Zayante band-winged grasshopper (*Trimerotropis infantilis*)

and

Mount Hermon June beetle (*Polyphylla barbata*)

5-Year Review: Summary and Evaluation

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U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Ventura, California

August 2009

5-YEAR REVIEW
Zayante band-winged grasshopper (*Trimerotropis infantilis*) and Mount Hermon June beetle (*Polyphylla barbata*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

Zayante band-winged grasshopper (*Trimerotropis infantilis*)

The Zayante band-winged grasshopper (ZBWG) is a small, pale-gray-to-light-brown grasshopper, with dark cross bands on the forewings and pale yellow hindwings. It ranges from 13.7 to 21.6 millimeters (mm) (0.54 to 0.85 inches (in)) in length, with females generally being larger than males. The adult flight activity period of the ZBWG extends from July until the first ground-soaking rains of the winter (usually around early November) (Arnold 2004e). Adults may live for more than a month and usually are found either directly on sandy soil or on the foliage of the silver bush lupine (*Lupinus albifrons*), which makes up over 60 percent of their diet (Chu 2002). Females oviposit eggs directly into loose, sandy soil. The eggs over-winter in the soil, and nymphs begin to appear in May, with the first adults appearing in July.

Mount Hermon June beetle (*Polyphylla barbata*)

The Mount Hermon June beetle (MHJB) is a small, dark-brown scarab beetle, with light, irregular and broken stripes on the elytra. It can be distinguished from the other three members of the *Polyphylla* genus that occur in the same general area by the presence of randomly-scattered, erect hairs on the elytra. The MHJB ranges from 20 to 22 mm (0.79 to 0.87 in) in length, with females generally being slightly smaller than males. Seasonal activity in this species occurs between May and August and lasts approximately 12 weeks (Arnold 2003a, 2004c, 2005, 2006c, 2007). Females are flightless and emerge from burrows only to mate, after which they

immediately return underground. Activity in this species is strictly crepuscular, with males emerging at dusk and emitting a crackling sound as they fly low over the ground or brush, likely following pheromonal cues to find females for mating (Arnold 2004e). Larvae of this species are believed to be generalists, foraging on multiple species, mostly on root shoots, subterranean stem material, and fungal mycorrhizae (Hill 2006).

These two insect species are known only from the Zayante sandhills of Santa Cruz County, California. Although both insects were likely much more widely distributed throughout the Zayante sandhills area prior to the fragmentation of habitat and suppression of fire, populations are currently concentrated in the same small area between the communities of Mt. Hermon to the south, Bonny Doon to the west, Scotts Valley to the east, and Quail Hollow County Park to the north. Although there are behavioral and microhabitat differences between the two insects, both occur in the same or very similar habitat. Because of their overlap in area and habitat use, and their similarity related to threats, we have included both insects in the same 5-year review.

Methodology Used to Complete This Review:

This review was carried out by staff of the Ventura Fish and Wildlife Office. The source for much of the background material used to generate this review was the Sandhills Conservation and Management Plan (McGraw 2004b) based on the doctoral work of McGraw (2004a) and ongoing monitoring efforts of Arnold (1999a, 1999b, 2000a, 2000b, 2001, 2002a, 2002b, 2003a, 2003b, 2004a, 2004b, 2004c, 2005, 2006a, 2006b, 2006c, 2007). Other information was collected from a variety of sources including: the Internet, published and unpublished literature, personal communications with experts in the field, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game. Due to land ownership patterns and the fragmented nature of the habitat occupied by ZBWG and MHJB, important information was also obtained through personal communication with various private and public entities. We received no information from the public in response to our Federal Register (FR) notice initiating this 5-year review (73 FR 11945). This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of their progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

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Federal Register (FR) Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of both of these taxa and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 5, 2008 (73 FR 11945).

Listing History:

Original Listing
FR Notice: 62 FR 3616
Date of Final Listing Rule: February 24, 1997
Entity Listed: Both insects listed as full species
Classification: Both insects listed as endangered

Associated Rulemakings:

Endangered and threatened wildlife and plants; final determination of critical habitat for the Zayante band-winged grasshopper (66 FR 9219).

Review History:

No 5-year review has been conducted for either the ZBWG or MHJB, but their status was reviewed during preparation of the recovery plan (Service 1998).

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for the ZBWG and MHJB is 8 according to the recovery plan inclusive of the two insects, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (48 FR 43098). This number indicates that the taxa are both monotypic species facing a moderate degree of threat and high potential for recovery.

Recovery Plan or Outline

Name of Plan or Outline: Recovery Plan for Insect and Plant Taxa from the Santa Cruz Mountains in California
Date Issued: September 28, 1998

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. Because the species under review are invertebrates, the DPS policy is not applicable, and the application of the DPS policy to the species' listing is not addressed further in this review.

Information on the Species and its Status

As previously mentioned, the range and habitat requirements of these two species are very similar. The five areas of ZBWG occupied habitat are encompassed completely within the range of the MHJB. Because of this overlap in range and habitat requirements and since the majority of threats are habitat based, inclusion of both in the same review allows for a more focused and meaningful discussion on threats facing Zayante sandhills habitats in Santa Cruz County.

Species Biology and Life History

ZBWG. The ZBWG is a small, pale-gray-to-light-brown grasshopper, with dark cross bands on the forewings and pale yellow hindwings. It ranges from 13.7 to 21.6 mm (0.54 to 0.85 in) in length, with females generally being larger than males. The lower hind tibiae are blue-gray, and there is a band running at an upward slant from front to back across each eye.

The majority of this insect's time is divided between resting and performing locomotive activities (90.3 percent) (Chu 2002). Males produce a buzzing or crackling sound with their wings in flight. Movements are usually short, often only 1 to 2 meters (m) (3.3 to 6.6 feet (ft)) when flushed (Service 1998). Arnold (2002b) found that almost half of recaptured individuals were located on the same transect interval as the previous capture, although some longer dispersals of up to 284 m (930 ft) did occur.

The adult flight activity period of the ZBWG extends from July until the first ground-soaking rains, which usually do not occur until early November (Arnold 2004e). Adults may live for more than a month and usually are found either directly on the sandy soil or on the foliage of the silver bush lupine (*Lupinus albifrons*), which makes up over 60 percent of their diet (Chu 2002). Females oviposit eggs directly into loose, sandy soil. The eggs will over-winter in the soil and nymphs will begin to appear in May, with the first adults appearing in July.

MHJB. The MHJB is a small, dark-brown scarab beetle, with light, irregular and broken stripes on the elytra. It can be distinguished from the other three members of the *Polyphylla* genus that occur in the same general area by randomly scattered erect hairs and broken, white, vertical striping on the elytra. MHJBs range from 20 to 22 mm (0.79 to 0.87 in) in length, with females generally being slightly smaller than males.

Seasonal activity in this species occurs between May and August and lasts approximately 12 weeks (Arnold 2003b, 2004c, 2005, 2006c, 2007). Females are flightless and emerge from burrows only to mate, after which they immediately return underground. Activity in this species is strictly crepuscular, with males emerging at dusk and emitting a crackling sound as they fly low over ground or brush likely following pheromonal cues to find females for mating (Arnold 2004e). Copulation may last from 2 minutes to over an hour (Arnold 1999a). Little is known about the entirety of the life cycle; however, Arnold (2004e) believes that it likely is a 2- to 3-year life cycle, with the majority of time spent under ground. Arnold (2000b, 2001) also believes, based on mark-recapture studies, that adult males live for no longer than 1 week. Information on female lifespan is unknown.

Larvae of this species are believed to be generalists, foraging on multiple species, mostly on root shoots, subterranean stem material, and fungal mycorrhizae (Hill 2006). It is likely, considering their short lifespan, that adult males do not feed, focusing instead solely on reproduction over consecutive days until their energy reserves are expended (Hazeltine 1993). Foraging information regarding adult females is unknown.

Spatial Distribution

ZBWG. The ZBWG is known only from the Zayante sandhills of Santa Cruz County, California, where it is distributed over an area of less than 10.4 square kilometers (km^2) (4 square miles (mi^2)). Within this small area, populations are concentrated between the communities of Mt. Hermon to the southwest, Scotts Valley to the east, and Quail Hollow County Park to the north.

The ZBWG is currently believed to be limited to the five remaining areas of open sand parkland habitat (see Habitat section below for description); however, there are differing perspectives on the total number of occupied areas and/or populations. The five areas where populations presently occur are: 1) Quail Hollow County Park; 2) Quail Hollow Quarry (Graniterock Quarry) area; 3) the area between East Zayante Road, Olympia Wellfield, and Mt. Hermon Road; 4) Mt. Hermon area between Graham Hill and Mt. Hermon Roads and from the old Kaiser/Hanson Quarry to East Zayante Road; and 5) the area between Kings Village Road/Blue Bonnet Lane and Green Valley Road in the city of Scotts Valley (Map 1). Experts often further subdivide these general areas to represent the possible occurrence of demes (a local population in which individuals are genetically similar) that have limited interbreeding potential. Examples of potential demes include the West Ridge, North Ridge, and South Ridge in area 2, the Freeman Mitigation Site, Western extremes and Southern extremes of area 3, and Hanson Quarry and the adjacent areas around Mt. Hermon Cross. While areas 3 and 4 are relatively close to one another, it should be noted that there is a small, deep valley between them and two major roads that likely prevent any substantial emigration between sites.

Area 1 is within Quail Hollow County Park and is therefore protected from mining and residential development; however, the park has not yet prepared any recreational or resource vegetation oriented management plan and has not yet implemented any recovery actions for the ZBWG.

Area 2, the Quail Hollow Quarry, includes three main subdivisions. These are North Ridge, West Ridge, and South Ridge. The majority of this area is owned by the quarry and is managed according to a Habitat Conservation Plan (HCP). Some occupied habitat adjacent to South Ridge is privately owned without any conservation measures in place and another 9.3 ha (23 ac) of occupied habitat adjacent to West Ridge is owned by the Zayante Conservation Bank and is slated for conservation.

Area 3 is between East Zayante Road, Olympia Wellfield, and Mount Hermon Road. Within this area are the Freeman Site, the old Olympia and Geyer Quarries, the old Ferrari Quarry, and the land separating the quarries. The Freeman Site is being managed as a mitigation site under an HCP for the Hanson Quarry. This HCP is now expired and the site is being managed by the Center for Natural Lands Management. The rest of these sites are unmanaged, and both the

ZBWG populations at the old Olympia and Geyer quarries are believed to be extirpated (Arnold, in litt. 2002; California Natural Diversity Database (CNDDB) 2006).

Area 4 ranges between Mt. Hermon and the old Kaiser/Hanson Quarry. The area directly around Mt. Hermon includes property adjacent to Mt. Hermon Peak and is privately owned with no fee title acquisitions or easements in place or in progress. This area is undergoing habitat conversion and no vegetation management activities are being undertaken. The Hanson Quarry area was managed under an HCP until the recent expiration of that plan. Long-term management is now being carried out by the Center for Natural Lands Management.

Area 5 was only discovered to be occupied during the 2007 flight season. This area is located on private property between Kings Village Road/Blue Bonnet Lane and Green Valley Road in the city of Scotts Valley (Arnold, pers. comm. 2007c). Very little is known about this population at this time.

At least one distinct population of ZBWG, the Alma population, which was possibly located just southwest of Los Gatos, is likely extirpated. Specimens were collected from this site, believed to be the town of Alma in the northern foothills of the Santa Cruz Mountains, in 1928. This area, and any associated sandhills habitat, was inundated by the filling of Lexington Reservoir in 1952. Another possible collection area for these specimens was the Almaden Mine area in the region of the current Quicksilver Almaden County Park, as suggested by White (in litt. 1993). No surveys have occurred in this County Park, and it is unknown whether ZBWGs are there, or if suitable habitat exists (Arnold, in litt. 2008b). The persistence of either of these populations would have greatly extended the range of the species and demonstrates how widely distributed some sandhills species were prior to destruction and fragmentation of habitat, and suppression of natural disturbance.

MHJB. The MHJB, like the ZBWG, is also known only from the Zayante sandhills of Santa Cruz County, California, and is primarily distributed over an area that is likely less than 25.9 km^2 (10.0 mi^2).

As with the ZBWG, there are differing perspectives on total numbers of occupied areas/ and or populations of the MHJB. For the purposes of this review, we consider the MHJB to be limited to eight general areas where populations are believed to persist. The eight areas are: 1) Quail Hollow County Park; 2) Quail Hollow Quarry area; 3) the area between East Zayante Road, Olympia Wellfield, and Mt. Hermon Road; 4) the Mt. Hermon area from just across Graham Hill Road in Henry Cowell State Park to Mt. Hermon Road and from the east side of the old Kaiser/Hanson Quarry almost to East Zayante Road on the western side; 5) the area between Kings Village Road/Blue Bonnet Lane and Green Valley Road in the city of Scotts Valley (Arnold, pers. comm. 2007c); 6) north of Quail Hollow County Park in the West Lompico area; 7) Redwood Glen area, off Bean Creek Road in Scotts Valley (McGraw, pers. comm. 2008c); and 8) private lands in the Bonny Doon area west of the Bonny Doon Ecological Reserve (Map 1). The seventh and eighth populations were first discovered in August and June of 2008, respectively. Both populations were initially found with the discovery of a single male at a black-light trap (McGraw, pers. comm. 2008a, 2008b, 2008c). Subsequent observations in the Bonny Doon area have confirmed this population (Arnold, pers. comm. 2008a), while no

subsequent observations in the Glenwood area have yet been made. Hazeltine (1993) considered observation of a single male likely an "artifact," two or more observations indicate a breeding area. Although only a single male was observed in Glenwood, the geographic isolation of each of these sites in relation to other MHJB populations, leads us to believe that both of these occurrences are distinct, functional populations. The potential for demes similar to those observed in the ZBWG are recognized for the MHJB based on the same geographic areas.

Some information indicates the existence of populations of both insect species in the Weston Ridge area at the head of Ruins Creek and along Canham Road in the Glenwood area at some point within the last 20 to 50 years. The discovery of the new population in the Redwood Glen area increases the likelihood that these populations did exist at one time and perhaps still persist. Surveys in these areas should be undertaken to resolve this question.

Areas 1-5 are generally the same as those for ZBWG; see above under ZBWG for descriptions of areas 1-5.

Area 6 is north of Quail Hollow County Park in a residential neighborhood. This is privately-owned land and is not secure at this time.

Area 7 is located in the Redwood Glen area off Bean Creek Road, Scotts Valley. This population was only discovered in August of 2008 (McGraw, pers. com. 2008c). This population is on private property where only one individual has been observed.

Area 8 is on privately-owned land west of the Bonny Doon Ecological Reserve. This occupied habitat was only recently discovered (McGraw, in litt. 2008a); little is known about this population and the land is not secure at this time. Approximately 248 ha (613 ac) of sandhills habitat exists in this area (McGraw 2004b). The distribution and abundance of MHJB in this area has not been determined at this time.

Abundance

ZBWG. Population surveys of ZBWG have been conducted only at locations where HCPs have been approved. These locations are: Quail Hollow Quarry; Hanson Quarry; and the off-site mitigation parcel for Hanson Quarry, the Freeman Site (Table 1).

Population surveys were conducted prior to years shown in Table 1 (2003) at the same locations; however, earlier survey results are not comparable with those in Table 1 due to differences in areas surveyed, techniques used, and insufficient sampling to determine peak flight season. Therefore, there is not enough data to generate population trends at the present time. Data from these three sites may not reflect population trends for the ZBWG across the entirety of its range. All three sites are being actively managed to benefit the ZBWG, which is not true of other sites occupied by the species. Land management practices can substantially affect ZBWG population trends. Populations at sites managed to benefit the species are more likely to reflect a positive trend than at sites that are not managed.

TABLE 1. Zayante band-winged grasshopper survey results (Arnold 2004a, 2004b, 2005, 2006b, 2007).

Location	Habitat Ha (ac)	Year	Population Estimate
Quail Hollow Quarry	10.2 (25.2)	2003	29,570
Quail Hollow Quarry		2005	23,128
Quail Hollow Quarry		2007	23,805
Hanson Quarry	0.7 (1.6)	2004	1,591
Hanson Quarry		2006	3,361
Freeman Mitigation Site	1.7 (4.2)	2004	9,075
Freeman Mitigation Site		2006	18,134

Although specific trend information is lacking, Arnold (pers. comm. 2007c) believes that ZBWG populations are in a serious decline and that the reduction in available habitat due to successional processes may drive this species to eventual extinction. Arnold's concern may be supported indirectly by declines observed in the federally endangered Ben Lomond wallflower (*Erysimum teretifolium*) populations that often co-occur with ZBWG (White, in litt. 1993). The range of the Ben Lomond wallflower is shrinking, there have been recent extirpations of some populations, and the population overall is declining largely due to habitat loss and alteration (Service 2008). Although no direct link has been found between these two taxa, it has been suggested that their co-occurrence is a result of similar habitat requirements (Arnold, pers. comm. 2007b).

MHJB. Similar to ZBWG, population surveys of MHJB have been conducted only at locations where HCPs have been approved. These locations are the same as for ZBWG: Quail Hollow Quarry; Hanson Quarry; and the off-site mitigation parcel for Hanson Quarry, the Freeman Site (Table 2). The results of surveys at these three locations suggests that populations are stable; however, trends generated from two and even three seasons of data should not be considered to accurately describe a population, especially for an r-selected species where annual variation in population numbers is expected to be high. Population fluctuations at these sites are likely within the normal year-to-year variation for this species, but monitoring is needed to determine the normal range of fluctuation in population numbers for this species (Arnold 2006c). These data also apply to only three habitat areas which are actively managed for protection from further habitat loss and even have some non-native plant controls in place. Such sites are useful in providing information about areas of known conditions and may elucidate impacts from pressures such as drought, disease, or climatic changes. Other sites without similar management practices in place may exhibit different population trends.

TABLE 2. Mount Hermon June beetle survey results (Arnold 2003a, 2006c).

Location	Habitat Ha (ac)	Year	Male Population	Total Population*	Average Populaton*
Quail Hollow Quarry	40.5 (100)	2000	181,844 – 302,893	363,688 – 603,786	483,737
Quail Hollow Quarry		2002	311,285 – 337,317	622,570 – 674,634	648,602
Quail Hollow Quarry		2004	253,528 – 274,477	507,056 – 548,954	528,005
Quail Hollow Quarry		2006	273,014 – 296,007	546,028 – 592,014	569,021
Hanson Quarry	0.7 (1.6)	2003	1,241,251 – 1,337,651	2,482,502 – 2,675,302	2,578,902
Hanson Quarry		2005	1,310,083 – 1,411,839	2,620,166 – 2,823,678	2,721,922
Freeman Mitigation Site	1.7 (4.2)	2003	1,029,266 – 1,109,203	2,058,532 – 2,218,406	2,138,469
Freeman Mitigation Site		2005	860,679 – 927,523	1,721,358 – 1,855,046	1,788,202

* assuming a 1:1 male to female ratio.

Habitat or Ecosystem

The Zayante sandhills of Santa Cruz County are comprised of outcrops of sandy soils of the Zayante series derived from marine deposits. Habitats endemic to the Zayante soil series are: sandhills chaparral, sand parkland (also referred to as ponderosa pine parkland or sandhills parkland), and open sand parkland. Morgan (1983) differentiated sand parkland habitat as "high–quality" (referred to as "open sand parkland" by McGraw (2004b)), characterized by widely-spaced ponderosa pines (*Pinus ponderosa*) with a barren, open sand understory, and "low–quality," characterized by a higher density of ponderosa pines and other trees with a fairly continuous understory of grass. A suite of associated plants and insects, including three other federally-endangered species, the Ben Lomond spineflower (*Chorizanthe pungens* ssp. *hartwegiana*), the Ben Lomond wallflower, and the Santa Cruz cypress (*Callitropsis abramsiana*), are endemic to the Zayante sandhills.

Sand mining and urban development have severely reduced these rare and geographically limited habitats. These two factors were initially the major threat to both ZBWG and MHJB populations. Although Sandhills habitats continue to be lost and degraded as a result of these activities, albeit at a lesser rate than in the past, fire suppression and resulting habitat conversion are now the leading cause of habitat loss and degradation. Natural fire regime in the sandhills community drives what Lee (1994) described as a, "...continually changing pattern of habitat patches with particular fire histories, sizes, and species composition. These patches over time would appear to migrate over the landscape as they went through cycles of senescence, episodic disturbance and rejuvenation." Disruption of these patch dynamics can lead cyclical habitat types into a stasis of primarily late successional stages dominated by woody invasive and native species and invasive annual grasses (Marangio and Morgan 1987; Sprugel 1991; Lee 1994;

Brunette 1997; Service 1998; McGraw 2004b). In recent decades, this effect has led to conversion of much of the existing sandhills habitat types, and a continual decline in available open, loose sand habitat required by both the ZBWG and MHJB to thrive and complete their life cycles (Arnold, pers. comm. 2007b; McGraw 2004b).

Estimates based on historic aerial images indicate that originally there was approximately 2,535 ha (6,265 ac) of sandhills habitat and that by 1992 it had been reduced to 1,460 ha (3,608 ac), or 57 percent of its original extent, through sand mining, development, and habitat conversion (Lee 1994).

ZBWG. "High quality" open sand parkland is considered to be generally synonymous with ZBWG habitat. The limited overstory and exposed sandy substrate of "high-quality" or open sand parkland are considered to be critical for ZBWG survival and reproduction (Arnold 2004c).

Through analysis of aerial photos taken in 1943, McGraw (2004b) estimated that there was approximately 405 ha (1,000 ac) of sand parkland (including both high- and low-quality habitat) at the time. Marangio and Morgan (1987) estimated that only 101 ha (250 ac), or 25 percent, of this habitat type remained by 1986. More recent estimates range from approximately 78 ha (193 ac) (Lee 1994) to 84 ha (208 ac) (McGraw 2004b). However, open sand parkland, the habitat occupied by ZBWG, makes up only a small portion of sand parkland. According to Lee (1994), by 1994 open sand parkland habitat had been reduced to only about 13 ha (32 ac) based on remote sensing via aerial photographic analyses and extensive ground truthing. McGraw (2004b) put the estimate of available open sand parkland habitat slightly higher at 23 ha (57 ac) (5.7 percent of the 1943 extent) across 14 locations, with a mean patch size of 1.6 ha (4 ac). This habitat type is usually situated on the upper slopes of the highest hills and ridges, but may also occur on lower slopes.

Open sand parkland actually supports three *Trimerotropis* grasshopper species which partition the habitat according to variations in disturbance, slope, and density of the chaparral community (Arnold 2004e). *T. thalassica* occurs on steeper slopes than preferred by the other two species and is often found in association with sandhills chaparral, *T. pallidipennis* often occurs in anthropogenically disturbed areas such as mine pits and dirt roads, and ZBWG only inhabits relatively flat, ridge-top, open sand parkland areas (Arnold, pers. comm. 2007b). Thus, the habitat occupied by ZBWG is likely even more limited.

MHJB. The habitat requirements for MHJB are somewhat less restricted than ZBWG, although loose, sandy soil is still required for burrowing by both sexes and all life stages of MHJB. While high-quality open sand parkland habitat may be considered optimal MHJB habitat, MHJB also occurs in low-quality sand parkland and sand chaparral habitat. Habitat conversion to types characterized by stabilized, more-developed soils (soils with higher organic matter and more advanced successional characteristics) does not support MHJB populations. As with ZBWG, Lee (1994) quantified historic and contemporary habitat acreages via aerial photos and soil maps and estimated an original extent of 1,672 ha (4,132 ac) of sand parkland and sand chaparral habitat types. By 1992, Lee (1994) estimates that this habitat had been reduced to 1,042 ha (2,575 ac), or 62 percent of its original extent.

Like the ZBWG, the MHJB shares its range with other beetle species of the same genus. While *Polyphylla crinita, P. nigra,* and *P. decemlineata* share MHJB's range, they are separated temporally by breeding activity (Arnold 2004d).

Changes in Taxonomic Classification or Nomenclature:

No changes in taxonomic classification of nomenclature to either species have occurred since listing.

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Threats that were considered to seriously impact these species were discussed at the time of listing and mentioned in the recovery plan (Service 1998). Four of these threats pertain to this factor and are addressed here.

Sand Mining

At the time the ZBWG and MHJB were listed, sand mining was occurring on a large scale on many of the remaining deposits of Zayante sandhills soils. Consequently, sand mining was considered to be the primary threat to the ZBWG and MHJB and all other species endemic to this limited habitat. Of the six commercial sand mines that have occurred in sandhills habitat, three have been closed for some time and two are nearing closure (McGraw 2004b; Davilla, pers. comm. 2006). Although there are likely to be few mining operations in the future and there are more environmental controls on mining, approximately 80 percent of the original 405 ha (1,000 ac) of sand parkland has already been altered, much due directly to sand mining (Lee 1994; McGraw 2004b). Although sand mining is still occurring and is still altering habitat occupied by these species, progress has been made in reducing this threat. The two operations nearing closure began prior to the listing of the species and requirements for HCPs and are not regulated under such plans. The majority of current and future mining is occurring at Quail Hollow Quarry, is expected to be completed in 15 to 100 years, and is covered under an HCP (Granite Rock Company (Graniterock) 1998; McGraw 2004b). According to this HCP, Graniterock will maintain the North Ridge (4.5 ha (11.1 ac)) and West Ridge (8.5 ha (21.1 ac)) as habitat set-asides, maintain other protected areas in perpetuity (18.3 ha (45.2 ac)), and sell the South Ridge (13.2 ha (32.6 ac)) to the County. This totals 44.5 ha (110 ac) conserved under this HCP, most of which is sandhills chaparral, sand parkland, and open sand parkland. Both set-asides and the buffer areas of South Ridge will be managed to prevent vegetation encroachment and habitat succession. This HCP allows for the destruction of 2.4 ha (6 ac) of sand parkland habitat, or approximately 2 to 3 percent of the total remaining sandhills habitat and 17 percent of the 14.0 ha (34.5 ac) of sand parkland habitat within the area covered by the HCP. Although restoration and revegetation of previously mined areas is called for in this HCP, the success of such efforts

in sandhills habitats is unproven. Some restoration specialists working with sandhills species now believe that previously quarried areas, even if restored, will likely never support successful sandhills communities (Davilla, pers. comm. 2006; Schettler, pers. comm. 2006). Because little of the habitat required by this species remains, even small losses of habitat are significant.

Urban Development

Urban development was considered to be another primary threat to these species at the time of listing. Development is not occurring at as rapid a rate as it was in the past (Levine, pers. comm. 2006), but the lasting effects of past development (e.g., habitat fragmentation) remain. Reduction in the rate of development in much of the sandhills area is likely due in part to the listing of more species in the area making permitting more difficult, but more likely due to the economic slowdown that has reduced overall activity in the housing and development markets in recent years (Slater, pers comm. 2008). ZBWG areas 4 and 5 and MHJB areas 4, 5, 6, and 7, all contain residential areas within the suitable habitat area occupied by the insects. ZBWG and MHJB area 1 is within 350 m (0.217 mi) of a residential area, and all remaining occupied habitat areas are within 75 m (0.047 mi) of residential areas.

Agriculture

At the time of listing, agriculture was considered to be a minor threat to these species. While agricultural conversion of sandhills habitat for vineyard creation and expansion is occurring in some areas, no other known agricultural conversion of ZBWG or MHJB habitat is currently occurring or is known to have occurred since listing.

Recreational Use

Recreational use was considered to be an important threat at the time of listing. At this time, recreational use has changed little and continues to threaten ZBWG and MHJB habitat. An HCP and recreational plan are being developed for Quail Hollow County Park (area 1 listed above for both species), and fences and signs have been erected to protect sandhills habitat. However, these fences are often cut and neighboring equestrians use the area, resulting in large quantities of erosion (McGraw, pers. comm. 2006; West, pers. observation. 2006a). The effects of recreational activities are also apparent at the South Ridge site in Quail Hollow Quarry (area 2 for both species). Recreational activity at this site seems to be limited to hikers and dog-walkers accessing areas on foot, despite fencing and signage (West, pers. obs. 2006b). Hiking and some biking is common at most sandhills sites (McGraw 2004b), and "sandboarding" activities have been observed at one sandhills area (West, pers. obs. 2007). Such threats are likely to be controlled only via fencing, signage, and active enforcement of trespassing laws at each sandhills site.

Another threat to ZBWG and MHJB habitat is alteration as a result of fire suppression. See factor E for a discussion of this threat.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overcollection was recognized as a potential threat to these species in the recovery plan (Service 1998). Whether or not insect collectors are in fact attempting to collect these species is unknown. While collection of some orders of arthropods is common, collection and trade of most orthoptera (grasshoppers and relatives) is not (Arnold, pers. comm. 2007c). Collection of beetles is known and is a problem for many species. Difficulty in identification amongst co-occurring *Polyphylla* species, and similar appearance to many common species, likely prevent MHJB from being targeted by species-specific collectors. While the potential threat of collection does exist, we do not believe that this is a significant threat at this time.

FACTOR C: Disease or Predation

No major threats to these species have been identified related to disease or predation. One ZBWG was observed to be parasitized by what was likely a tachnid fly (White, in litt. 1993). Aside from this single observed event, no parasitism has been observed and it is unknown to what extent parasitism is a threat.

While the cryptic coloration and dramatic escape flights clearly indicate evolutionary adaptations suited to avoidance of predators, there is no known focus by any known species to utilize the ZBWG as prey that would warrant consideration as a serious threat to the persistence of this species. The low-level flights and mostly fossorial nature of the MHJB likely prevent the species from much large-scale predation.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing regulatory mechanisms that were in effect were considered to not provide adequate protections for ZBWG and MHJB and their habitats.

<u>County Protections</u>

The Zayante sandhills sand parkland habitat is designated as a sensitive habitat through the Santa Cruz County Sensitive Habitats Protection Ordinance (Santa Cruz County Code 2007b); sensitive habitats receive additional consideration for conservation of sensitive species and resources during project review. Additionally, protection is afforded under the Santa Cruz County Local Coastal Program (Santa Cruz County Code 2007a). This program directs the implementation of Sensitive Habitat Protections, including direct protection of species federally-listed as rare or endangered and areas providing habitat for species federally-listed as rare or endangered (Santa Cruz County Code 2007b).

The City of Scotts Valley and County of Santa Cruz are continuing to develop an HCP for the sandhills region; however, considerable work remains for this plan to be finalized, and it is unclear which species will be included in the final document. An Interim Programmatic HCP (IPHCP) is being developed to cover identified areas in the city of Scotts Valley and the County

of Santa Cruz, but it has yet to be completed. This HCP will cover the MHJB, but not the ZBWG.

The Zayante Sandhills Conservation Bank was established to preserve sandhills habitat in Santa Cruz County through the sale of conservation credits as mitigation for development within the county. Sandhills habitat held in this bank will be preserved, enhanced, or restored in perpetuity. Mitigation may be directed through conservation measures detailed in HCPs. This process may be streamlined with the completion of the Interim and Regional HCPs currently in preparation. The Conservation Bank holds 22.7 ha (56 ac) of conservation credits, of which 17.8 ha (44 ac) are suitable for MHJB mitigation (Burrowes, pers. comm. 2008). At this time, 0.48 ha (1.19 ac) have been purchased from the Bank as mitigation for projects within the cities of Scotts Valley, Ben Lomond, and Mt. Hermon (Burrowes, pers comm. 2008). The Olympia Sandhills Preserve's 76.5 ha (189 ac) of sandhills habitat was recently sold to the Santa Cruz Land Trust for preservation.

State Protections

Neither species is listed as endangered or threatened under the California Endangered Species Act (CESA), although it should be noted that invertebrates are not eligible for listing under CESA. However, the federally-endangered status of these species necessitates review under the California Environmental Quality Act (CEQA) (California Public Resources Code 2003) to determine whether significant impact will occur from any and all proposed permitted projects. If, under CEQA review, significant environmental impacts are identified, the project may be revised to avoid or mitigate identified impacts. If such a revision is not possible, an Environmental Impact Report (EIR) may be required to detail the environmentally significant impacts, list ways to minimize such impacts, or to indicate alternatives to the project.

The Surface Mining and Reclamation Act also affords some protections to sensitive species and habitats; however, this act generally defers to the mitigation requirements under CEQA. Oversight of these regulations is generally handled by Santa Cruz County, as mentioned above, and enforcement has traditionally been limited (Arnold, pers comm. 2008a). Some direction is given regarding reclamation and restoration; however, as noted in the discussion of sand mining under Factor A above, restored quarried areas are not likely to support successful, self-sustaining, sandhills communities.

Federal Protections

No populations occur on Federal lands. Where the species occur on private lands, protections afforded by section 7 of the Act are triggered only if there is a Federal nexus (i.e., an action funded, permitted, or carried out by a Federal agency). If a proposed project does not involve a Federal agency but may result in the take of a listed animal species, the project proponent should apply for an incidental take permit, pursuant to section 10(a)(1)(B) of the Act. To qualify for the permit, the project proponent would need to submit an application to the Service together with an HCP that describes, among other things, how the impacts of the proposed taking of federally listed species would be minimized and mitigated and how the plan would be funded. Only a few HCPs and management plans discussed in the recovery plan have been implemented so far and

most have only provided a portion of the necessary protections (See section III. for further details on completed HCPs). The Service has participated in the efforts to develop HCPs mentioned above through section 10 of the Act.

While regulatory protections have improved for these species since they were listed, some of the threats to the species are either currently unregulated, or of a kind not addressed by land-use regulations (i.e., invasive species encroachment, fragmentation effects). Thus regulatory restrictions that focus primarily on direct habitat destruction and take, even when applicable, are currently inadequate to conserve these species.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

At the time of listing other natural or manmade factors including fire suppression and habitat succession were considered to be important threats to the species.

Fire suppression/forest or chaparral succession

The disruption of natural fire cycles resulting in unchecked succession is likely the most serious threat at the present time to the remaining sandhills habitat, and in turn, all four listed species and subspecies endemic to this habitat: ZBWG, MHJB, Ben Lomond wallflower, and Ben Lomond spineflower (McGraw 2004b; Arnold, pers. comm. 2007b; McGraw, pers. comm. 2006). Sandhills communities are fire-adapted, and fire plays a major role in resetting soil succession (McGraw 2004b). While it is widely known that fire may prevent the permanent establishment of pioneering native species, it has also been shown to play a role in the reduction of invasive non-native species in the sand parkland, open sand parkland, and sandhills chaparral habitat types (McGraw 2004a,b). Suppression of fire in a fire adapted ecosystem often releases pioneering native and non-native species from natural controls and allows for rapid colonization.

Not only does suppression of fire directly leave leaf litter in place to accumulate, but McGraw (2004a) found that non-native species prevented sloughing of this litter that otherwise occurs easily during rain and wind events from the bare sandy soil. Subsequently, litter build-up resulting from anchoring by stems of non-native plants alters the temperature and humidity levels in the soil, especially in layers close to the surface (McGraw 2004a, Sayer 2006). This alteration of soil conditions accelerates soil succession and allows additional non-native species to establish themselves, eventually encouraging encroachment of woody species. The effect of this litter build up and establishment of pioneering plants directly affects the availability of the exposed sandy soil in open sand parkland habitats required for egg laying by ZBWG and burrowing necessary for the MHJB's primarily fossorial lifestyle. Even with litter removal via manual methods such as raking, McGraw (2004a) found that the remaining non-native plant species significantly reduced soil moisture content. The effect that this may have on survival and development of ZBWG eggs and MHJB eggs and larvae within the soil is unknown. Manual litter removal also may disrupt the upper layers of soil containing eggs, larvae, and adult beetles, resulting in their destruction.

The process of litter build-up and vegetative encroachment is commonly recognized as part of the successional cycle, which ultimately leads to habitat type conversion. Aerial photograph

analysis of seven sandhills locations showed that, in the absence of fire, average woody plant cover increased from 27 to 59 percent over a period of 39 years, from 1963 to 2002 (McGraw, unpubl. data 2004). This indicates an annual encroachment rate of 0.82 percent. Using this encroachment rate as a model, simplistic projections indicate that the remaining 41 percent of open habitat in this area could potentially be converted to a community type dominated by woody plant species in as little as 50 years. This assessment does not include complex processes that may affect encroachment rate as succession proceeds, such as those discussed in the Habitat Fragmentation section below, but underscores the importance of this threat to sandhills habitat as a whole.

Without concerted management efforts, it is likely that widespread habitat conversion in the Santa Cruz sandhills will continue to occur (McGraw 2004b; Levine, pers. comm. 2006). This conversion will lead to increased canopy density and litter levels that will eventually result in habitat types that may not support the threatened and endangered open sand specialists endemic to sandhills parkland.

Habitat Fragmentation

As succession continues, and core sand parkland areas shrink, it is likely that further fragmentation of the habitat patches described by McGraw (2004b) and Lee (1994) will occur. Populations existing in such patches of fragmented habitat are often compared to populations on actual offshore islands. The theory of island biogeography developed by MacArthur and Wilson (1967) is often used to describe the dynamics of such populations. As these habitat patches, or "islands," shrink, there is a corresponding increase in distance between patches. As the distance between patches increases, the likelihood of genetic exchange between patches decreases and the extinction rate of original species dependent on the habitat increases. The result of this effect is a decrease in overall diversity of the original species within the patch. Drivers of this effect may be any of a variety of factors such as: the eventual exclusion of a critical resource, inbreeding depression, or a reduction in the population to a level where stochastic fluctuations make the potential for extinction increasingly likely.

Open habitat patches are also often referred to as "gaps." These gaps are usually the result of some disturbance agent. In the case of the sandhills, this agent is fire. As fragmentation of these gaps increases, they will become smaller and the ratio of edge, or gap circumference, to gap area will increase. As this ratio increases, the rate of succession also increases (Bullock et al. 1995). Therefore, it is possible that the rate of successional processes converting the habitat of these species will increase over time. Since flight dispersal in these species is limited, possibility of fragmentation dividing population occurrences is a real threat. This is especially problematic in the MHJB where flightless females likely cannot disperse over long distances through complex and unsuitable habitat. The limitation on female dispersal in this species also has implications for extinction events on individual habitat patches. While some species may recolonize habitat previously occupied by an extirpated population, the inability of females to disperse to such a habitat may make those extirpations permanent.

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental

drying (Field et al. 1999, Cayan et al. 2005, IPCC 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species at this time. Therefore, the unpredictable impacts of climate change on Sandhills habitat makes it impractical for the Service to determine the effect on the ZBWG and MHJB.

III. RECOVERY CRITERIA

According to the recovery plan, the recovery objective for the ZBWG and MHJB is removal from the U.S. Fish and Wildlife Service's list of threatened and endangered species. At the time the recovery plan was written, four of the five listing factors were identified as potential threats to the persistence of these species. Listing factor C was not identified as a threat to either species.

Interim downlisting criteria:

Applicable only to ZBWG:

The 7 discrete areas of sand parkland containing the 10 currently known collection sites have been secured through fee-title acquisition, conservation easements, or Habitat Conservation Plans including HCPs for Graniterock Quarry, Kaiser Sand and Gravel Felton Plant, and the County of Santa Cruz.

HCPs have been completed for Graniterock Quarry (Quail Hollow Quarry) and Kaiser Sand and Gravel's Felton Plant (Hanson Quarry). The regional HCP for the County of Santa Cruz has yet to be completed, and it is unclear at this time which species will be covered by this plan and when it will be completed. An IPHCP is being produced that will cover specific neighborhoods and provide incidental take coverage for the MHJB. The IPHCP will not include any areas occupied by the ZBWG.

While the recovery plan indicates 7 discrete areas of sand parkland containing 10 currently known collection sites, these sites are not detailed in the plan and it is not clear where these sites are located or at what scale individual sites are recognized. Therefore, it is not clear specifically which sites are being referenced. For the purposes of this review, we are considering the five discrete areas identified in the aforementioned Spatial Distribution section.

The first area is Quail Hollow County Park (Quail Hollow Ranch). This area is protected as a county park, but has yet to complete or implement any recreational or resource vegetation oriented management plans.

The second area is Quail Hollow Quarry (Graniterock Quarry) area. This area includes three main sub-areas that may contain distinct populations of both insects. These are the North Ridge, West Ridge, and South Ridge. The majority of this area is owned by the quarry and is managed

according to an HCP. Some occupied habitat adjacent to the South Ridge is privately owned without any conservation measures in place and another 23 acres of occupied habitat adjacent to the West ridge is owned by the Zayante Conservation Bank and slated for conservation.

The third area is between East Zayante Road, Olympia, and Mt. Hermon Road. Within this area are the Freeman Site, the old Olympia and Geyer Quarries, the old Ferrari Quarry, and the land separating the quarries. The Freeman Site is being managed as a mitigation site under the HCP for the Hanson Quarry. This HCP is now expired, but the site is being managed in perpetuity by the Center for Natural Lands Management. The Olympia Sandhills Preserve, mentioned in Factor D above, is 76.5 ha (189 ac) of sandhills habitat that was recently sold to the Santa Cruz Land Trust for preservation. It is unknown whether the ZBWG persists at this site, and it is believed that both the ZBWG populations at the old Olympia and Geyer quarries are extirpated (Arnold, in litt. 2002; California Natural Diversity Database (CNDDB) 2006). The remaining lands within this area are unmanaged.

The fourth area is around Mt. Hermon proper from just across Graham Hill Road in Henry Cowell State Park to Mt. Hermon Road and from the east side of the old Kaiser/Hanson Quarry almost to East Zayante Road in the west. The area directly around Mt. Hermon includes property adjacent to Mt. Hermon Peak that is privately owned with no fee title acquisitions or easements in place or in progress. This area is undergoing habitat conversion and no vegetation management activities are being undertaken. The site of Hanson Quarry was managed under an HCP until the recent expiration of that plan. Their permanent management obligations are now being carried out by the Center for Natural Lands Management.

The fifth area was only discovered to be occupied during the 2007 flight season. This area is located on private property between Kings Village Road and Green Valley Road in the city of Scotts Valley (Arnold, pers. comm. 2007c). Very little is known about this population at this time.

Since the areas identified as in need of securing have not all been secured at this time, we consider that this recovery criterion has not been fully met.

Applicable only to MHJB:

The 28 currently known sites have been secured through fee-title acquisition, conservation easements, or Habitat Conservation Plans including Graniterock Quarry, Kaiser Sand and Gravel Felton Plant, County of Santa Cruz, and the City of Scotts Valley. Conservation easements should be negotiated with private landowners not included in Habitat Conservation Plans for high-priority and medium-priority parcels in sandhills habitat.

The regional HCP for the County of Santa Cruz has yet to be completed, and it is unclear at this time which species will be covered by this plan and when it will be completed. The IPHCP that is being produced will cover specific neighborhoods and provide incidental take coverage for the MHJB.

While the recovery plan indicates that 28 known sites should be secured, these sites are not detailed in the plan and it is not clear where these sites are located or at what scale individual sites are recognized. Therefore, it is not clear specifically which sites are being referenced. For the purposes of this review, we are considering the eight discrete areas identified in the aforementioned Spatial Distribution section.

The first area is Quail Hollow County Park (Quail Hollow Ranch). This area is protected as a county park, but has yet to complete or implement any recreational or resource oriented management plans.

The second area is Quail Hollow Quarry (Graniterock Quarry) area. The majority of this area is owned by the quarry and is managed according to an HCP; however, some occupied habitat adjacent to South Ridge is privately owned and another 23 acres of occupied habitat adjacent to West Ridge is owned by the Zayante Sandhills Conservation Bank.

The third area is between East Zayante Road, Olympia, and Mt. Hermon Road. Within this area are the Freeman Site, the old Olympia and Geyer quarries and private land separating them, and the old Ferrari Quarry. The Freeman Site is being managed as a mitigation site under an HCP for the Hanson Quarry. This HCP is now expired, but the site is being managed in perpetuity by the Center for Natural Lands Management. The rest of these sites are currently unmanaged.

The fourth area is around Mt. Hermon proper from just across Graham Hill Road in Henry Cowell State Park to Mt. Hermon Road and from the east side of the old Kaiser/Hanson Quarry almost to East Zayante Road in the west. The area directly around Mt. Hermon includes property adjacent to Mt. Hermon Peak that is privately owned with no fee title acquisitions or easements in place or in progress. This area is undergoing habitat conversion and no vegetation management activities are being undertaken. The site of Hanson Quarry was managed under an HCP until the recent expiration of that plan. Management of their mitigation lands is now being carried out by the Center for Natural Lands Management. Additionally, the Meyer HCP was completed to plan for development of a single family dwelling near the city of Scotts Valley.

The fifth area is located on private property between Blue Bonnet Road, Green Valley Road, and Lockhart Gulch Road in the city of Scotts Valley (Arnold, pers. comm. 2007c). Very little is known about this population at this time and the land is not secure.

The sixth area is north of Quail Hollow County Park in the West Lompico area. This is privately owned land and not secure at this time.

The seventh area is located in the Redwood Glen area off Bean Creek Road, Scotts Valley. This population was only discovered in August of 2008 (McGraw, pers. com. 2008c). This population is on private property where only one individual has been observed.

The eighth area is on privately owned land west of Bonny Doon Ecological Reserve. This occupied habitat was only recently discovered (McGraw, in litt. 2008) and the land is not secure at this time. Approximately 248 hectares (613 acres) of sandhills habitat exists in this area (McGraw 2004b). It is unknown how much could be occupied by the MHJB at this time.

High-priority parcels identified by the recovery plan are between Mission Springs, Mt. Hermon Road, and the town of Olympia. At the time of this review, to our knowledge no attempt to establish conservation easements has been made. Medium-priority parcels are between Highway 17 and Henry Cowell Redwoods State Park along Graham Hill Road. This is a long stretch of land and much of it is not sandhills habitat. Habitat south of Mt. Hermon Peak, on the south side of Graham Hill Road, and inside Henry Cowell Redwoods State Park appears to be sandhills habitat by examination of satellite images. This habitat should be protected as it is within the boundaries of Henry Cowell Redwoods State Park. Further habitat identified as medium-priority is described as north of Lockhart Gulch, but south of Gibbs Avenue. The establishment of the Zayante Conservation Bank has provided an outlet for mitigation requirements to be met where funds may focus on key, high-value parcels of sandhills habitat for purchase and conservation.

Since the majority of areas identified as in need of securing have not been secured at this time, we consider that this recovery criterion has not been fully met.

Applicable to both ZBWG and MHJB:

Management plan for Quail Hollow Ranch County Park developed and being implemented.

At the time of this status review the management plan for Quail Hollow Ranch County Park was still being developed. Therefore, we consider that this criterion has not been met.

Population numbers are stable or increasing.

While actual trend information on ZBWG is unavailable, based on continued loss and alteration of habitat it is believed that this species is in decline across the entirety of its range (Arnold, pers. comm. 2007a). While available data on MHJB seems to indicate that monitored populations are stable (Table 2), the limited duration of monitoring efforts are not sufficient to draw meaningful conclusions regarding population trends range-wide (Arnold pers. comm. 2007a). Therefore, we consider that this criterion has not been met.

IV. SYNTHESIS

The primary threat to these species at the time of listing was habitat destruction due to sand mining (Service 1998). Much of the historical habitat for ZBWG and MHJB was destroyed by mining and the remaining habitat has been degraded and heavily fragmented. Based on current research, it appears that efforts to restore degraded habitat have not been successful. Mining activity has been reduced since the ZBWG and MHJB were listed, and many of the quarries are either closed or nearing closure (McGraw 2004b; Davilla, pers. comm. 2006). However, approximately 80 percent of the original 405 ha (1,000 ac) of sand parkland has already been destroyed, much of which was directly due to mining (Lee 1994; McGraw 2004b). As a result, even minor losses of the remaining habitat are now important to the future status of the species. Early mines did not require habitat conservation measures to be permitted, and three of the six mines operated in sandhills habitats were closed and left as is with no habitat restoration or

revegetation attempted. Where restoration of sandhills habitat has been attempted, it has met with limited success (Davilla, pers. comm. 2006; Schettler, pers. comm. 2006). Residual effects from mining, including habitat fragmentation, also pose a serious challenge to future conservation efforts.

Alteration of habitat due to suppression of natural fire cycles is now the predominant threat preventing the recovery of the ZBWG and MHJB. Fire suppression continues throughout the Santa Cruz sandhills and conversion of habitat is widespread. Introduction of fast-growing and hardy non-native species has exacerbated this problem. Arnold (pers. comm. 2007a) believes that ZBWG and to a lesser extent MHJB populations are in a state of decline and that the reduction in available habitat due to successional processes is now largely to blame. Rates of annual encroachment indicated by McGraw's unpublished data (2004) at around 0.8 percent annually will reduce remaining "islands" of open habitat quickly. As these successional processes continue, increased habitat fragmentation, reduction in fragment sizes, and declines in numbers of individuals and populations will increase the risk of stochastic extinction events, further reducing chances for recovery of these species.

The result of the threats to these species mentioned above has likely been a decline in numbers across most of the occupied sandhills habitats. A lack of consistent monitoring efforts makes interpretation of population trends speculative. At least three populations of the ZBWG are believed to be extirpated. The closest reliable measure that can be used to infer population trends for these species is related to available habitat. Sand parkland habitat has been reduced by approximately 80 percent over a 60-year period. While the foremost threat to sandhills habitat identified at the time of listing, sand mining, has been much reduced, habitat is still being lost via this mechanism and other threats have become more severe. Habitat conversion in the sandhills due to the suppression of natural disturbance factors, such as fire, is a continuing threat to sandhills habitat. Conversion of the patch mosaic created by episodic fires to a uniform habitat "frozen" in a late successional stage would eliminate necessary habitat for many species, including the ZBWG and MHJB and the other listed species endemic to the Zayante sandhills. Considering that this conversion rate may be accelerating and habitat fragmentation is increasing, open habitat species that are already rare in the sandhills are unlikely to recover without the employment of more aggressive management strategies.

Effective management of any rare species is usually contingent upon reliable data regarding distribution, range, population numbers, and population trends. Although not traditionally considered a threat, the absence of such data slows management actions and makes intelligent, well-planned management decisions that may result in positive change on a declining population exceedingly difficult. This is the case that we are presented with regarding both of these endangered insects.

In conclusion, we are not recommending a change of status for either the ZBWG or the MHJB at this time for the following reasons: only a small number of populations of both species still exist; only a remnant of the original habitat for both species remains; and existing threats to both species persist, especially from habitat succession due to disrupted fire cycles. Under these conditions, extinction of both species could occur in a relatively short period of time, possibly in as little as 50 years.

V. RESULTS

Recommended Listing Action:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (indicate reason for delisting according to 50 CFR 424.11):
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
_X__ No Change

New Recovery Priority Number and Brief Rationale:

We recommend a recovery priority number change from 8 to 5 for the ZBWG. The rationale for this change is the continuing loss of suitable habitat due to woody plant encroachment leading to habitat conversion and the relative absence of management mechanisms in place to deal with this threat. At the current rate of 0.82 percent annual encroachment predicted by McGraw (unpubl. data 2004), it could take as little as 36 years for sandhills parkland habitat suitable for this species to drop below a total of 0.2 ha (0.5 ac). The designation of recovery priority number 5 would indicate a species under a high degree of threat, with a low recovery potential.

We recommend no change in recovery priority number for the MHJB. While under considerable threat, this species has less restricted range requirements than does the ZBWG thereby reducing the level of threat to this species.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

1. The recovery plan should be updated. Measurable recovery criteria should be included and the current downlisting criteria should be clarified. Specifically, the sites listed for fee-title acquisition should be clearly identified so that they may be located and surveyed.

2. Active management should be employed to prevent encroachment of both native and non-native plant species in fire-suppressed areas that threaten habitat type conversion that may lead to extirpation of individual populations. Prescribed burns mimicking natural fire cycles may be used to create a habitat mosaic inclusive of persistent denuded areas. This may require large, initial burn areas with subsequent mosaic patches burned into emerging chaparral shrubs prior to first seed set. This method may be the most effective way to thin vegetation and restore open habitat; however, in many areas the proximity of human habitation precludes this as an option. Mechanical means of vegetation and leaf litter removal (i.e., raking) have proven effective in reducing the chances of habitat type conversion (McGraw 2004a, 2004b). Effectiveness of this method to improve sandhills habitat and increase reproductive success in Ben Lomond wallflower is being examined at the Bonny Doon Ecological Reserve. Similar investigations should be initiated in habitat occupied by ZBWG and MHJB. The effects of mechanical or manual vegetation management methods should be evaluated for potential effects on what Colvin (1997)

referred to as the "egg pod bank" (eggs in development within the soil) in addition to fossorial juveniles and adults. Further, investigation into the effects of above-surface fire on subterranean egg pod banks, juveniles, and adults should be included to determine whether a "steaming" effect may cause mortality to any of these stages during wet-season fires which are often used for controlled burning purposes. All areas of potentially suitable habitat that are cleared by these methods or are cleared naturally (e.g., by fire) should be monitored to identify re-colonization potential of these insects and to track occupied habitat. Outreach to local landowners in these areas may facilitate the implementation of such management strategies over larger, contiguous pieces of occupied habitat and thereby maximize the conservation potential of all remaining populations. Vegetation clearing efforts could also be approached from a fuels reduction angle, which may benefit all parties involved.

3. Surveys and monitoring should be undertaken for all known populations and potentially suitable habitat areas to ensure that all populations are identified, population trends are tracked, and reliable demographic information is collected. Outreach to owners of private holdings with potentially conservable habitat and populations should be attempted and permission should be secured to survey these private holdings where necessary. Specifically, all populations listed in the CNDDB and McGraw (2004b) should be surveyed to focus future recovery efforts. Focus areas with suitable habitat, but not known to be occupied by either species (not listed in the CNDDB records) include: areas between and surrounding Vista Robles Drive and Marion Avenue in Ben Lomond, the area north of Quail Hollow County Park, the areas north of the intersection of Pine Flat Road and Bonny Doon Road in Bonny Doon, the area between Martin Road and Pine Flat Road in Bonny Doon, and Weston Ridge north of Scotts Valley and Felton. Additionally, coordination of recovery partners and consolidation of population data into the CNDDB records should be undertaken.

4. Genetic analyses should be undertaken to determine the relatedness of individuals from different populations. This would give an indication of gene flow between groups and fill in species information regarding genetic variation between or within populations and whether there is any sort of genetic bottleneck affecting these populations. This information in turn may indicate geographic isolation, the timescale of such isolation, and whether inbreeding depression may be placing such populations at an elevated risk of stochastic extinction.

5. The IPHCP and eventually the Regional HCP should be completed. These plans will streamline permitting and conservation efforts and allow more effective use of the Zayante Sandhills Conservation Bank as a mitigation tool.

VII. REFERENCES CITED

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Zayante band-winged grasshopper (*Trimerotropis infantilis*)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change needed

Review Conducted By: _Christopher West_____

FIELD OFFICE APPROVAL:

Field Supervisor, U.S. Fish and Wildlife Service

Approve Diane K Noda Date 8/11/09

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Mount Hermon June beetle (*Polyphylla barbata)*

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change needed

Review Conducted By: _Christopher West_____

FIELD OFFICE APPROVAL:

Field Supervisor, U.S. Fish and Wildlife Service

Approve Diane K Noda Date 8/11/09