Midwest, indicating that agricultural intensification may have led to the local extirpation and decline of Illinois bumble bees (Grixti *et al*. 2009).

Water impoundments

Sites where *B. frankilini* was historically found in Jackson County, OR (Copper and 2 mi N of Copper) were inundated by Lake Applegate following the completion of Applegate Dam in the fall of 1980. Historic records exist for *B. franklini* from 1963 and 1968 at these sites (see Appendix I).

Livestock grazing

BLM and Forest Service lands historically occupied by *B. franklini* are periodically subject to substantial livestock impact. Livestock grazing may adversely impact bumble bee populations by (1) depleting bumble bee food sources (Carvell 2002, Hatfield & LeBuhn 2007, Kruess & Tscharntke 2002a, 2002b, Morris 1967, Sugden 1985, Vazquez & Simberloff 2003), (2) trampling of above ground nesting sites (Sugden 1985), and (3) negatively impacting nesting rodents which in turn reduces the number of nest sites available for bumble bees (Johnson & Horn 2008, Schmidt *et al.* 2009). Although livestock grazing has differing impacts on flora and fauna based on the type, habitat, intensity, timing and length of livestock grazing (Gibson *et al*. 1992) several studies of livestock grazing on bees suggest increased intensity of livestock grazing negatively affects the species richness of bees (Carvell 2002, Hatfield & LeBuhn 2007, Morris 1967, Sugden 1985, Vazquez & Simberloff 2003).

Urban development

While urban gardens and parks may provide habitat for some pollinators including bumble bees (Frankie *et al*. 2005, McFrederick & LeBuhn 2006), they tend not to support the species richness of bumble bees that can be found in nearby wild landscapes (R. Thorp personal observation) or that was present historically (McFrederick & LeBuhn 2006). There is indication that human built structures such as roads and railroads fragment plant populations and restrict bumble bee movement (Bhattacharya *et al.* 2003). However, *B. franklini* has been found in urban areas of Ashland, and nests of a close relative, *B. occidentalis*, have been found in urban San Francisco (R. Thorp personal observation).

Habitat fragmentation

Agricultural intensification, livestock grazing, urban development, as well as other factors, can lead to the fragmentation of bumble bee habitat into pieces that are too small or too distant to support diverse bumble bee communities (Goulson *et al.* 2008). Habitat fragmentation has been shown to reduce bumble bee foraging rates and alter their foraging patterns (Rusterholz and Baur 2010). Fragmented habitats may not support healthy metapopulation structures and may eliminate or decrease source populations of bumble bees for recolonization (National Research Council 2007).

Natural and introduced fire

Fire is an important natural and managed disturbance throughout natural areas in the United States. Due to decades of fire suppression and the growing proximity of housing developments to wildlands, suppression of wildfire is seen as necessary to protect natural resources, homes, and businesses. Fire suppression can lead to extensive changes in forest and grassland structure. In forests, these changes include an increase in combustible fuel loads, increase in tree density, increase in fire intolerant species, and loss of the herbaceous layer as the shrub community matures (Huntzinger 2003). In forested meadows fire suppression can lead to invasion and maturation of shrubs and trees and an increase in invasive plants species. Eventually continued succession results in the degradation and loss of the grasslands (Panzer 2002, Schultz & Crone 1998).

Due to the important role of fire in many native ecosystems, controlled burning is an increasingly common management tool. While the effects of fire on vegetation and vertebrate communities are more clearly understood than its effects on invertebrates, it is known that whether fire benefits, harms, or has no significant effect on invertebrates depends greatly on the biology of the specific taxa (Gibson *et al*. 1992).

Current site fuel loads, including invasive trees and shrubs, combined with reduction and fragmentation of *B. franklini* populations, and reduction in size of native meadows, makes natural or prescribed burning a potential threat to *B. franklini*.

Catastrophic, large scale, and high temperature fires resulting from the long time fire suppression efforts of Forest Service, state, and private landowners could also threaten *B. franklini*. A single fire event in an area where *B. franklini* are concentrated could extirpate an entire population.

<u>Invasive species</u>
Invasion and dominance of native grasslands by exotic plants is a common issue (Warren 1993, Schultz 1998), and has likely occurred at historic *B. franklini* locations. Invasive plant species that displace native plant communities have the potential to negatively impact *B. franklini* if they provide less pollen or nectar than the native species, or if they bloom during a different time period than the native plant species.

B) Overutilization for commercial, recreational, scientific, or educational purposes
<u>Collecting</u>
Insect collecting is a valuable component of scientific research, and is often necessary for documenting the existence of populations and population trends. In general, because of the high fecundity of individual insects, the collection of insects does not pose a threat to their populations. However, in the case of *B. franklini*, which is extremely rare and has small populations, and relatively low fecundity compared to most insects, the collecting of a small number of queens could significantly reduce the production of offspring and pose a threat to the entire species.

C) Disease or predation
<u>Spread of diseases and pests by commercial bumble bees</u>
Dr. Thorp, one of the authors of this petition, hypothesizes that the decline of *B. franklini* was caused by an introduced disease carried by commercially reared bumble bee colonies. The close relationship of *B. franklini* and three other declining U.S. bumble bee

species to the European buff-tailed bumble bee (*B. terrestris*), the timing, speed, and severity of the population crashes, and the fact that other bumble bee species living in the same areas continue to thrive, suggest that an escaped exotic disease organism is the main cause of the dramatic decline in *B. franklini*.

Nosema bombi

The National Academy of Sciences National Research Council report on the Status of Pollinators in North America states that the microsporidium *Nosema bombi* may be the primary factor responsible for the decline of *Bombus franklini* (National Research Council 2007).

Nosema bombi is a microsporidian that infects bumble bees primarily in the malpighian tubules, but also in fat body, nerve cells, and sometimes the tracheae (Macfarlane *et al*. 1995). Colonies can appear to be healthy but still carry *N. bombi* (Ronny Larson 2007) and transmit it to other colonies. The effect of *N. bombi* on bumble bees varies from mild to severe (Macfarlane *et al*. 1995, Otti & Schmid-Hempel 2007, 2008, Ronny Larson 2007, Rutrecht *et al.* 2007).

The probable route of introduction and spread of *N. bombi* is as follows. Commercial bumble bee production in North America began in the early 1990's. During this period, queens of both *B. occidentalis* and *B. impatiens* were shipped to rearing facilities in Belgium. Between 1992 and 1994, the Animal and Plant Health Inspection Service (USDA-APHIS) granted permission for *B. occidentalis* and the eastern *B. impatiens* (*Pyrobombus*) to be shipped from Belgium back to the U.S. (Flanders *et al*. 2003). These colonies were likely produced in a rearing facility that also was rearing *B. terrestris*, a member of the subgenus *Bombus* and a close relative of *B. occidentalis* and *B. franklini*. It is hypothesized that a virulent strain of *N. bombi* from *B. terrestris* spread to *B. impatiens* and *B. occidentalis* prior to their shipment back to the U.S. Once in the U.S., it is hypothesized that commercially reared colonies of *B. occidentalis* spread this virulent strain of *N. bombi* to wild populations of *B. occidentalis* and *B. franklini* (*B. occidentalis* has also undergone a dramatic decline since the late 1990s) (Evans *et al*. 2008). In 1997, bumble bee producers in North America experienced major problems with infection by *N. bombi* in commercial *B. occidentalis* colonies (Flanders *et al.* 2003, Velthius & van Doorn 2006), and eventually stopped producing *B. occidentalis*.

N. bombi (as well as *Crithidia bombi*, another bumble bee pathogen) has been shown to spread from commercial bumble bees in greenhouses to nearby wild bumble bees (Colla *et al.* 2006). As bumble bees in greenhouses frequently forage outside the greenhouse (Whittington *et al*. 2004), it is likely that *N. bombi* could spread from commercial bumble bee colonies to wild populations through shared use of flowers. *N. bombi* isolated from commercial European *B. terrestris* colonies exported to Japan were found to infect two native Japanese bumble bees in lab trials (Niwa *et al.* 2004). *N. bombi* has been found in China in wild-caught *Bombus lucorum* and in queens of *Bombus terrestris* from New Zealand. *B. lucorum* are native to China and are closely related to the non-native *B. terrestris*, which have been imported from New Zealand into China for pollination (Jilian *et al*. 2005).

Researchers at the University of Illinois at Urbana-Champaign have recently identified a strain of *N. bombi* in multiple species of North American bumble bees that is genetically identical to that found in European bumble bees (Illinois Natural History Survey Reports 2007). However, characterizing the geographic origins of different strains of *N. bombi* is complicated by the existence of multiple rRNA strains in single spores (O'Mahony *et al*. 2007). It is not presently clear whether this *Nosema* is an introduced species or if the pathogen occurs naturally in North American *Bombus* populations. Further testing will determine if this pathogen was recently spread to North American bumble bees (L. Solter, personal communication, March 2008).

Colonies imported to commercial rearing facilities are typically subject to inspection, however, such checks often only include honey bee diseases as regulations are often copied from pre-existing honey bee regulations (Velthius & van Doorn 2006). Few precautions to prevent commercially reared colonies from interacting with wild populations have been deemed necessary since they have been used in their countries of origin.

Bumble bee colonies can be infected with *N. bombi* and show no apparent symptoms, making it possible for apparently healthy colonies to carry and spread the pathogen. Because *N. bombi* can be present in areas throughout the bee body, surveys of *N. bombi* cannot be restricted to smears from the gut and malpighian tubules or to fecal sampling of spores, which is a method commonly used (Ronny Larson 2007). Methods have recently been developed to detect *N. bombi* infections by PCR diagnosis, which provides a much more accurate picture of low-level infections (Klee *et al.* 2006).

Crithidia bombi

The internal protozoan parasite, *Crithidia bombi*, could also be leading to the decline of *B. franklini*. *Crithidia bombi* has been shown to be present in higher frequencies in bumble bees near greenhouses where commercial colonies of *B. impatiens* are used than in bumble bees remote from these facilities (Colla *et al.* 2006). Wild bumble bees were found to have *C. bombi* infection rates as high as 47% near commercial greenhouses using bumble bees with the rates of infection for all bumble bee species decreasing with increased distance from the greenhouses (Otterstatter & Thompson 2008). Otterstatter and Thompson (2008) note that pathogen spillover from bumble bees in commercial greenhouses is likely contributing to the decline of wild North American bumble bees. *Crithidia bombi* has been shown to spread to new bumble bee hosts through shared use of flowers (Durrer & Schmid-Hempel 1994). *Crithidia bombi* has been shown to have detrimental effects on colony founding success of queens, the fitness of established colonies, as well as the survival and foraging efficiency of worker bumble bees (Brown *et al.* 2000, 2003, Otterstatter *et al.* 2005, Gegear *et al.* 2005, 2006). Honey bees have also been shown to be possible vectors for *Crithidia bombi* (Ruiz-González & Brown 2006). *C. bombi* does not infect honey bees but they can carry this parasite and possibly spread it to bumble bees in the commercial rearing process.

Locustacarus buchneri
Commercially raised bumble bee colonies can potentially spread the bumble bee tracheal mite *Locustacarus buchneri* to wild populations. Goka *et al.* (2001) found that commercially raised bumble bees from Europe had a higher rate of infestation by tracheal mites than wild bees (17 to 20% in commercially raised bees vs. 1 to 8% of wild bees). Although the means of mite dispersal are currently not well understood, tracheal mites could spread from commercial to wild colonies through drifting workers or contact on shared flowers. Bumble bees in the sub-genus *Bombus* sensu stricto, such as *B. franklini*, may be more susceptible to tracheal mite infestation than other bumble bees. Otterstatter and Whidden (2004) found that the bumble bee tracheal mite (*L. buchneri*) was most prevalent in bumble bee species belonging to the subgenus *Bombus* sensu stricto.

Deformed wing virus
Commercial bumble bee rearing may also provide an opportunity for the transmission of honey bee diseases to bumble bees. Commercial bumble bee producers sometimes introduce young honey bees to nesting bumble bee queens to stimulate them to begin egg-laying. This practice exposes bumble bees to diseases carried by the honey bees. Deformed wing virus (DWV), a honey bee pathogen that results in crippled wings, was thought to be specific to honey bees. However, starting in 2004, dead bumble bee queens with crumpled, vestigial wings were found in European commercial bumble bee breeding operations at a frequency of around 10% (Genersch *et al.* 2006). DWV is pathogenic to at least two bumble bee species (*B. terrestris* and *B. pascuorum*), causing wing deformity similar to clinically DWV-infected honey bees (Genersch *et al.* 2006). The symptoms of DWV have also been observed in commercially raised *B. impatiens* colonies in North America (E. Evans personal observation, March 2008). The research has not been conducted to determine if other species of bumble bees are also susceptible to this disease. Since bees exhibiting symptoms of DWV are unable to forage, DWV infection has the potential to negatively impact the success of colonies.

<u>Use of commercial bumble bee colonies in scientific studies</u>
Commercially produced bumble bee colonies that were potential carriers of pests or disease were distributed throughout much of North America during the time that *B. franklini* and other closely related wild bumble bees began to decline. In addition to being used for commercial pollination, *B. occidentalis* colonies were used for field research between 1992 and 2000 in CA, WA, and Alberta (Macfarlane *et al.* 1994, Mayer *et al*. 1994, Richards & Myers 1997, Macfarlane & Patten 1997, Mayer & Lunden 1997, 2001, Thomson 2004, 2006, Thorp unpublished). The potential for spread of an exotic strain of *Nosema* or other disease organisms through wild populations of *B. franklini* and other species in the subgenus *Bombus* in North America is well supported.

D) The inadequacy of existing regulatory mechanisms
Currently *B. franklini* has no substantive protection for habitat or take under federal law or Oregon or California state law. *B. franklini* has no legal protection under the U.S. Endangered Species Act and neither Oregon nor California allows listing of insects under their respective state endangered species statutes.

B. franklini is currently considered to be a “Species of Concern” by U.S. Fish and Wildlife Service (USFWS 2009), is on the “Special Animals List” of the California Department of Fish and Game (CDFA 2009), is listed as a “Sensitive Species” by the Interagency Special Status/Sensitive Species Program of the USDA Forest Service and Bureau of Land Management (Forest Service/BLM 2009) and was recently listed as critically imperiled by the IUCN Red List of endangered species (IUCN 2009). Although *B. franklini* is widely recognized as a vulnerable species, it receives no formal or informal protection.

The primary threat to this species is the spread of disease by bumble bees from outside of its geographic range. There are currently no federal regulations that limit the interstate transport of bumble bees even outside their native range (Flanders 2003). The Oregon State Department of Agriculture currently does not allow *B. impatiens* to enter the state. Although Oregon does not allow import, these regulations are not always enforced and growers are not always aware of the regulations. Photos in a 2007 news story published by the Associated Press highlighted a strawberry grower in Oregon who purchased colonies of *B. impatiens* for pollination (Associated Press 2007). The California Department of Food and Agriculture allows *B. impatiens* to enter the state for greenhouse pollination, but not for open field pollination, but again, this law may not be regularly enforced. Current law also allows the transport of two species of bumble bees from Canada (*B. impatiens* and *B. occidentalis*) to all U.S. states except Hawaii under the Honeybee Act § 322.4 and § 322.5, which is enforced by the U.S. Department of Agriculture’s Animal and Plant Health Inspection Service (APHIS). Requests can be made to APHIS for bumble bees to be imported from other countries; if this situation occurred, APHIS would evaluate the request and decide whether or not to allow importation (§ 322.12 of the Honeybee Act). Interstate and international transport of bumble bees into western states, such as *B. impatiens*, to areas where they do not normally occur, may increase the exposure of wild bumble bees to exotic pathogens and destroy the isolated populations of *B. franklini* that remain.

E) Other natural or manmade factors affecting its continued existence

<u>Pesticides</u>

The application of insecticides, herbicides and fungicides may negatively affect remaining populations of *B. franklini*. For example, fungicides may alter the intestinal floras of bees. Interactions among multiple chemicals may have synergistic effects within colonies of bumble bees; Pilling & Jepson (1993) demonstrated that the effect of an insecticide on honeybees was enhanced when combined with fungicides.

Insecticides

Insecticide applications may threaten populations of *B. franklini*. The National Academy of Science National Research Council’s report on the Status of Pollinators in North America notes that bumble bees can be negatively affected by many pesticides, but the lack of large scale monitoring of bumble bees makes the scope of the problem difficult to fully determine. The report also points out that ground-nesting bumble bees are uniquely susceptible to pesticides that are used on lawns or turf (National Research Council 2007). Foraging bees are poisoned by pesticides when they absorb the fast-acting toxins through their integument (the outer "skin" that forms their exoskeleton), drink contaminated nectar, or gather pesticide-covered pollen or micro-encapsulated poisons. Pesticide drift from aerial spraying can kill 80% of foraging bees close to the source and drift can continue to be dangerous for well over a mile (Johansen & Mayer 1990). Insecticides applied in the spring, when bumble bee queens are foraging and colonies are small, are likely to have a more significant effect on bumble bee populations (Goulson *et al.* 2008). The relatively recent and increased use of persistent neonicotinoid pesticides, known to be highly toxic to bees, may be contributing to the decline of bumble bees in the subgenus *Bombus* (Colla & Packer 2008), such as *B. franklini*.

Insecticides are used in wild lands, agricultural landscapes, and urban areas to control both native and non-native pest species. In forested areas insecticides have been used to control defoliators such as tussock moth, gypsy moth, and spruce budworm. In New Brunswick, Canada, bumble bee populations declined drastically when exposed to fenitrothion (reviewed in Kevan & Plowright 1995) resulting in reduced pollination of nearby commercial blueberries and other plants such as orchids and clovers (Kevan 1975, Plowright *et al.* 1978, 1980). Organophosphate, carbamate, and pyrethroid insecticides have been associated with bee poisonings in food crops (Johansen 1977, Kearns *et al.* 1998). Bumble bee deaths have been reported after pesticide applications to oil rape seed and field bean crops (Thompson & Hunt 1999, Thompson 2001). Bumble bees also are at risk from insecticides used for turf management in golf courses and urban parks (Gels *et al.* 2002). In Europe, the recent declines in bumble bees have been partially attributed to the use of pesticides (Williams 1986, Thompson & Hunt 1999, Rasmont *et al.* 2006).

Since males and queens, the reproductive units for bumble bees, are produced at the end of the colony cycle, even sub-lethal doses of pesticides can have substantial adverse effects on subsequent generations. Bees exposed to pesticides outside the nest may have trouble navigating their way back to the nest after foraging, or they may be unable to fly at all (Johansen & Mayer 1990). The use of Spinosad, a commonly used insect neurotoxin, has led to workers with reduced foraging efficiency when bumble bee larvae are fed with pollen containing this pesticide (Morandin *et al*. 2005). In an examination of the effect of chitin synthesis inhibitors on *Bombus*, Mommaerts *et al.* (2006) found that even at very low concentrations, diflubenzuron and teflubenzuron increased egg mortality and removal of larvae. Bumble bee workers exposed to low levels of Imidacloprid show reduced pollen consumption and ovarian development (Colla & Packer 2008).

Herbicides

Herbicides can be a valuable tool for the control of invasive weed species. However, the use of broad-spectrum herbicides to control weeds can indirectly harm *B. franklini* and other pollinators by decreasing the usability of habitat for pollinators through removal of flowers that provide pollen and nectar for existing populations (Williams 1986, Shepherd *et al*. 2003). Just as pollinators can influence the plant community, changes in vegetation can have an impact on pollinators (Kearns & Inouye 1997).

The broadcast application of a non-selective herbicide can indiscriminately reduce floral resources, host plants, and nesting habitat (Smallidge & Leopold 1997). Bumble bees require consistent sources of nectar, pollen, and nesting material during times adults are active, typically from mid-February to late September in temperate areas. Such a reduction in resources could cause a decline in bumble bee reproductive success and/or survival rates. Kevan (1999) found that herbicides reduced Asteraceae and Lamiaceae flowers in France, contributing to a decline in bumble bee populations. Kevan (1999) also found that herbicide applications have reduced the reproductive success of blueberry pollinators by limiting alternative food sources that can sustain the insects when the blueberries are not in bloom. Kearns *et al.* (1998) state “herbicide use affects pollinators by reducing the availability of nectar plants. In some circumstances, herbicides appear to have a greater effect than insecticides on wild bee populations… Some of these bee populations show massive declines due to the lack of suitable nesting sites and alternative food plants.”

It is possible that the use of herbicides may affect *B. franklini* by reducing its ability to rear brood; a similar effect has been observed in honeybees (Moffett & Morton 1975).

<u>Population Dynamics and Structure</u>

Small populations, such as that of *B. franklini*, are generally at greater risk of extirpation from normal population fluctuations due to predation, disease, and changing food supply, as well as from natural disasters such as droughts. They may also experience a loss of genetic variability and reduced fitness due to the unavoidable inbreeding that occurs in such small populations (Cox & Elmqvist 2000). Bumble bees may be particularly susceptible to inbreeding due to low effective population size (Packer & Owen 2001). As with all other hymenopterans, their sex determination system is haplodiploidy. The sex of offspring is determined by whether or not the egg is fertilized. Unfertilized, or haploid, eggs become males and fertilized, or diploid, eggs become females. This sex determination system may result in lower levels of genetic diversity than diploid-diploid sex determination. Some bumble bees have been found to have particularly low levels of genetic diversity (Darvill *et al*. 2006, Ellis *et al.* 2006). Inbreeding depression has been shown to negatively affect bumble bee colony size (Herrmann *et al.* 2007), a key factor in a colony’s reproductive success. Low genetic diversity may also increase the risks that *B. franklini* faces from threats such as parasites, diseases, and habitat loss. In haplodiploid organisms, such as bumble bees, low population levels and resulting inbreeding depression may also increase the risk of population extinction by resulting in sterile diploid male production (Zayed & Packer 2005). *Bombus franklini* is rare and has very small populations, and is likely more vulnerable to habitat change and stochastic events due to low genetic variability.

<u>Global climate change</u>

Global climate change may threaten *B. franklini*. A changing climate may cause shifts in the range of host plant species and can be especially detrimental to dependent pollinators when combined with habitat loss (National Research Council 2007). *B. franklini* is restricted to habitat patches where host species are present, and its limited historic distribution suggests that it probably has a limited ability to disperse. Darvill *et al.* (2010) suggest that the decline of another bumble bee species, *B. muscorum*, from the mainland of the UK has been severe because of its limited ability to disperse when faced with agricultural intensification. The ecology of *B. franklini*, combined with the patchy distribution of its remaining habitat, might hinder dispersal made necessary by climate change and cause the extirpation of remaining populations.

An increase in atmospheric CO_2 from global climate change may alter plant nectar production, which could negatively impact bumble bees (reviewed by Davis 2003). An additional impact of climate change, increased amounts of UV-B radiation from a reduction in ozone, could delay flowering in plants and reduce the amount of flowers that plants produce (National Research Council 2007). These impacts could have negative effects on all bumble bees.

<u>Competition from Honey bees</u>

Honey bees (*Apis mellifera*) are not native to North America. The European honey bee was introduced to eastern North America in the early 1620's and into California in the early 1850's. It has long been assumed, but difficult to demonstrate, that honey bees have a negative impact on native bees through competition for floral resources (Sugden *et al.* 1996, Butz Huryn 1997). Recently, Thomson (2004, 2006) conducted competition experiments on *B. occidentalis* colonies placed at three distances from introduced honey bee hives. Thomson found decreased foraging activity, especially for pollen, and lowered reproductive success in *Bombus* colonies nearest the *Apis* hives. Evans (2001) found the same results in a similar study with *B. impatiens* colonies in Minnesota. In Scotland, Goulson and Sparrow (2009) found that bumble bee workers have smaller bodies at sites where honey bees were present, and they suggested that reduced worker size may be detrimental to bumble bee colony success. However, honey bees have existed in eastern North America for over 350 years and in the west for more than 150 years without noticeable declines in bumble bee populations over large portions of their ranges. It is likely that the effects in the studies mentioned above are local in space and time and are most pronounced where floral resources are limited and large numbers of commercial honey bee colonies are introduced. Due consideration should be given to when, where, and how many honey bee colonies are moved into areas with sensitive bumble bee populations.

<u>Competition from other non-native bees</u>

There is potential for non-native commercially raised bumble bees to naturalize and out-compete native bumble bees for limited resources such as nesting sites and forage. In British Columbia, a queen and numerous workers of the commercially reared *B. impatiens* has been captured in the wild near greenhouses that use commercial bumble bees, suggesting that this species has naturalized outside of its native range (Ratti & Colla *in press*). A study comparing reproductive output of native Japanese bumble bees with non-native *B. terrestris* colonies, founded by bees that had escaped from commercially produced colonies, found *B. terrestris* to have over four times the reproductive output of native Japanese bumble bees (Matsumra *et al.* 2004). A study in England comparing the nectar-foraging and reproductive output of a native subspecies of *B. terrestris* with commercially raised *B. terrestris* colonies found that the commercially raised colonies had higher nectar-foraging rates and greater reproductive output (Ings *et al.* 2006). Commercial bumble bee producers have likely selected for colonies that are highly productive to ensure strong colony populations for use in pollination. While this is a desirable quality for commercial rearing, it could prove to aid invasion of non-native species, subspecies, or varieties of bumble bees that would outcompete native bumble bee populations.

VIII. CONCLUSION

Bombus franklini is in imminent danger of becoming extinct. The present distribution and abundance of this species has dramatically declined. From 1998 to 2009, Professor Robbin Thorp surveyed from nine to seventeen historic sites per year (often visiting sites multiple times throughout the season). Dr. Thorp also surveyed from six to nineteen additional sites each year, some of which were visited more than once in a year and some were revisited in different years (Table 1). In 1998, *B. franklini* was found at eight sites out of twelve surveyed (Figure 1). Over the next ten years there was a rapid and marked decline in the number of sites where *B. franklini* was found and number of individuals found. A single worker of *B. franklini* was sighted in 2006, which represents the only individual that has been found since 2003.

The sighting of a *B. franklini* worker in 2006 provides hope that some populations remain in California or Oregon, and that this species may rebound in time. It is important to continue surveys to determine where remaining populations of *B. franklini* are located and to protect those populations from the threats listed above. The best way to provide comprehensive protection of *B. franklini* is through listing under the Endangered Species Act.

For the above reasons, *B. franklini* meets all five criteria under the Endangered Species Act for consideration as a threatened or endangered species: 16 U.S.C. § 1533 (a)(1)(A,B,C,D,E) (Section 4).

"A) the present or threatened destruction, modification, or curtailment of its habitat or range; B) overutilization for commercial, recreational, scientific, or educational purposes; C) disease or predation, D) the inadequacy of existing regulatory mechanisms; E) other natural or manmade factors affecting its continued existence"

These threats, the small number of extant populations, and the natural instability of small populations, lead us to conclude, unequivocally, that *Bombus franklini* is immediately approaching extinction and must be given protection under the Endangered Species Act. **The Xerces Society for invertebrate Conservation** and **Dr. Robbin Thorp** petition for listing Bombus franklini as an endangered species under the Endangered Species Act, 16 U.S.C. 1531 *et seq*. We also appeal for an emergency listing pursuant to 16 U.S.C. § 1533(b)(7) and 50 CFR 424.20 in order to ensure the species' survival. While the species is emergency listed, the U.S. Fish and Wildlife Service should finalize a standard listing rule for Franklin's bumble bee.

IX. REFERENCES CITED

Associated Press. October 8, 2007. Plight of the Bumblebee, Grants Pass, OR. See caption for Photo 2. Available online: http://www.cbsnews.com/stories/2007/10/08/tech/main3341254.shtml (accessed 17 May 2010).

Bhattacharya, M., R. B. Primack, and J. Gerwein. 2003. Are roads and railroads barriers to bumblebee movement in a temperate suburban conservation area? Biological Conservation 109: 37-45.

Biesmeijer, J. C., S. P. M. Roberts, M. Reemer, R. Ohlemüller, M. Edwards, T. Peeters, A. P. Schaffers, S. G. Potts, R. Kleukers, C. D. Thomas, J. Settele, and W. E. Kunin. 2006. Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. Science 313: 351-354.

Brown, M. J. F., R. Loosli, and P. Schmid-Hempel. 2000. Condition-dependent expression of virulence in a trypanosome infecting bumblebees. Oikos 91: 421-427.

Brown, M. J. F., R. Schmid-Hempel, and P. Schmid-Hempel. 2003. Strong context-dependent virulence in a host-parasite system: reconciling genetic evidence with theory. Journal of Animal Ecology 72: 994-1002.

Burns, I. 2004. Social development and conflict in the North American bumblebee *Bombus impatiens* Cresson. U of MN. Ph.D. Thesis.

Butz Huryn, V. 1997. Ecological impacts of introduced honey bees. Quarterly Review of Biology. 72: 275-297.

Cameron, S. A., H. M. Hines, and P. H. Williams. 2007. A comprehensive phylogeny of the bumble bees (*Bombus*). Biological Journal of the Linnean Society 91: 161-188.

Carvell, C. 2002. Habitat use and conservation of bumblebees (Bombus spp.) under different grassland management regimes. Biological Conservation 103: 33-49.

Carvell, C., D. B. Roy, S. M. Smart, R. F. Pywell, C. D. Preston, and D. Goulson. 2006. Declines in forage availability for bumblebees at a national scale. Biological Conservation 132: 481-489.

California Department of Food and Agriculture (CDFA). 2009. State of California. The Resources Agency Department of Fish and Game. Biogeographic Data Branch California Natural Diversity Database Special Animals (901 taxa). February 2009.

Code, B. H. and S. L. Haney. 2006. Final Report: Franklin's Bumble Bee Inventory in the Southern Cascades of Oregon. Prepared for: The Bureau of Land Management, Medford, Oregon, 4 Oct. 2006. Available online: http://www.fs.fed.us/r6/sfpnw/issssp/documents/inventories/inv-rpt-iihy-bofr-med-southerncascades-inventory-2006-10.pdf (accessed 17 May 2010).

Colla, S. R., M. C. Otterstatter, R. J. Gegear, and J. D. Thomson. 2006. Plight of the bumble bee: Pathogen spillover from commercial to wild populations. Biological Conservation 129: 461-467.

Colla, S. R. and L. Packer. 2008. Evidence for the decline of Eastern North American Bumble Bees, with special focus on *Bombus affinis* Cresson. Biodiversity and Conservation 17: 1379-1391.

Cox, P. A. and T. Elmqvist. 2000. Pollinator extinction in the Pacific Islands. Conservation Biology 14: 601-611.

Darvill, B., J. S. Ellis, G. C. Lye, and D. Goulson. 2006. Population structure and inbreeding in a rare and declining bumblebee, *Bombus muscorum* (Hymenoptera: Apidae). Molecular Ecology 15: 601-611.

Darvill, B., S. O'Connor, G. C. Lye, J. Waters, O. Lepais, and D. Goulson. 2010. Cryptic differences in dispersal lead to differential sensitivity to habitat fragmentation in two bumblebee species. Molecular Ecology 19: 53-63.

Davis, A. R. 2003. Influence of elevated CO_2 and ultraviolet-B radiation levels on floral nectar production: a nectary-morphological perspective. Plant Systematics and Evolution 238: 169-181.

Diekotter, T., K. Walther-Hellwig, M. Conradi, M. Suter, and R. Frankl. 2006. Effects of landscape elements on the distribution of the rare bumblebee species *Bombus muscorum* in an agricultural landscape. Biodiversity and Conservation 15: 57-68.

Durrer, S. and P. Schmid-Hempel. 1994. Shared use of flowers leads to horizontal pathogen transmission. Proceedings of the Royal Society of London Series Bulletin 258: 299-302.

Ellis, J. S., M. E. Knight, B. Darvill, and D. Goulson. 2006. Extremely low effective population sizes, genetic structuring and reduced genetic diversity in a threatened bumblebee species, *Bombus sylvarum* (Hymenoptera: Apidae). Molecular Ecology 15: 4375-4386.

Evans, E. C. 2001. Competition between European honey bees and native bumblebees: resource overlap and impact on reproductive success. Master's Thesis, University of Minnesota.

Evans, E., R.W. Thorp, S. Jepsen, and S. Hoffman Black. 2008. Status Review of Three Formerly Common Species of Bumble Bee in the Subgenus Bombus. The Xerces

Society. Available online: http://www.xerces.org/wp-content/uploads/2009/03/xerces_2008_bombus_status_review.pdf (accessed 17 May 2010).

Fitzpatrick, U., T. E. Murray, R. J. Paxton, J. Breen, D. Cotton, V. Santorum, and M. J. F. Brown. 2007. Rarity and decline in bumblebees: a test of causes and correlates in the Irish fauna. Biological Conservation 136: 185-194.

Flanders, R. V., W. F. Wehling, and A. L. Craghead. 2003. Laws and regulations on the import, movement, and release of bees in the United States. Pp. 99-111. In: K. Strickler and J. H. Cane (eds.). For nonnative crops, whence pollinators of the future? Thomas Say Publications in Entomology: Proceedings. Entomological Society of America, Lanham, MD. 204 pp.

Forest Service/BLM. 2010. Interagency Special Status Sensitive Species Program. Available online: http://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml (accessed 17 May 2010).

Frankie, G. W., R. W. Thorp, M. Schindler, J. Hernandez, B. Ertter, and M. Rizzardi. 2005. Ecological patterns of bees and their host ornamental flowers in two northern California cities. Journal of the Kansas Entomological Society 78: 227-246.

Frison, T. H. 1921. New distribution records for North American Bremidae, with the description of a new species (Hym.) Entomological News 32: 144-148.

Frison, T. H. 1923. Systematic and biological notes on bumblebees (Bremidae; Hymenoptera). Transactions of the American Entomological Society 48: 307-326.

Frison, T. H. 1926. Descriptions and records of North American Bremidae together with notes on the synonymy of certain species (Hymenoptera). Transactions of the American Entomological Society 52: 129-145.

Gegear, R. J., M. C. Otterstatter, and J. D. Thomson. 2005. Does parasitic infection impair the ability of bumblebees to learn flower-handling techniques? Animal Behaviour 70: 209-215.

Gegear, R. J., M. C. Otterstatter, and J. D. Thomson. 2006. Bumble-bee foragers infected by a gut parasite have an impaired ability to utilize floral information. Proceedings of the Royal Society B. 273: 1073-1078.

Gels, J., D. W. Held, and D. A. Potter. 2002. Hazards of insecticides to the bumble bees *Bombus impatiens* (Hymenoptera: Apidae) foraging on flowering white clover in turf. Journal of Economic Entomology 95: 722-728.

Genersch, E., C. Yue, I. Fries, and J. R. de Miranda. 2006. Detection of Deformed wing virus, a honey bee viral pathogen, in bumble bees (*Bombus terrestris* and *Bombus* *pascuorum*) with wing deformities. Journal of Invertebrate Pathology 91: 61-63.

Gibson, C., V. Brown, L. Losito, and G. McGavin. 1992. The response of invertebrate assemblies to grazing. Ecography 15: 166-176.

Goka, K., K. Okabe, M. Yoneda, and S. Niwa. 2001. Bumblebee commerce will cause worldwide migration of parasitic mites. Molecular Ecology 10: 2095-2099.

Goulson, D., G. C. Lye, and B. Darvill. 2008. Decline and conservation of bumble bees. Annual Review of Entomology 53: 191-208.

Goulson, D. and K. R. Sparrow. 2009. Evidence for competition between honeybees and bumblebees; effects on bumblebee worker size. Journal of Insect Conservation 13: 177-181.

Greene, J. W. 1858. Descriptions of several new hymenopterous insects from the North west coast of America. Annals of Lyceum of Natural History of New York 7: 11-12.

Grixti, J. C., L. T. Wong, S. Cameron, and C. Favret. 2009. Decline of bumble bees (*Bombus*) in the North American Midwest. Biological Conservation. 142: 75-84.

Hatfield, R. G. and G. LeBuhn. 2007. Patch and landscape factors shape community assemblage of bumble bees, *Bombus* spp. (Hymenoptera: Apidae), in montane meadows. Biological Conservation 139: 150-158.

Herrmann, F., C. Westphal, R. F. A. Moritz, and I. Steffan-Dewenter. 2007. Genetic diversity and mass resources promote colony size and forager densities of a social bee (*Bombus pascuorum*) in agricultural landscapes. Molecular Ecology: 1167-1178.

Hobbs, G. A. 1968. Ecology of species of *Bombus* (Hymenoptera: Apidae) in southern Alberta. VII. Subgenus *Bombus*. Canadian Entomologist 100: 156-164.

Hines, H. M. and Hendrix, S. D. 2005. Bumble bee (Hymenoptera: Apidae) diversity and abundance in tallgrass prairie patches: effects of local and landscape floral resources. Environmental Entomology 34: 1477-1484.

Huntzinger M. 2003. Effects of fire management practices on butterfly diversity in the forested western United States. Biological Conservation 113: 1-12.

Illinois Natural History Survey Reports. 2007. Diseases of Beneficial Insects. No. 392. p.8. Available online: http://www.inhs.uiuc.edu/inhsreports/2007/summer2007.pdf (accessed 18 May 2010).

Ings, T. C., N. L. Ward, and L. Chittka. 2006. Can commercially imported bumble bees out-compete their native conspecifics? Journal of Applied Ecology 43: 940-948.

IUCN 2009. Red List of Threatened Species. Available online: http://www.iucnredlist.org/details/135295 (accessed 26 February 2009).

Jilian, L., W. Jie, P. Wenjun, A. Jiandong, G. Zhanbao, and T. Yuemin. 2005. *Nosema bombi*, a microsporidian pathogen of the bumble bee *Bombus lucorum*. Journal of Apicultural Science 49: 53-57.

Johansen, C. A. 1977. Pesticides and pollinators. Annual Review of Entomology 22: 177-192.

Johansen, C. A. and D. F. Mayer. 1990. Pollinator Protection: a Bee and Pesticide Handbook. Wicwas Press, Cheshire, Connecticut.

Johnson, M. D. and C. M. Horn. 2008. Effects of rotational grazing on rodents and raptors in a coastal grassland. Western North American Naturalist 68: 444-452.

Kearns C. A., D. W. Inouye, and N. Waser. 1998. Endangered mutualisms: the conservation of plant–pollinator interactions. Annual Review of Ecology and Systematics 29: 83-112.

Kearns, C. A. and D. W. Inouye. 1997. Pollinators, flowering plants, and conservation biology. BioScience 47: 297-307.

Kevan, P. G. 1975. Forest application of the insecticide Fenitrothion and its effect on wild bee pollinators (Hymenoptera: Apoidea) of lowbush blueberries (*Vaccinium* spp.) in southern New Brunswick, Canada. Biological Conservation 7: 301-309.

Kevan, P. G. 1999. Pollinators as bioindicators of the state of the environment: species, activity and diversity. Agriculture Ecosystems and Environment 74: 373-393.

Kevan, P. G. and R. C. Plowright. 1995. Impact of pesticides on forest pollination. pp. 607-618 *In* J. A. Armstrong and W. G. H. Ives (eds.) *Forest Insect Pests in Canada*. Natural Resources Canada, Canadian Forest Service, Science and Sustainable Development Directorate, Ottawa, Ontario, Canada.

Kirby, W. 1837. The Insects. *In* Richardson, J., Swainson, W., and Kirby, W. (eds.), Fauna Boreali-Americana, part 4. 325 pp. Josiah Fletcher, Norwich.

Klee, J., W. Tek Tay, and R. J. Paxton. 2006. Specific and sensitive detection of *Nosema bombi* (Microsporidia: Nosematidae) in bumble bees (*Bombus* spp.; Hymenoptera: Apidae) by PCR of partial rRNA gene sequences. Journal of Invertebrate Pathology 91: 98-104.

Kosior, A., W. Celary, P. Olejniczak, J. Fijat, W. Krol, W. Solarz, and P. Plonka. 2007. The decline of the bumble bees and cuckoo bees (Hymenoptera: Apidae: Bombini) of western and central Europe. Oryx 41: 79-88.

Kruess, A. and T. Tscharntke. 2002a. Contrasting responses of plant and insect diversity to variation in grazing intensity. Biological Conservation 106: 293-302.

Kruess, A, and T. Tscharntke. 2002b. Grazing intensity and the diversity of grasshoppers, butterflies, and trap-nesting bees and wasps. Conservation Biology 16: 1570-80.

LaBerge, W. E. 1980. A revision of the bees of the genus *Andrena* of the Western Hemisphere. Part X. Subgenus *Andrena*. Transactions of the American Entomological Society 106: 395-525.

LaBerge, W. E. 1986. A revision of the bees of the genus *Andrena* of the Western Hemisphere. Part XI. Minor subgenera and subgeneric key. Transactions of the American Entomological Society 111: 441-567.

Le Féon, V., A. Schermann-Legionnet, Y. Delettre, S. Aviron, R. Billeter, R. Bugter, F. Hendrick, and F. Burel. 2010. Intensification of agriculture, landscape composition and wild bee communities: A large scale study in four European countries. Agriculture, Ecosystems & Environment 137: 143-150.

Macfarlane, R. P., K. D. Patten, L. A. Royce, B. K. W. Wyatt, and D. F. Mayer. 1994. Management potential of sixteen North American bumble bee species. Melanderia 50: 1-12.

Macfarlane, R. P., J. J. Lipa, and H. J. Liu. 1995. Bumble bee pathogens and internal enemies. Bee World 76: 130-148.

Macfarlane, R. P. and Patten, K. D. 1997. Food sources in the management of bumble bee populations around cranberry marshes. *In* Proceedings of the 7th International Symposium on Pollination. K. W. Richards (ed.) Acta Horticulturae: 239-244.

Matsumura, C., M. Nakajima, J. Yokoyama, and I. Washitani. 2004. High reproductive ability of an alien bumblebee invader, *Bombus terrestris* L., in the Hidaka region of southern Hokkaido, Japan. Japanese Journal of Conservation Ecology 9: 93-101.

Mayer, D. F., K. D. Patten, and R. P. Macfarlane. 1994. Pear pollination with managed bumble bee (Hymenoptera: Apidae) colonies. Melanderia 50: 20-23.

Mayer, D. F. and J. D. Lunden. 1997. A comparison of commercially managed bumblebees and honey bees (Hymenoptera: Apidae) for pollination of pears. *In* Proc. 7th International Symposium on Pollination. K. W. Richards (ed.) Acta Horticulturae 437: 283-287.

Mayer, D. F. and J. D. Lunden. 2001. Honey bee management and wild bees for pollination of hybrid onion seed. *In* Proceeding of the 8th International Symposium on Pollination P. Benedek and K. W. Richards (eds.) Acta Horticulturae 561: 275-278.

McFrederick, Q. S. and G. LeBuhn. 2006. Are urban parks refuges for bumble bees *Bombus* spp. (Hymenoptera: Apidae)? Biological Conservation 129: 372-382.

Memmott, J., N. M. Waser, and M. V. Price. 2004. Tolerance of pollination networks to species extinctions. Proceedings of the Royal Society B 271: 2605-2611.

Milliron, H. E. 1971. A monograph of the Western Hemisphere bumblebees. I. The genera *Bombus* and *Megabombus* subgenus *Bombias*. Memoirs of the Entomological Society of Canada 82: 1-80.

Moffett, J. O. and H. L. Morton. 1975. How herbicides affect honey bees. American Bee Journal 115(5): 178, 179, and 200.

Mommaerts, V., G. Sterk, and G. Smagghe. 2006. Hazards and uptake of chitin synthesis inhibitors in bumblebees *Bombus terrestris.* Pest Management Science 62: 752-758.

Morandin, L. A., M. L. Winston, M. T. Franklin, and V. A. Abbott . 2005. Lethal and sublethal effects of spinosad on bumble bees (*Bombus impatiens* Cresson). Pest Management Science 61: 619-626.

Morris, M. G. 1967. Differences between invertebrate faunas of grazed and ungrazed chalk grassland. I. Responses of some phytophagous insects to cessation of grazing. Journal of Applied Ecology 4: 459-474.

National Research Council. 2007. Status of Pollinators in North America. The National Academies Press, Washington, DC.

NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available online: http://www.natureserve.org/explorer (accessed 18 May 2010).

Niwa, S., H. Iwano, S Asada, M. Matsuurra, and K. Goka. 2004. A microsporidian pathogen isolated from a colony of the European bumblebee, Bombus terrestris, and infectifity on Japanese bumblebee. Japanese Journal of Applied Entomology and Zoology 48: 60-64 (in Japanese with English abstract).

Öckinger, E. and H. G. Smith. 2007. Semi-natural grasslands as population sources for pollinating insects in agricultural landscapes. Journal of Applied Ecology 44: 50-59.

O'Mahoney, E. M., W. T. Tay, and R. J. Paxton. 2007. Multiple rRNA variants in a single spore of the microsporidian Nosema bombi. Journal of Eukaryotic Microbiology 54: 103-109.

Oregon Department of Fish and Wildlife (ODFW). 2010. Available online: http://www.fws.gov/oregonfwo/Species/Data/ (accessed 17 May 2010).

Otterstatter, M. C. and T. L. Whidden. 2004. Patterns of parasitism by tracheal mites (*Locustacarus buchneri*) in natural bumble bee populations. Apidologie 35: 351-357.

Otterstatter, M. C., R. J. Gegear, S. R. Colla, and J. D. Thomson. 2005. Effects of parasitic mites and protozoa on the flower constancy and foraging rate of bumble bees. Behavioral Ecology and Sociobiology 58: 383-389.

Otterstatter, M. C., and J. D. Thomson. 2008. Does pathogen spillover from commercially reared bumble bees threaten wild pollinators? PLoS ONE 3: e2771.doi:10.1371/journal.pone.0002771. Available online: http://www.plosone.org/doi/pone.0002771 (accessed 5 March 2009).

Otti, O. and P. Schmid-Hempel. 2007. *Nosema bombi*: A pollinator parasite with detrimental fitness effects. Journal of Invertebrate Pathology 96: 118–124.

Otti, O. and P. Schmid-Hempel. 2008. A field experiment on the effect of *Nosema bombi* in colonies of the bumblebee *Bombus terrestris*. Ecological Entomology 33: 577–582.

Packer, L. and R. Owen. 2001. Population genetic aspects of pollinator decline. Conservation Ecology 5: Article 4.

Panzer, R. 2002. Compatibility of prescribed burning with the conservation of insects in small, isolated prairie reserves. Conservation Biology 16: 1296-1307.

Pilling, E. D. and P. C. Jepson. 1993. Synergism between EBI fungicides and pyrethroid insecticide in the honeybee (*Apis mellifera* L). Pesticide Science 39:293-299.

Plath, O. E. 1927. Notes on the nesting habits of some of the less common New England bumblebees. Psyche 34: 122-128.

Plowright, R. C., B. A. Pendrel, and I. A. McLaren. 1978. The impact of aerial fenitrothion spraying upon the population biology of bumble bees (*Bombus* Latr: Hym.) in south-western New Brunswick. Canadian Entomologist 110: 1145-1156.

Plowright, R. C., J. D. Thomson, and G. R. Thaler. 1980. Pollen removal *in Cypripedium acaule* (Orchidae) in relation to aerial fenitrithion spraying in New Brunswick. Canadian Entomologist 112: 765-769.

Plowright, R. C. and W. P. Stephen. 1980. The taxonomic status of *Bombus franklini* (Hymenoptera: Apidae). Canadian Entomologist 112: 475-479.

Ratti, C. M. and S. Colla. *In press*. Discussion of the presence of an eastern bumble bee species (*Bombus impatiens* Cresson) in western Canada. Pan-Pacific Entomologist.

Rasmont, P., A. Pauly, M. Terzo, S. Patiny, D. Michez, S. Iserbyl, Y. Barbier, and E.

Haubruge. 2006. The survey of wild bees (Hymenoptera, Apoidea) in Belgium and France. p.18 *In* Status of the World's Pollinators. Food and Agriculture Organization of the United Nations, Rome.

Richards, K. W. and T. W. Myers. 1997. Commercially managed colonies of bumblebees for pollination of cicer milkvetch. *In* Proceedings of the 7th International Symposium on Pollination. K.W. Richards (ed.). Acta Horticulturae 437: 293-297.

Ronny Larson, J. I. 2007. Cytological variation and pathogenicity of the bumble bee parasite *Nosema bombi* (Microspora, Nosematidae). Journal of Invertebrate Pathology 94: 1-11.

Ruiz-Gonzalez, M. X. and M. J. F. Brown. 2006. Honey bee and bumblebee trypanosomatids: specificity and potential for transmission. Ecological Entomology 31: 616-622.

Rusterholz, H. P. and Baur, B. 2010. Delayed response in a plant–pollinator system to experimental grassland fragmentation. Oecologia 163: 141-152.

Rutrecht, S. T., J. Klee, and M. J. F. Brown. 2007. Horizontal transmission success of *Nosema bombi* to its adult bumble bee hosts: effects of dosage, spore source and host age. Parasitology 134: 1719-1726.

Schmidt, N. M., H. Olsen, and H. Leirs. 2009. Livestock grazing intensity affects abundance of Common shrews (*Sorex araneus*) in two meadows in Denmark. BMC Ecology 9:2doi:10.1186/1472-6785-9-2. Available online: http://www.biomedcentral.com/1472-6785/9/2 (accessed 17 May 2010).

Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus *Bombus* s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68: 46-51.

Schultz, C. B. and E. E. Crone. 1998. Burning prairie to restore butterfly habitat: a modeling approach to management tradeoffs for the Fender's blue. Restoration Ecology 6: 244-252.

Scullen, H. A. 1927. Bees belonging to the family Bremidae taken in western Oregon, with notes. Pan-Pacific Entomologist Pan-Pacific Entomologist4(2): 69-76, 121-128.

Shepherd, M., S. L. Buchmann, M. Vaughan, and S. H. Black. 2003. Pollinator Conservation Handbook. The Xerces Society, Portland, Oregon.

Smallidge, P. J. and D. J. Leopold. 1997. Vegetation management for the maintenance and conservation of butterfly habitats in temperate human-dominated habitats. Landscape and Urban Planning 38: 259-280.

Stephen W. P. 1957. *Bumble bees of western America (Hymenoptera*: *Apoidea)*. Oregon State College Agricultural Experiment Station: Technical Bulletin No. 40. 163pp.

Sugden, E. 1985. Pollinators of *Astragalus monoensis* Barneby (Fabaceae) - New host records - Potential impact of sheep grazing. Great Basin Naturalist 45: 299-312.

Sugden, E. A., R. W. Thorp, and S. L. Buchmann. 1996. Honey bee-native bee competition: focal point for environmental change and agricultural response in Australia. Bee World 77: 26-44.

Thompson, H. M. and L. V. Hunt. 1999. Extrapolating from honeybees to bumblebees in pesticide risk assessment. Ecotoxicology 8: 147-166.

Thompson, H. M. 2001. Assessing the exposure and toxicity of pesticides to bumblebees *Bombus* sp.). Apidologie 32: 305-321.

Thomson, D. 2004. Competitive interactions between the invasive European honey bee and native bumble bees. Ecology 85: 458-470.

Thomson, D. M. 2006. Detecting the effects of introduced species: a case study of competition between *Apis* and *Bombus*. Oikos 114: 407-418.

Thorp, R. W. 1970. The type locality of *Bombus franklini* and notes on putative Arizona records of other Bombini (Hymenoptera: Apidae). Pan-Pacific Entomologist 46: 177-180.

Thorp, R. W. 1999. Franklin's bumble bee, *Bombus franklini* (Frison 1921): a species of special concern. Unpublished Report to USDA Forest Service, Ashland. OR on 1998 season (submitted 23 Nov 99).

Thorp, R. W. 2001. Franklin's bumble bee, *Bombus franklini* (Frison 1921): a species of special concern. Unpublished Report to US Fish and Wildlife Service, Portland, OR on 1999-2000 seasons (submitted 14 May 2001).

Thorp, R. W. 2004. Franklin's bumble bee, *Bombus* (*Bombus*) *franklini* (Frison). Unpublished Report to US Fish and Wildlife Service, Portland, OR on 2001-2003 seasons (submitted 29 June 2004).

Thorp, R. W. 2005a. Franklin's bumble bee, *Bombus* (*Bombus*) *franklini* (Frison). Unpublished Report to US Fish and Wildlife Service, Portland, OR on 2004 season (submitted 29 March 2005).

Thorp, R. W. 2005b. Franklin's bumble bee, *Bombus* (*Bombus*) *franklini* (Frison). Unpublished Report to US Fish and Wildlife Service, Portland, OR on 2005 season (submitted 7 November 2005).

Thorp, R. W. 2005c. Species Profile: *Bombus franklini*. In Shepherd, M. D., D. M. Vaughan, and S. H. Black (Eds). Red List of Pollinator Insects of North America. CD-ROM Version 1 (May 2005). Portland, OR: The Xerces Society for Invertebrate Conservation.

Thorp, R. W. 2008. Franklin's Bumble Bee, *Bombus* (*Bombus*) *franklini* (Frison) (Hymenoptera: Apidae), Report on 2006-2007 Seasons (Submitted 10 March 2008).

Thorp, R. W., D. S. Horning, Jr., and L. L. Dunning. 1983. Bumble bees and cuckoo bumble bees of California. Bulletin of the California Insect Survey 23: 1-79.

USFWS, Oregon Fish and Wildlife Office. 2009, Endangered Species – Species Data. Available online: http://www.fws.gov/oregonfwo/Species/Data/ (accessed 26 February 2009).

Vazquez, D. P., and D. Simberloff. 2003. Changes in interaction biodiversity induced by an introduced ungulate. Ecology Letters 6: 1077-1083.

Velthius, H. H. W. and A. van Doorn. 2006. A century in advances in bumblebee domestication and the economic and environmental aspects of its commercialization for pollination. Apidologie 37: 421-451.

Warren, M. S. 1993. A review of butterfly conservation in central southern Britain: II. site management and habitat selection of key species. Biological Conservation 64: 37-49.

Whittington, R., M. L. Winston, C. Tucker, and A. L. Parachnowitsch. 2004. Plant-species identity of pollen collected by bumblebees placed in greenhouses for tomato pollination. Canadian Journal of Plant Science 84: 599-602.

Williams, P. H. 1986. Environmental change and the distribution of British bumble bees (*Bombus* Latr.). Bee World 67: 50-61.

Williams, P. H. 1991. The bumble bees of the Kashmir Himalaya (Hymenoptera: Apidae, Bombini). Bulletin of the British Museum of Natural History (Entomology) 60: 1-204.

Williams, P. H. 1998. An annotated checklist of bumble bees with an analysis of patterns of description (Hymenoptera: Apidae, Bombini). Bulletin of the British Museum of Natural History (Entomology) 67: 79-152.

Zayed, A. and L. Packer. 2005. Complementary sex determination substantially increases extinction proneness of haplodiploid populations. Proceedings of the National Academy of Sciences 102(30): 10742-10746.

X. PERSONAL COMMUNICATION

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XI. APPENDIX I: Table of historic and recent records of *B. franklini*.

State	County	Locality	Date	Observer/ Collector	Determiner	Notes	Reference
CA	Siskiyou	Hilt	1998	Robbin Thorp		2 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Hilt, 17 mi W	29-Sep-63	LL Dunning	RW Thorp	1 male	RM Bohart Museum, UC Davis
CA	Siskiyou	Hilt, 2.2 mi S	29-Sep-63	LL Dunning	RW Thorp	1 male	RM Bohart Museum, UC Davis
CA	Siskiyou	Hilt, 7 mi W	24-Apr-64	RW Thorp	RW Thorp	1 queen	RM Bohart Museum, UC Davis
CA	Siskiyou	Everitt Mem. Hwy. (FH 98) MP 10.2, ca 6500'	3-Aug-89	RS Jacobson	RW Thorp	1 worker	RM Bohart Museum, UC Davis
CA	Siskiyou	Marble Mtn. Wilderness Area, Back [Black] Meadows, south slope of Boulder Peak	early June to mid August 1997	Melissa Brooks, CSUH			Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Bear Valley area, elevation approx 5500 ft.	early June to mid August 1997	Melissa Brooks, CSUH			Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Big Meadows Elevation: 6500 ft.? (north of Shackleford Creek).	early June to mid August 1997	Melissa Brooks, CSUH			Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Lower Wright Lake area elevation above 7000 ft. (located at the north east base of Boulder Peak)	early June to mid August 1997	Melissa Brooks, CSUH			Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Pacific Crest Trail ca 1/2 mile south of Paradise Lake	early June to mid August 1997	Melissa Brooks, CSUH			Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Upper Kelsey creek area, elevation approx 5600 ft. (east of Paradise Lake and Kings Castle Peak)	early June to mid August 1997	Melissa Brooks, CSUH			Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Back [Black] Meadows, south slope of Boulder Peak	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Bear Valley area, elevation approx 5500 ft.	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Big Meadows Elevation: 6500 ft.? (north of Shackleford Creek).	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Lower Wright Lake area elevation above 7000 ft. (located at the north east base of Boulder Peak)	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Pacific Crest Trail ca 1/2 mile south of Paradise Lake	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Marble Mtn. Wilderness Area, Upper Kelsey creek area, elevation approx 5600 ft. (east of Paradise Lake and Kings Castle Peak)	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
CA	Siskiyou	Montague, 1 mi W [=	Historic				Thorp, R. 2009. Pers. comm. with Xerces

		Yreka, 6.4 km (4 mi) E]					Society
CA	Trinity	Willo Creek, Trinity Alps, 17 mi N Weaverville	Aug 1969				Source: USU/USDA Bee Collection
CA	Siskiyou	Hilt	29 Jul 1989	A. Scholl, R.W. Thorp	R.W. Thorp	12 workers, deposited at Univ Bern	Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus Bombus s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68:46-51.
CA	Siskiyou	Yreka, 4 mi E	29 Jul 1989	A. Scholl, R.W. Thorp	R.W. Thorp	2 workers, deposited at Univ Bern	Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus Bombus s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68:46-51.
CA	Siskiyou	Hilt, 12km W (7mi W)	unknown	unknown	R.W. Thorp	deposited at UCDavis, locality data separated from other data	Thorp, R. W., D. S. Horning, Jr., and L. L. Dunning. 1983. Bumble bees and cuckoo bumble bees of California. Bulletin of the California Insect Survey 23:1-79.
CA	Siskiyou	Hilt, 27 km W (17 mi W)	unknown	unknown	R.W. Thorp	deposited at UCDavis, locality data separated from other data	Thorp, R. W., D. S. Horning, Jr., and L. L. Dunning. 1983. Bumble bees and cuckoo bumble bees of California. Bulletin of the California Insect Survey 23:1-79.
CA	Siskiyou	Hilt, 3.5 km S (2.2 mi S)	unknown	unknown	R.W. Thorp	deposited at UCDavis, locality data separated from other data	Thorp, R. W., D. S. Horning, Jr., and L. L. Dunning. 1983. Bumble bees and cuckoo bumble bees of California. Bulletin of the California Insect Survey 23:1-79.
OR	Douglas	Sutherlin, 3 mi W of	1998	Robbin Thorp		1 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Douglas	Roseberg	29 June 1925	H.A. Scullen	T.H. Frison	1 worker, deposited at INHS?	Scullen, H. A. 1927. Bees belonging to the family Bremidae taken in western Oregon, with notes. Pan-Pac. Entomol. 4(2):69-76, 121-128.
OR	Douglas	Roseberg	11 Jul 1930	H.A. Scullen	W.P. Stephen	1 male, deposited at OSU: OSAC Corvallis?	Stephen W. P. 1957. Bumble bees of western America (Hymenoptera: Apoidea). Oregon State College Agr. Exp. Sta.: Tech. Bull. No. 40. 163pp.
OR	Douglas	Roseburg	11 Jul 1930	T.H. Frison	H.A. Scullen	1 M deposited at OSU: OSAC, #128064	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Douglas	Roseburg	11 Jul 1930	H.A. Scullen	T.H. Frison	deposited at OSU: OSAC, #128169	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Gold Hill, 3 mi E of	1998	Robbin Thorp		44 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Jackson Campground	1998	Robbin Thorp		2 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Kenney Meadow Recreation Area	1998	Robbin Thorp		3 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Ruch	1998	Robbin Thorp		3 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Buncom, 1.5 mi E of	1999	Robbin Thorp		1 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Gold Hill, 3 mi E of	2000	Robbin Thorp		5 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Ruch, 4 mi SSE (=Little Applegate Rd MP 1)	2000	Robbin Thorp		1 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Ashland: Mistletoe Road	2002	P. Schroeder		1 ind	Thorp, R. 2008. Franklin's Bumble Bee, Bombus (Bombus) franklini (Frison) (Hymenoptera: Apidae). Report on 2006-2007 Seasons. Submitted 10 March 2008.
OR	Jackson	Mt. Ashland nr. summit "seep site"	2003	Robbin Thorp		82 ind. total observed at these three sites from 1998-2006	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Mt. Ashland nr. summit	2006	Robbin Thorp		82 ind. total observed at these three sites from 1998-2006	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Gold Hill	2 July 1925	H.A.	T.H. Frison	1 worker,	Scullen, H. A. 1927. Bees belonging to the

				Scullen		deposited at INHS?	family Bremidae taken in western Oregon, with notes. Pan-Pac. Entomol. 4(2):69-76, 121-128.
OR	Jackson	Gold Hill	12 July 1930	H.A. Scullen	T.H. Frison	1 W deposited at OSU: OSAC, #127959	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Gold Hill	12 July 1930	H.A. Scullen	T.H. Frison	1 W deposited at OSU: OSAC, #128029	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Gold Hill	12 Jul 1930	H.A. Scullen	T.H. Frison	1 W deposited at OSU: OSAC, #128344	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	2-Sep-46	AT McClay	RW Thorp	3 workers	RM Bohart Museum, UC Davis
OR	Jackson	Medford	3-Sep-46	AT McClay	RW Thorp	3 workers, 4 males	RM Bohart Museum, UC Davis
OR	Jackson	Medford	4-Sep-46	AT McClay	RW Thorp	1 worker, 4 males	RM Bohart Museum, UC Davis
OR	Jackson	Medford	8-Sep-46	AT McClay	RW Thorp	1 worker, 1 male	RM Bohart Museum, UC Davis
OR	Jackson	Medford	9-Sep-46	MF McClay	RW Thorp	1 male	RM Bohart Museum, UC Davis
OR	Jackson	Medford	8-Sep-49	AT McClay	RW Thorp	2 workers	RM Bohart Museum, UC Davis
OR	Jackson	Medford	10-Sep-49	AT McClay	RW Thorp	1 male	RM Bohart Museum, UC Davis
OR	Jackson	Gold Hill	12 Jul 1950	H.A. Scullen	W.P. Stephen	1 worker, deposited at OSU: OSAC Corvallis?	Stephen W. P. 1957. Bumble bees of western America (Hymenoptera: Apoidea). Oregon State College Agr. Exp. Sta.: Tech. Bull. No. 40. 163pp.
OR	Jackson	Medford	3 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #128239	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	3 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127928	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	3 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127929	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	3 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127931	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	4 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #128274	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	4 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #128099	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	4 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127925	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	4 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127926	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	4 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127930	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	4 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127927	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	5 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127933	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	5 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127934	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	5 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127935	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	7 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #128309	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	9 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127932	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.

OR	Jackson	Medford	14 Sep 1950	A.T. McClay		deposited at OSU: OSAC, #127936	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Medford	22-Sep-52	AT McClay	RW Thorp	1 male	RM Bohart Museum, UC Davis
OR	Jackson	Medford	10 Sep 1953	A.T. McClay		deposited at OSU: OSAC, #128204	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Ashland	12 Jul 1958	David Bowdoin		Worker, specimen #5, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland	17 Jul 1958	David Bowdoin		Worker, specimen #1, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland, 8 mi ENE	17-Sep-63	LL Dunning	RW Thorp	2 workers, 3 males	RM Bohart Museum, UC Davis
OR	Jackson	Ashland, 8 mi ENE	17-Sep-63	RW Thorp	RW Thorp	1 worker, 3 males	RM Bohart Museum, UC Davis
OR	Jackson	Copper, 2 mi N	18-Sep-63	LL Dunning	RW Thorp	2 males	RM Bohart Museum, UC Davis
OR	Jackson	Copper, 2 mi N	18-Sep-63	RW Thorp	RW Thorp	2 workers	RM Bohart Museum, UC Davis
OR	Jackson	Copper, 14 mi N	18-Sep-63	RW Thorp	RW Thorp	1 worker	RM Bohart Museum, UC Davis
OR	Jackson	Mt. Ashland	25-Jun-64	LL Dunning	RW Thorp	1 worker	RM Bohart Museum, UC Davis
OR	Jackson	Mt. Ashland	25-Jun-64	RW Thorp	RW Thorp	2 workers	RM Bohart Museum, UC Davis
OR	Jackson	Mt. Ashland	5-Jul-64	LL Dunning	RW Thorp	1 worker	RM Bohart Museum, UC Davis
OR	Jackson	8 miles W of Copper	May 1968	W.P. Stephen	W.P. Stephen	deposited at OSU: OSAC, #127924	Source: ORNIHC Data 04, OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	8 miles W of Copper	May 1968	W.P. Stephen	W.P. Stephen	deposited at OSU: OSAC, #127940	Source: ORNIHC Data 04, OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Copper	8 May 1968	W.P. Stephen	W.P. Stephen	7 deposited at OSU: OSAC, #127941	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Jackson	Copper, nr. [see 17.6 mi S Ruch]	8 May 1968	RC Plowright, WP Stephen	W.P. Stephen	12 queens plus 207 other specimens, deposited at OSU: OSAC Corvallis	Plowright, R. C. and W. P. Stephen. 1980. The taxonomic status of *Bombus franklini* (Hymenoptera: Apidae). Canad. Entomol. 112:475-479.
OR	Jackson	Mt Ashland	25 Jun 1968	R.C. Plowright, W.P. Stephen	W.P. Stephen	1 queen plus 207 other specimens, deposited at OSU: OSAC Corvallis	Plowright, R. C. and W. P. Stephen. 1980. The taxonomic status of *Bombus franklini* (Hymenoptera: Apidae). Canad. Entomol. 112:475-479.
OR	Jackson	Union Creek	25-Apr-76	G Pederson	RW Thorp	1 queen	RM Bohart Museum, UC Davis
OR	Jackson	Ruch	28-May-86	RW Thorp	RW Thorp	1 worker	RM Bohart Museum, UC Davis
OR	Jackson	Ruch	28-May-86	RW Thorp	RW Thorp	5 workers	RM Bohart Museum, UC Davis
OR	Jackson	Gold Hill	29-May-86	RW Thorp	RW Thorp	7 workers	RM Bohart Museum, UC Davis
OR	Jackson	Ashland	Oct 1988	J. Kerbo		Drone, specimen #6, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland	29 May 1990	A. Scholl, R.W. Thorp	R.W. Thorp	4 queens, 1 worker, deposited at Univ Bern	Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus Bombus s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68:46-51.

OR	Jackson	Ruch	29 May 1990	A. Scholl, R.W. Thorp	R.W. Thorp	12 workers, deposited at Univ Bern	Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus Bombus s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68:46-51.
OR	Jackson	Central Point	30 May 1990	A. Scholl, R.W. Thorp	R.W. Thorp	2 workers, deposited at Univ Bern	Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus Bombus s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68:46-51.
OR	Jackson	Gold Hill	30 May 1990	A. Scholl, R.W. Thorp	R.W. Thorp	12 workers, deposited at Univ Bern	Scholl, A., R. W. Thorp, and E. Obrecht. 1992. The genetic relationship between *Bombus franklini* (Frison) and other taxa of the subgenus Bombus s. str. (Hymenoptera: Apidae). Pan-Pacific Entomologist 68:46-51.
OR	Jackson	Ashland	Oct 1990	D. Bruchman		Queen, specimen #2, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland	Oct 1992	E. Plaisance		Drone, specimen #3, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Medford: Roxy Ann Peak	25 May 1997	P. Schroeder		Queen, specimen #10, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Medford: Roxy Ann Peak	25 May 1997	P. Schroeder		Queen, specimen #11, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland: Ashland Pond	8 Jun 1997	C. Ferguson		Worker, specimen #12, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland: Ashland Pond	8 Jun 1997	C. Ferguson		Worker, specimen #13, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland: SOU Roca Cyn	20 Apr 1998	C. Ferguson		Queen, specimen #9, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Ashland: SOU Roca Cyn	26 Apr 1998	C.		Queen,	Southern Oregon University Bee Collection

				Ferguson		specimen #14, deposited at Southern Oregon University Bee Collection	record data
OR	Jackson	Lost Creek Reservoir	15 June 1998	C. Ferguson		Queen, specimen #8, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Shale City Rd. (to Grizzly Peak) T38 SU, R-2E (#28)	29 June 1998	C. Ferguson		Queen, specimen #7, deposited at Southern Oregon University Bee Collection	Southern Oregon University Bee Collection record data
OR	Jackson	Medford	3-10 Sep 1950	A.T. McClay	W.P. Stephen	2 queens, 12 workers, 24 males, deposited at OSU: OSAC Corvallis?	Stephen W. P. 1957. Bumble bees of western America (Hymenoptera: Apoidea). Oregon State College Agr. Exp. Sta.: Tech. Bull. No. 40. 163pp.
OR	Jackson	Medford	9-11 Sep 1953	A.T. McClay	W.P. Stephen	5 workers, 4 males, deposited at OSU: OSAC Corvallis?	Stephen W. P. 1957. Bumble bees of western America (Hymenoptera: Apoidea). Oregon State College Agr. Exp. Sta.: Tech. Bull. No. 40. 163pp.
OR	Jackson	Ashland to Klamath Falls (ENE from Rt. 66, 3 mi E Ashland)	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Ashland, 5 mi ENE jct on Dead Indian Mem. Rd.	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Grizzly Peak	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Phoenix (jct Fern Valley & Payne rds)	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Ruch 4.5 mi S (=14 mi. N. Copper)	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Ruch, 17.6 mi S (=2 mi N Copper)	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Union Creek [Campground site #89]	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Mt. Ashland campground	observed at one or more of these three sites from 1998-2006	Robbin Thorp		82 ind. total observed at these three sites from 1998-2006	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Jackson	Mt. Ashland nr. summit	observed at one or more of these three sites from 1998-2006	Robbin Thorp		82 ind. total observed at these three sites from 1998-2006	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Josephine	Selma, 3 mi S	1998	Robbin Thorp		2 ind	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Josephine	Grants Pass	12 July 1930	H.A. Scullen	T.H. Frison	1 W deposited at OSU: OSAC, #127994	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Josephine	Grants Pass	13 Jul 1930	H.A. Scullen	T.H. Frison	2 W deposited at OSU: OSAC, #128134	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.
OR	Josephine	Merlin	June 1988	Judy Rigel		Worker, specimen #4, deposited at Southern Oregon University Bee	Southern Oregon University Bee Collection record data

						Collection	
OR	Josephine	Merlin	June 1988				Source: SOU Collection
OR	Josephine	Lake Creek, 5600'	Aug 1995				Source: USU/USDA Bee Collection
OR	Josephine	Lake Creek, 5600'	Historic			[Not visited, most recent]	Thorp, R. 2009. Pers. comm. with Xerces Society
OR	Josephine	Wonder, W of [Uncertain locality]	Historic				Thorp, R. 2009. Pers. comm. with Xerces Society
OR	unknown	unknown	unknown	C.F. Baker	T.H. Frison	1 worker: morphotype, deposited at USNM	Frison, T. H. 1923. Systematic and biological notes on bumblebees (Bremidae; Hymenoptera). Trans. Amer. Entomol. Soc. 48:307-326.
OR	unknown	unknown	unknown	C.F. Baker	T.H. Frison	1 male: allotype, deposited at USNM	Frison, T. H. 1923. Systematic and biological notes on bumblebees (Bremidae; Hymenoptera). Trans. Amer. Entomol. Soc. 48:307-326.
OR?	(no labels or information)		W.P. Stephen?	W.P. Stephen?		83 deposited at OSU: OSAC, no barcode	OSU: OSAC label data, recorded by S. Foltz and E. Cheng, 2009.