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Field studies and management recommendations
for Myrtle's silverspot butterfly
at the Point Reyes National Seashore

Alan E. Launer
Dennis D. Murphy

Center for Conservation Biology
Department of Biological Sciences
Stanford University, Stanford CA 94305

Introduction

On June 22 1992, the U.S. Fish and Wildlife Service issued a final ruling that conferred protection to Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) under the Endangered Species Act of 1973 (as amended). This ruling, designating the Myrtle's silverspot butterfly as an endangered species, was deemed justified in order to protect this insect from imminent extinction due to projected habitat loss, associated proposed residential and commercial development, and habitat degradation, resulting from improper grazing regimes and invasion of alien plant species.

Myrtle's silverspot butterfly is a generally recognized subspecies in the diverse *Speyeria zerene* species complex. Populations of this butterfly species are found scattered across western North America, from the Rocky Mountains west to the coast of central California, and from northwestern Arizona north to southeastern Alaska. Across this region, *Speyeria zerene* populations are found in habitats ranging from coastal dune/grassland communities to inland, mid-elevation sagebrush and forest communities.

A substantial number of described subspecies of *Speyeria zerene* exist. Clusters of *Speyeria zerene* populations that have been designated as distinct subspecies have been defined primarily on the basis of adult butterfly morphology, geographic distribution, habitat type, and, to a limited extent, putative phylogenetic affinities. However, subspecific designations of zerene silverspot butterflies are far from precise, and populations comprised of individuals that are phenotypically intermediate between named subspecies are fairly common. Furthermore, phenotypically intermediate individuals can often be found in low frequencies in otherwise pure populations.

Populations of the Myrtle's silverspot butterfly were formerly found along dunes and bluffs in coastal central California, from San Mateo County in the south, to Jenner

Beach (Sonoma County) in the north (Map 1). North of Jenner Beach and south of Anchor Bay (Mendocino County), populations of individuals that appear to be phenotypically intermediate between Myrtle's silverspot butterfly and Behrens' silverspot butterfly, *Speyeria zerene behrensii*, were known to exist. By the late 1970s all populations south of the Golden Gate were thought to be extinct and Myrtle's silverspot butterfly was considered to be thriving only at Point Reyes National Seashore (Marin County). In 1990, a biological consultant observed Myrtle's silverspot butterflies in abundance in the coastal grasslands north of Estero de San Antonio, at the site of a proposed destination resort (Marin Coast Golf Ranch). This finding triggered studies at the proposed resort site and throughout the historic range of the butterfly. In 1991 and 1992, surveys for adult Myrtle's silverspot butterflies were conducted by researchers from the Center for Conservation Biology (Stanford University). These surveys documented Myrtle's silverspot butterflies in several locations in addition to Point Reyes National Seashore and the proposed resort site including (Map 2), Estero Lane (Sonoma County), Estero Road (Marin County), and the hills north of Dillon Beach and south of Estero de San Antonio (Marin County). With the exception of these three sites, Point Reyes National Seashore, and the proposed resort site (and immediate vicinity), no Myrtle's silverspot butterflies were observed at any other survey sites. In particular, no butterflies were observed in the vicinity of the Bodega Bay Golf Course. Before this portion of the coast was developed for residential and recreational purposes, it was considered one of the largest, or at least one of the most accessible, localities supporting the Myrtle's silverspot butterfly.

In addition to the apparent decline of phenotypically pure populations of Myrtle's silverspot butterflies, phenotypically intermediate populations originally found north of Jenner Beach and populations of Behrens' silverspot butterfly found yet farther north are thought to have declined in recent years, and many of these populations may

be extinct.

However, while it is highly probable that Myrtle's silverspot butterfly is declining, the precise status of the zerene silverspot butterflies in coastal California remains unclear. One population of zerene silverspot butterflies of currently undetermined phylogenetic affinity was recently discovered in eastern Sonoma County, in the vicinity of Sears Point. Individual butterflies from this population range in phenotype from being similar to the coastal *S. zerene myrtleae* to being similar to the inland subspecies *Speyeria zerene zerene*. This population of butterflies, first discovered by researchers from the Center for Conservation Biology in the early 1990's, is currently being described as a new subspecies by S. Mattoon and J. Emmel. In light of this recent discovery, and considering the incomplete database on the distribution of *Speyeria* in central California, there may still be a number of butterfly populations that may be assignable as Myrtle's silverspot butterflies scattered throughout coastal and inland Marin and Sonoma Counties. It is doubtful that any populations of Myrtle's silverspot butterfly still exist south of the Golden Gate.

The habitat of the Myrtle's silverspot butterfly has traditionally been considered to include only low elevation dune and grassland areas, immediately inland from the coast. This habitat is well within the summer "fog belt," a physical setting that ensures comparatively "buffered" environmental conditions. Until recently higher elevation coastal bluff grasslands and scrub were not considered to serve as habitat for the Myrtle's silverspot butterfly. However, this limited view of Myrtle's silverspot butterfly habitat has been shown to be incomplete, and work completed since 1991 has greatly expanded the definition of habitat for Myrtle's silverspot butterflies. Work at the proposed resort site and at Point Reyes National Seashore determined that grasslands and small valleys in rolling hills, up to several miles from the coast (including estuaries) and up to 750 feet in elevation, can be densely populated by the

butterfly. In particular, areas protected from the persistent wind were often found to support large numbers adult butterflies. In these upland areas, *Viola adunca*, the ostensible larval hostplant, is widespread, but is patchily distributed. Also in these areas, native plant species that potentially could provide nectar are generally scarce, and bull thistle, *Cirsium vulgare*, tends to be the most frequently visited nectar source. Consequently, adult butterflies are apparently attracted to the comparatively moist areas that support this alien thistle.

The life cycle of Myrtle's silverspot butterfly is typical for species of the genus *Speyeria*. Eggs are deposited singly or in small groups throughout the summer adult butterfly flight season. These eggs are laid on or near plants of the genus *Viola* (violets). The violet associated with Myrtle's silverspot butterflies at Point Reyes and elsewhere in coastal California is *Viola adunca*, and at Point Reyes these violets are senescent by late July. Myrtle's silverspot butterfly eggs hatch in one to three weeks, depending on weather conditions. Immediately upon hatching, the larvae usually devour the by then empty egg cases, and wander off unknown, but undoubtedly short, distances (the newly hatched larvae are only a few millimeters in length). The larvae enter a diapause that is sustained until the following winter. During winter, some combination of conditions that include moisture, photoperiod, and temperature serve to "waken" larvae from dormancy, presumably after rains have allowed for violets to produce new growth sufficient to sustain butterfly larvae. The larvae feed for several months, and most probably pupate in May or early June.

Speyeria larvae are notoriously difficult to observe since they are crepuscular, or possibly even nocturnal in warmer areas, and apparently have a habit of feeding and then dispersing into surrounding foliage for undetermined periods of time. Individuals exist as pupae for two to three weeks, and exist as adult butterflies for two to five weeks. It is unknown exactly when most mortality occurs, but several of the life

history stages certainly are vulnerable. In particular, diapausing larvae and smaller post-diapause larvae are probably susceptible to a variety of physical threats (especially limited or excessive moisture) and starvation if diapause is too long or if *Viola* foliage is not available. Predation on larval stages by invertebrate predators (mainly ants and spiders) may cause sufficient mortality to impact overall population dynamics, but predation on adult butterflies and on post-diapause larvae by vertebrates is probably not a factor.

Review of 1992 research activities at Point Reyes National Seashore

In 1992, a mark-recapture study was designed as the first step in estimating number of Myrtle's silverspot butterflies at the Point Reyes National Seashore and in delineating the geographic range of constituent populations. This proposed study, requiring the handling of specimens, was halted when the butterfly was unexpectedly listed immediately prior to the field season. As no Myrtle's silverspot butterflies were allowed to be handled in 1992, field activities were redesigned in order to investigate general distribution patterns at Point Reyes National Seashore, and to design and test a long-term monitoring scheme (see "Report on the 1992 status of Myrtle's silverspot butterfly, *Speyeria zerene myrtleae*, at Point Reyes National Seashore," an unpublished report submitted to Point Reyes National Seashore by H. R. Sparrow and A. E. Launer).

Results from 1992 field activities indicated that Myrtle's silverspot butterflies exist in two broad geographic zones at the national seashore -- at the tule elk range at Tomales Point and throughout the central portion of the seashore from coastal dunes to bluffs and hills along the east side of Drake's Estero. In the tule elk range, the butterflies were found primarily in upland grassland and scrub. In the central location, butterflies were found in both low elevation dune and scrub communities and in

upland grassland and valley areas.

In four areas (see the 1992 report), preliminary transects designed to allow long-term monitoring of the butterfly were established and monitoring protocols developed. These transects were marked with metal and wooden stakes, and were each walked on at least three occasions. Results from these activities indicated that to compensate for daily variations in butterfly activity and seasonal variations in butterfly distribution and abundance, each transect would need to be walked on a minimum of six occasions, and preferably on as many as ten occasions. Additionally, it was determined that the visits must be scheduled throughout the butterfly flight season, with monitoring activity initiating in early July and terminating in late August or early September. Given the problems associated with variable weather at Point Reyes, successful sampling in all four areas throughout the season will be difficult to complete.

Field activities in 1993

Our studies during the 1993 summer field season focused on three research activities. The first activity continued investigations of the general status of the butterfly at Point Reyes National Seashore. The second included a mark-recapture study centered at the dune/scrub interface at North Beach, one of the areas known to support comparatively high numbers of butterflies. The third activity evaluated further the efficacy of monitoring protocols that were developed in 1992.

Methods

Point Reyes National Seashore was visited by Center personnel on 18 occasions during a six week span starting in the first week of July 1993. During these visits, portions of 37 person-days were spent on site. Six of these visits (nine person-

days) were spent investigating butterfly distributions, and walking the monitoring transects. These visits were designed to provide a coarse-grained assessment of butterfly distribution. The remaining 12 visits (28 person days -- the majority of the 1993 activities) were spent conducting a mark-recapture study centered at North Beach.

The mark-recapture study (under Federal Fish and Wildlife permit number PRT-775311) was conducted according to the techniques discussed in Ehrlich and Davidson 1960 ("Techniques for capture-recapture studies of lepidoptera populations," *Journal of the Lepidopterists' Society*). This method has not been found to negatively impact physically large and robust butterflies, such as Myrtle's silverspot butterfly. Data were analyzed using a standard Jolly-Seber population estimation program.

Results and discussion

General status of Myrtle's silverspot butterfly

At Point Reyes National Seashore, the 1993 surveys indicate that the general distribution of the butterfly did not appreciably differ from the distribution noted in 1992. Myrtle's silverspot butterflies were again observed in the tule elk range at Tomales Point, as well as scattered throughout the central portion of the national seashore. The numbers of butterflies observed in 1993, however, were generally lower than those observed in 1992. The frequencies of observations of Myrtle's silverspot butterflies at the proposed resort site north of Estero de San Antonio were also lower in 1993 than in either 1992 or 1991. It is our opinion that a small region-wide decline in the number of Myrtle's silverspot butterflies occurred in 1993, and that the lower number of observations were not an artifact of sampling. This decline is most likely a short-term response to weather conditions and not necessarily indicative of long-term population trends.

Mark-recapture of Myrtle's silverspot butterflies at North Beach and structure of the butterfly population

Seventy-six Myrtle's silverspot butterflies were individually marked during the mark-recapture study, and 24 recaptures were recorded in 1993. The 76 marked individuals included 38 of each sex. Estimates for the number of butterflies at least visiting the North Beach site range from 250 to 750 individuals. The relatively small number of adult recaptures precludes a more precise estimate.

Based on condition at first capture, butterflies appear to have begun emerging from pupae at Point Reyes during the last week of June 1993. Individual butterflies continued to emerge until early August. Given the two to five week "lifespan" of adults, adult butterflies were likely present at Point Reyes until mid-September 1993. As is typical of most butterflies, the timing of the male and the female butterfly flight seasons differed. In 1993 adult male butterflies reached peak abundance at the end of July, while adult females butterflies did not reach peak abundance until seven to ten days later.

The estimate of between 250 to 750 individual butterflies should not be taken as an estimate of overall Myrtle's silverspot butterfly population size in central Point Reyes since we were unable to spatially delineate the boundaries of the population. Moreover, there are several different possibilities for Myrtle's silverspot butterfly population structure in central Point Reyes. The potential population structure extremes at Point Reyes are on the one hand a single large and diffuse population (with "hot spots" of butterfly abundance), and on the other, a number of geographically small, demographically independent populations. Some evidence exists supporting both of these alternatives.

At Point Reyes high concentrations of nectar-producing plants draw butterflies

from unknown distances. In the case of North Beach, some butterfly reproduction probably occurs within several hundred meters of North Beach as documented by three mating pairs captured there in 1993. It is unlikely that either unmated females or mating pairs fly more than several hundred meters. Conversely, observations that imply movements over more considerable distances, even on the order of several kilometers, have been noted. During both study years there were numerous observations of butterflies flying through the grasslands east of North Beach, across the main road, both toward and away from the estero. While conclusive proof of movements between distant population centers would be desirable, the practicalities of conducting a mark-recapture in areas supporting low butterfly densities eliminated this option (note that after a few attempts, it was deemed impractical in 1993 to conduct a mark-recapture study in areas lacking abundant nectar resources -- in the upland areas butterflies were encountered too infrequently).

Further insights on the population structure of the Myrtle's silverspot butterflies at Point Reyes may be obtained from work completed at other sites. At the proposed resort site, a more intensive mark-recapture study conducted in 1991 showed that Myrtle's silverspot butterflies generally stayed within circumscribed topographic units, at that site discrete drainage systems within wind-protected valleys and moist flatlands. Within such areas individual butterflies were documented to move 1500 meters. Transfers between topographic units, which would have entailed dispersal across hundreds of meters of exposed grasslands, were not recorded. It was concluded that between occasional topographic-unit transfers did occur, but that such transfers occurred comparatively infrequently. It has also been noted that Oregon silverspot butterflies (*Speyeria zerene hippolytta*) routinely fly kilometers from ostensible oviposition areas to concentrations of nectar.

The sex ratio observed at North Beach in 1993 (50:50) may also be indicative

that only a subset of the population was being captured. In general, female butterflies are less likely to be encountered than are male butterflies. This results in mark-recapture studies of butterflies nearly always handling many more males than females. Indeed, most estimates of butterfly population size are based on doubling the estimate of male butterflies and ignoring data on female butterflies. The few instances in which more females than males are captured typically occur when sampling is restricted to the end of the flight season (butterflies, and *Speyeria* in particular, are generally protandrous), or when sampling occurs where abundant nectar sources attract females from surrounding areas (*Speyeria* males apparently nectar less frequently than do females). As the first possibility is unlikely, the timing of the 1993 study indicates that if anything females may have been undersampled, it is probable that the North Beach study site represents just a portion of the geographic range of the Myrtle's silverspot butterfly population(s) at central Point Reyes.

Whether butterflies present at North Beach are members of the same population as those butterflies observed at South Beach, the east side of Drake's Estero, or in the vicinity of Drake's Beach, is unresolved. However, given the dispersal abilities of the butterfly and our observations from last two field seasons, we feel it is likely that all the Myrtle's silverspot butterflies in central Point part of a single diffuse population.

The butterflies at Tomales Point are most likely geographically isolated enough to be considered a demographically independent population.

Evaluation of long-term monitoring

A majority of the stakes indicating key points along the monitoring transects established in 1992 had been removed by the 1993 study period. In most cases, stakes were observed lying on the ground in the general vicinity where they had been left, but in several instances they were simply gone. The disappearance of these

markers presents a real problem for the design of long-term monitoring at the Point Reyes National Seashore. Future monitoring transects will probably have to rely on landscape-level features or cryptic markers, such as buried "rebar," for locating key points.

Additionally, the reasons for long-term monitoring need to be clarified because monitoring is neither an easy nor an inexpensive task -- any monitoring scheme must *a priori* clearly identify the appropriate level of information needed to trigger a management response. An important corollary is that if there are no management responses available to deal with the findings from a long-term monitoring study, then monitoring should not be undertaken; certainly documenting extinctions is interesting, but conservation monies are much better spent on activities that may actually aid in the preservation of biotic diversity.

Conclusions and recommendations

At the present time, populations of Myrtle's silverspot butterfly at Point Reyes National Seashore are apparently robust. Granted, little of the information necessary to conduct population viability analyses is presently available (and will not be available in the foreseeable future), but the geographic extent of the butterfly at Point Reyes and the estimated number of butterflies indicate that the butterfly is not in imminent danger of extinction -- it is very likely that Myrtle's silverspot butterflies will persist at Point Reyes National Seashore for at least 10 years even without any conservation activities designed specifically for their protection. However, given the current lack of knowledge concerning the long-term impacts of grazing and the likely negative impacts of alien plants species on the Myrtle's silverspot butterfly, it should not be assumed that the butterfly populations at Point Reyes are stable and will be extant in 50 years. While it is impossible to document long-term population trends at

Point Reyes, considering the levels of human activity in the area, and considering the disappearance of the butterfly from other physically similar circumstance, it is probable that there have been significant declines of Myrtle's silverspot butterflies at the Point Reyes National Seashore during the last one hundred years. Clearly, land management practices that focus on the butterfly need to be developed and implemented. Future work on Myrtle's silverspot butterfly at Point Reyes National Seashore should include the following:

1) Delineation of the distribution and sizes populations. While more information on butterfly population structure at Point Reyes is desirable, there are several limiting factors. Unfortunately, precise delineation of butterfly populations is a labor intensive task. In order to improve upon the 1993 results, many more butterflies need to be marked and recaptured. In scrub and dune areas of Point Reyes, Myrtle's silverspot butterflies are difficult to capture, and in grassland areas, butterflies are generally found in low densities -- indicating that a considerable amount of time would be required to significantly improve the quality of the results. A rough estimate of the amount of effort required to reach this next level of resolution is approximately ten-times that of the 1993 effort. Even if funding were available, it would be appropriate to ask whether the money would be better spent on other conservation activities.

We also have scientific reservations about suggesting intensive mark-recapture studies at Point Reyes. Because such studies would by necessity focus on areas of high butterfly abundance, it is unclear that the vegetation in such areas could support a high level of concentrated human activity.

Molecular techniques could be used to characterize populations. While this would necessitate the taking of specimens, this could be accomplished with limited impact on the populations by late-season sampling of old males. Such a sampling could be used to identify metapopulations and effective population sizes (N_e), and would be most useful if specimens from north of PRNS were included.

2) Distribution of *Viola*. Late winter and early spring field studies at PRNS should be conducted in order to document the distribution and abundance of the presumed larval host plant, *Viola adunca*. At the proposed resort site, physical and biotic environments, including topography and soil type, and land-use practices, both current and historical, apparently affect the distribution of violets. Although at the proposed resort site the violets proved much more widely distributed than adult Myrtle's silverspot butterflies, information on distribution of the violets allowed areas supporting high densities of both butterflies and violets to be targeted for future work and for conservation activities.

3) Distribution of potential nectar sources. Late spring and summer field studies should be conducted at PRNS to document the distribution and abundance of native and alien plant species potentially providing nectar to Myrtle's silverspot butterflies. At the proposed resort site, the physical and biotic environments, including topography and soil type, and land-use practices, both current and historical, apparently affect the distribution of those plant species.

4) Refinement of the long-term monitoring plan. When coupled with information from the 1992 and 1993 study seasons, data on the distribution and abundance of larval host plants and adult nectar sources should allow for a more efficient long-term monitoring plan to be designed. This plan should be designed in order to answer specific questions concerning changes of relative abundance of the butterfly and questions on the efficacy of various management practices.

In addition to the short-term activities, long-term conservation planning for Myrtle's silverspot butterfly at Point Reyes National Seashore should consider the following points:

- 1) An important outcome of the studies on the distribution and abundance of larval and adult host plants would be the identification of grazing regimes that are potentially detrimental or beneficial to the plants that the butterfly depends upon. After the broad patterns are assessed, experimentation involving sheep, cattle, and tule elk could be conducted in order to fully develop appropriate grazing regimes.
- 2) Alien plant species have invaded virtually all biological communities in central California. The impacts of such invasions on native biotic diversity are almost universally negative, but the extent of the impact in most cases is unknown. At Point Reyes, alien plant species are ubiquitous, and may be completely replacing native species in some areas. In particular, dune communities appear to be susceptible to becoming mounds of iceplant. As these dune communities apparently provide nectar resources to Myrtle's silverspot butterflies, loss of the

native wildflowers could result in a significant negative impact to the butterfly (note that during three years of study, no Myrtle's silverspot butterflies were observed to visit iceplant flowers). Studies need to be conducted in an effort to determine the extent that alien plant species are impacting the butterfly. Note that not all impacts will be negative as in upland areas the alien bull thistle is commonly visited by the butterflies.

3) A potential problem of overgrazing by tule elk exists at Tomales Point. While a hands-off management plan has been recommended for the tule elk herd at Tomales Point, it may become necessary to reduce the number of elk if plant communities supporting *Viola* and nectar-providing sources are being negatively impacted. If in the future, there is a conflict between management of the Tomales Point area for the tule elk versus management of the site for Myrtle's silverspot butterfly, it must be noted that the elk are the result of a well-documented introduction, while the site is one of the few, probably fewer than five, remaining sites supporting a natural population of Myrtle's silverspot butterfly. While it is doubtful that a conflict will arise, a very strong argument can be made for managing Tomales Point area for the butterfly as opposed to managing the area for elk.

4) Areas to be managed for the Myrtle's silverspot butterfly need to be designated. Eventually, the designation of areas to be managed specifically for the butterfly could serve as focal points for the preservation of many of the native animal and plant species at Point Reyes. Such areas could include multiple biological community types

(dune, scrub, and grasslands), and representative topographic diversity. Within each management zone, efforts to eliminate alien plant species, and efforts to implement proper grazing regimes could be concentrated. Two such areas, one at Tomales Point, and one extending from North Beach to Drake's Estero, might be sufficient. Note that considering the uncertainty of the long-term impacts of management practices, it would be best to leave some areas presently supporting butterflies "as is." (in general, placing all areas known to support a target organism under a single management regime is not a sound management option). Note that the role of fire as a management option should also be investigated.

5) While it is doubtful that illegal collecting constitutes a major threat to this butterfly, vigilance within the National Seashore needs to be maintained. In particular, areas supporting comparatively high concentrations of female butterflies, such as North Beach, should to be patrolled during the summer butterfly flight season. An important aspect in the protection against illegal collecting of this butterfly, and indeed all of the organisms, at Point Reyes, is the consistent and reasonable enforcement of policies on illegal collecting. The Seashore needs to state specifically the policies, both in the form of pamphlets and summary signs.

On the subject of collecting, the existence of private inholdings at Point Reyes present difficult problems for enforcement. For example, specimens of organisms not specifically protected by wildlife laws, such as the Endangered Species Act, may be legally collected from private inholdings. This loophole is a problem. Organisms supposedly

protected by the rules controlling collection of specimens within the Seashore, but that have populations straddling inholdings, may be threatened by legal collecting. Additionally, the inholdings render off-site enforcement nearly impossible -- specimens labeled as being collected in "Point Reyes" or even "North Beach, Point Reyes" may have come from inholdings and, therefore, be legal to possess or to sell.

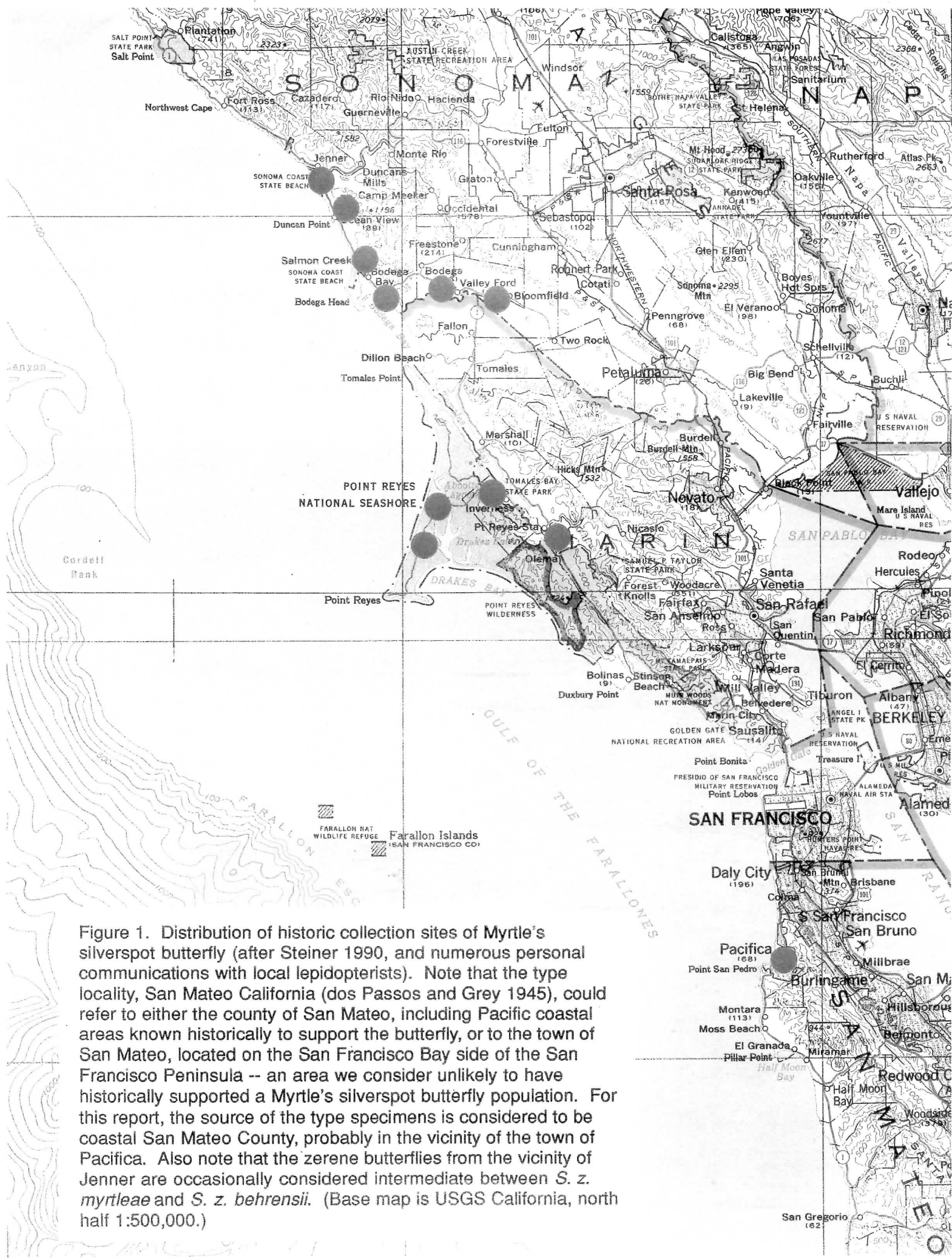


Figure 1. Distribution of historic collection sites of Myrtle's silverspot butterfly (after Steiner 1990, and numerous personal communications with local lepidopterists). Note that the type locality, San Mateo California (dos Passos and Grey 1945), could refer to either the county of San Mateo, including Pacific coastal areas known historically to support the butterfly, or to the town of San Mateo, located on the San Francisco Bay side of the San Francisco Peninsula -- an area we consider unlikely to have historically supported a Myrtle's silverspot butterfly population. For this report, the source of the type specimens is considered to be coastal San Mateo County, probably in the vicinity of the town of Pacifica. Also note that the zerene butterflies from the vicinity of Jenner are occasionally considered intermediate between *S. z. myrtilae* and *S. z. behrensii*. (Base map is USGS California, north half 1:500,000.)



Figure 2. General distribution of Myrtle's silverspot butterfly. Shading indicates areas where Myrtle's silverspot butterflies were observed during this study. The stippled area indicates an area where the butterfly was likely to have existed during the study period, but where access was limited. (Base map is USGS San Francisco Bay Region 1:125,000.)