Biological assessment of the greater Ballona Wetlands region: Terrestrial Arthropod species

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April 12, 1991

To keep every cog and wheel is the first precaution of intelligent tinkering

-Aldo Leopold

INTRODUCTION

The following report summarizes findings regarding the terrestrial Arthropod populations of the Playa Vista project area. The study was primarily designed to quantitatively assay two sets of species: those easily identified visually along a regular transect and those collected in pitfall traps situated to sample the major communities of areas most representative of historic conditions. The latter were all located in area B. Groups sampled included insects, arachnids, isopods, millipedes, and centipedes. A section is devoted to background information and discussion of all species of special interest, as efforts were made to survey their status. A comprehensive summary is presented of the total arthropod collections of Nagano (1981) and this study with comparative information from the nearby El Segundo sand dune system and coastal prairie at LAX.

Historical perspectives

The greater Ballona wetlands region was composed of five distinct communities: tidal salt marsh, freshwater marsh, riparian, coastal dune scrub, and coastal sage scrub. The first four communities are all highly degraded today with the entire ecosystem essentially collapsed. This assessment is inferred from the quantitative loss of species among all groups of organisms for which adequate documentation exists. The loss of native species is exacerbated by increases in alien species. Across much of the area alien plants and animals together approach 100% of the total biomass. A map of extrapolated historic community distributions, figure 1, presents one concept superimposed over the 1894 Geological survey quadrangle. Each community was essentially defined by functional relationships of the suite of plant species uniquely adapted to the Ballona physical environment. Resident herbivore arthropod populations historically must have been substantially different assemblages than today because of massive changes in the flora (Hendrickson, pers.

comm.). By the time the first aerial photographs were made in the late 1920's (figure 2), extensive change occurred and what is now the Playa Vista site had already been substantially denaturated. Today the sole vestiges of the historic eco-system with any native value are the coastal sage covered Ballona bluffs, small areas of freshwater marsh, sand dunes, and the pickleweed seasonal wetland. The remainder is an open space biological junkyard of trash species with a few flying charismatic jewels making periodic overflights.

Each of the five communities was physically discrete with clearly defined edges, excepting the tidal marsh/freshwater marsh. The latter provided a dynamic ecotone that varied both seasonally and spacially depending on the vagaries of weather conditions and interactions of floodwater with some constant stream flow, all of which were superimposed on the regular daily tidal cycles and high water table. This ecotone must have been relatively vast (Henrickson, pers. comm.). Today the ecotone is nonexistent. Its homolog may be that edge between introduced weeds as iceplant and the saltgrass-pickleweed marsh. The latter community is now supported by brackish water formed by rainfall and runoff that leaches the hypersaline substrate. It is completely unnatural in the absence of tidal flow.

The freshwater/brackish area of the marsh may have been far greater than indicated on the map (figure1) by three accounts: continuous drainage from Ballona Creek that must have been necessary to maintain the Ballona lagoon outlet, a high water table and a restricted tidal inflow from the small Ballona outlet relative to the large lagoon area. These factors defined the physical environment that fashioned the historic ecosystem. Although the landscape can never be restored to even approach the historic condition, an environment should be planned to provide for most of the original biota capable of re-introduction and with augmentation of the low density species still present that are approaching extirpation because of demographic and genetic stochasticity.

Arthropod study area

For general planning purposes the 1004 acre Playa Vista development site was divided into four areas: A, B, C, and D. Physical location of the sites is exhaustively described elsewhere in this document. Of the areas, only parts of B and D have any residual natural values with historic continuity. Although some native plant and animal species can be found on A and C, these are entirely vagrants that secondarily became established, in all likelihood from propagules or populations of the bluffs or area B. The survey of terrestrial arthropods, largely insects, reported here was confined to area B.

No formal arthropod surveys were conducted on areas A, C, and D because of their highly disturbed nature and improbability of significant findings. The conclusion was based on a walkover of most of the project and discussion with other biologists familiar to the area. Excepting the Centinela Creek riparian zone and a small part of the southwest corner of D, the vegetation on areas A, C, and D is all secondary and adventitious. Any arthropod associates would be secondary as well. Although succession *may* restore higher densities of some native shrubs, any introduced native arthropods would be immigrants. The chances of finding rare or unique species, especially endemics not present on quad B natural areas, seemed sufficiently remote to have represented a waste of the limited resources. Species likely to be of concern are mostly adapted to specialized habitats that are generally high in the required niche resources. Such resources simply do not occur on converted denatured sites. And the species themselves are even less likely without nearby large populations that can serve as reservoirs for recolonization. A few migrants of interest may occur on these sites, but their occurrence is trivial. Thus a small population of the wandering skipper butterfly (see below) occurs on A as a consequence of a small foodplant population. The magnitude larger population in area B deserves primary attention from a conservation standpoint.We elected to emphasize high concentrations of native plants on more natural areas for detailed treatment. The only native "hot spots" are restricted to area B.

Furthermore, continuing habitat deterioration mitigates against any identifiable arthropods with adapted traits to historic conditions having survived. On the sand dunes, two well known sand obligate populations have been recently extirpated. Neither the dunes ecotype of the Mormon metalmark or Belkin's tabanid fly persist although both were present in the mid-1980's. The western elfin butterfly has also recently been extirpated. Since all three species are associated with habitats that have some, albeit very poor, qualities remaining, the evidence strongly rules against any narrow endemics having survived on the wastelands outside of quad B.

The significance of Arthropods compared with Vertebrates in ecosystem evaluation.

Vertebrates for the most part can be characterized by long lives, low reproductive rates and resource utilization across a number of communities. Arthropods, particularly insects, on the other hand generally have short lives, very high reproductive rates, and highly specialized habitat requirements. The consequence of these life history variables to the understanding of biological values within limited preserves is that they must be provided for. For these reasons vertebrate populations, especially large species, are sensitive to habitat size and fragmentation while persistence of most arthropods at high densities within very small areas require habitats that provides specific resources and suitable abiotic environmental factors (Terborgh, 1988).

Attention to a few flagship or charismatic species as umbrellas or indicators (Noss, 1990) may overlook the value of habitat quality for a large segment of biodiversity. Serious impacts may be occurring for many small vulnerable species while attention is garnered by a few large species. Range requirements of large vertebrates that theoretically provide an umbrella encompassing the distribution of many small invertebrates may overlook specialized habitat quality factors. Consequently, assessment of biotic integrity at any site must consider all life forms and species without prejudice of anthropocentric bias. This view is especially true when viewing open space without regard to species composition (Murphy, 1989).

Prior surveys and taxonomic information

Unfortunately there are no systematic records of the biota of any of these communities prior to the extensive degradation and alteration of the Ballona ecosystem. A few isolated species were recorded early on, such as the sand obligate moths *Copeblepheron sanctaemonicae* and *Euxoa riversii*, which were taken in the 1890's on the "Santa Monica" (Playa del Rey) sand dunes. Terrestrial vertebrates provide the richest historic records with summaries by von Bloeker (1943) and Willets (1933) for birds, von Bloeker (1941) for reptiles and amphibians, and von Bloeker (1938-1940 unpublished notes, Los Angeles County Natural History Museum) for mammals. Early botanizing was sporadic indicated there were three narrow endemics, including two *Astragalus* and one *Potentilla*, genera which tend to support rich guilds of insects. All three endemic plants were extirpated long ago along with any of their monophagous predators. Other data on plant communities can be found in a series of notes of early collectors as Hasse, Munz, Johnson, Davidson, etc. which are archived in local herbaria. These data have not been systematized, but should be prior to specifying a meaningful restoration effort.

The only comprehensive data of terrestrial Arthropods across the Playa Vista site are from the report of Nagano et al. (1981). The study did not include sites C or D, nor any of the bluff area. The recent report by Mattoni (1990a) provides qualitative and quantitative surveys of the El Segundo sand dunes and Los Angeles coastal prairie. Many taxa of both communities occurred into what is now the Playa Vista site. Community composition of the sand dunes must have been virtually identical as the Ballona dunes were a northern extension of the El Segundo dunes. These data are consequently important to both the assessment of expected patterns of biodiversity and in the design of restoration projects. The data of both the Nagano and Mattoni reports are summarized in table 1.

Inspection of table 1 reveals a number of unidentified species, including several that could only be identified to family. This state of affairs is only too common when dealing with most invertebrates and is due to lack of support of taxonomic research by contemporary society. With increasing concerns over conservation issues the inability of conservation-biologists to have simple names available for the large segment of terrestrial natural communities represented by invertebrates is appalling. Beyond the inability to find names for many species lies our total ignorance of life histories and adaptive relationships. The shortcomings of this neglect were sharply focussed by Disney (1989) and Ehrenfeld (1989).

STUDY PLAN AND METHODS

The purpose of this study was to provide baseline information and begin a long term field study on patterns of diversity in the arthropod populations across the entire ecosystem. Such work requires quantitative information that can be simply and repeatably gathered at low cost. Two basic techniques were employed: 1) a routine transect walk to visually census all species that are unequivocally sight determinable and 2) pitfall traps. The pitfall traps were quart plastic tubs 12 cm in diameter and 12 cm deep containing about 200 ml glycol anti-freeze. Wooden lids placed over the traps protected them from rain and blow in. The traps were identical to those used for the LAX sand dunes (Mattoni, 1990a).Specimens were collected by decanting the entire fluid into a large vial and then refilling the trap with fresh glycol. All specimens were later classified, labelled and stored in alcohol. At such time that site is protected from vandalism, two additional quantitative methods will be used: malaise and yellow pan traps. All studies were terminated on 1 April, 1991.

A total of 35 traps were distributed along the transect path to sample all the major extant communities. Servicing was efficient with sample pick-up coinciding with the transect walks. Trap locations are shown in figure 3. All specimens collected were labelled and preserved. The material will be deposited in the Natural History Museum of Los Angeles County. The collections of Nagano (1981) are in that depository.

The transect walk was conducted at regular intervals. The transect path, illustrated in figure 3, extended across the dunes and salt marsh towards the south and east, traversing salt and mud flats, brackish water channels, into the freshwater and upland sites in the vicinity of the gas plant and continuing along the bluff base to the south east end of the site at Lincoln Blvd. Each visual sighting was recorded. All butterflies, dayflying moths, dragonflies, beeflies, robber flies, other large flies and obvious bee and wasp species were noted (table 2). All data were collected by one individual (Rick Rogers) walking at the same time and pace each sampling day. In cases of any question of identity, specimens were netted for close examination. Voucher specimens of most species were collected for future reference.

Other miscellaneous observations and collection efforts were made, including searching for tiger beetles and several flies that were known present in earlier

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surveys. These were special efforts to locate species that had special interest. Overall emphasis was to establish a simple, repeatable sampling program.

RESULTS

Arthropod communities of the recent past and present

The information of Nagano et al. (1981) included semi-quantitative estimates of abundance and associations of each species to specific communities tabulated. The greatest diversity of arthropods in 1980 was in the sand dunes area. Communities of both brackish and fresh water marshes, with their bordering mud- and salt-flats were well sampled, but monotonous. The riparian community was exemplified by collections taken in the willow groves found in the sand dune area. This community is not normal to the area and will be lost once tidal flushing is restored. Communities of the coastal sage community across the bluff slopes, which should far exceed the dunes areas in species richness, were not sampled. Furthermore, information for the bluff communities are almost altogether lacking and may remain always unknowable. This coastal sage associated community has never been thoroughly sampled, under the assumption that it shares a common biota with the geographically related scrub communities across the Los Angeles plain. Unfortunately, the native wildlife of all of these communities met catastrophic change before any were studied and coastal sage is now a *de facto* endangered community (Westman, 1987). The contiguous Baldwin Hills are included in this assessment.

Pattern of present day arthropod populations

The list of all specimens collected for this study are summarized in table 1 along with the data of Nagano et al. (1981). These data are presented in comparison with those from the El Segundo dunes ecosystem survey by Mattoni (1990a). The latter provide an historical baseline since both the sand dunes proper and the coastal prairie communities extended to Ballona. Historically the prairie community was continuous across the Ballona bluffs and onto the western alluvial floodplain of Ballona Creek. Altogether these lists are unique for any part of the Los Angeles coastal plain thereby providing an estimate of arthropod diversity patterns nowhere else available for the general region.

The list includes all species collected by all methods, without regard to relative abundance. Species found only at Ballona in communities other than sand dune are cited at the end of the table. The lack of comparative information on the wetland sites in the table lies in these habitats having never been well sampled historically. Comparisons of the 1980 with the 1990 can only be made with certainty for only those families of insects that were equally sampled. Biases exist because of the different experiences of field workers and methodology. There are also misidentifications and systematic disagreements to deal with and substantial undersampling by everyone. In our study sampling was based almost entirely on pitfall trapping and visual counts, with periodic random collections of aerial netting and foliage beating. We did no light trapping nor used special attractant traps. Thus nocturnal groups, as moths, were poorly documented. On the other hand, ground dwelling insects, as the rove and ground beetles, were very thoroughly sampled. As an example, while Nagano et al. recorded a number of Hymenoptera, we only noted the visually identifiable species along the transects. Conversely, we noted 17 species of beefly against 4 of Nagano et al., a function of Roger's expertise in this group. Overall, however, when the dunes are compared with the LAX dunes, Ballona is clearly depauperate of species in all groups that were equally sampled.

TRANSECT COUNTS. Results of the visual records from the transect walks are given in table 3. A total of 88 species was expected (table 2), with 86 species observed, including 11 seen only once. The pattern of distribution of all the species adequately sampled was highly non-random with only 2 of the 16 species occurring equally across all habitats. Taking samples greater than 30 as meaningful, two general patterns emerge:

1. In overall richness, the sand dune-pickleweed ecotone has twice the density of individuals (2.3 per meter annually), followed by the sand dunes and alluvium (1.2 and 1.2 per meter annually), with fresh and salt marsh communities poorest (0.37 and 0.43 per meter annually).

2. Individual species have highly non-random associations as:

Sand dunes: *Coniophorus fenestratus*

Alluvial wash: *Villa atrata*

Sand dunes and alluvial wash: *Glaucopsyche lygdamus, Callophrys perplexa, Leptotes marina, Strymon melinus*

Dunes-pickleweed ectone: *Polites sabuleti, Panoquina errans, Bembex comata*

Pickleweed marsh: *Perizoma custodiata, Villa lateralis*
Freshwater marsh: *Pyrgus albescens, Bombus sonorus, B. vosnesinskii.*
All habitats: *Poecilanthrax arethusa, Lepidanthrax sp.*

Monarch butterflies were the most commonly seen of all insects. Their distribution is highly non-random because their abundance was entirely due to a roosting site in the Eucalyptus grove. When in flight the butterfly can be found anywhere as they are very strong fliers. They would be expected to breed on the bluff given the presence of their milkweed larval foodplant. A maximum of 5000 individuals were noted in January, with populations of over 500 from mid-October until the end of February, when all dispersed. These insects are discussed below.

PITFALL TRAP DATA. All animals collected from the pitfall traps are summarized by community in table 4. The key to species code is given in table 5, and the 60 infrequently encountered species (ten or fewer captures) are listed in table 6. The 20 traps placed across the entire sand dunes complex produced a total of 4718 individuals over a one year cycle, or 235 per trap year. In comparison with the LAX sand dunes, 27178 were trapped in 60 traps, or 453 per trap year. These results provide a crude estimate that the Ballona dune remnant carries an arthropod population half the size of LAX in what were formerly almost contiguous biotas.

The density of individuals within the different communities correlates fairly well with the visual transect data. The alluvium produced the highest (334 per trap) and the dunes/pickleweed marsh ecotone the second highest value (328 per trap), with the salt panne the most barren (65 per trap). These results are not surprising given the relative amount of native plant cover on these sites.

Species richness is also lower at Ballona, where 109 species were captured from the dunes, compared with 153 species at LAX. Curiously, 18 of those species are unique to Ballona. In addition, individual species abundance differs widely from LAX. Among the eight most common species, there are only three shared between the two habitats. Of these three, the Argentine ant, *Iridomyrmex humilis*, is an introduced species. Each locality has a second introduced species in the top 8, but they are different. Numerical ranking of the Ballona species is shown in figure 4. Species code for the figure in table 5. What this means is unclear, except it must be recalled that the plant communities of the two localities differ widely, with only 14 native plant species at Ballona to 51 extant native plants at LAX.

The dunes fauna has some overlap with coastal sage, riparian and upper salt marsh communities with some dune species only tourists into the dunes area-and vice versa. In spite of overall habitat degradation, the ecotone or edge between dune and upper salt marsh remains a relatively species rich zone as indicated by both transect and pitfall counts. Historically this was a dynamic ecotone that is presently reduced to an edge between terrestrial iceplant and pickleweed upper marsh.

All the communities found on the Playa Vista property are highly degraded, if not essentially collapsed. This assessment is inferred from quantitative species loss among all groups of organisms for which there are complete data (see discussion below). In spite of limited data, arthropod populations exhibit similar patterns of extirpation. Butterfly losses include 8 of 31 resident species while among beeflies (Diptera: Bombyliidae), 12 of at least 30 species have probably disappeared. The diminution in the number of Carabid beetles between 1980 and 1990, from 13 to 9, is probably valid since this group was very thoroughly sampled both by Nagano and ourselves. For specific communities, three butterfly species of the riparian, formerly common in the Los Angeles basin, are not present. The extinct Ballona cinquefoil and Ventura milk vetch may have hosted several endemic herbivores. Both plants are in groups with many herbivore dependents. A cascade of extinctions would then be expected to follow extinction of these plants.

Native ants are a highly impacted insect group across the site, but past data are limited. Only three species now occur, as was also true in 1980, and though three additional species are expected, the historic populations were at least three times that rich (Roy Snelling, pers. comm.). Since as a group ants are keystone animals providing many ecological services, the loss of these native species probably had significant impact through the system. The loss of natives was probably due to introduction of the Argentine ant, *Iridomyrmex humilis*, which is now dominant on all sites, as well as being the commonest insect from the traps (figure 4, #2). This particular exotic species is uneradicable and irrevocably changed all Ballona communities.

Summary of arthropod species of special concern and interest
In order to identify arthropod species of more than usual interest that may be found in Ballona habitats, four groups are considered:

1) species listed in the "priority" category of the California Department of Fish and Game NDDB inventory database and found within the Venice quadrangle,

2) species which have been identified as limited distribution endemics restricted to sand dunes/coastal strand and wetlands habitat in the vicinity by Mattoni (1990a),

3) species identified by Nagano et al. (1981),

4) the highly visible and popular monarch butterfly.

A narrative of these taxa follows, with comments on the potential occurrence of significant species as they are associated with the identifiable community remnants.

NDDB listings/Venice quadrangle
Sands dunes/ sand obligate species

1. *Euphiloptes bernardino allyni* (=*E. battoides allyni*). El Segundo Blue butterfly. A detailed description of this taxa, its biology, distribution, and conservation biology, is in press (Mattoni. 1991. The endangered El Segundo blue butterfly. J. Res. Lepid. 28). In summary, the species now has three geographic locations: The Chevron Refinery, the LAX sand dunes, and Malaga Cove. It is secure at the first two sites, with the population expanding in response to the ecosystem restoration underway at LAX. At LAX the 1990 total adult population was in the order of 3000-5000. Historically the species occurred on the Playa del Rey dunes, extending into what is present day Venice. One male was sighted at Playa del Rey in the mid 1980's. The hostplant *Eriogonum parvifolium* population, then about 20 plants, has subsequently declined to 7 individuals. In the same time frame, the small population of the dunes ecotype of the Mormon metalmark butterfly, also dependent on this foodplant, disappeared. There is little question that the El Segundo blue can re-establish when the habitat is restored. However, populations of all the sand dune obligate species will have tentative long term viabilities because of random processes in the small sized fragment.

2. *Lorita scarifica* (=*L. abornana*). Lora Aborn's moth. A recent, yet unpublished, revision of the Cochylidae by M. Pogue at the Smithsonian Institution synonomized *L. abornana* to a widespread, common, neotropical species. However, J. Donahue (pers. comm.) found the situation may be more complex as his survey of genitalia morphology implies there may be several taxa hidden in a

complex species group. Several foodplants are used by the species, including *Eriogonum, Ambrosia,* and *Cuscuta.* The species flies throughout most of the year. On the LAX dunes the species is not only one of the commonest moths, but also is involved with regulating the El Segundo blue butterfly (Mattoni, l.c.). The species should not be considered of concern until additional work is undertaken.

3. *Eucosma hennei.* Henne's eucosman moth. The species is restricted to the El Segundo dunes and the Osa Flaco dunes complex. It's only known foodplant resource is *Phacelia ramosissima* in which the larvae are borers in the stems and roots of very mature plants. The adult flight period is from July through September. The moth is not common at LAX and has not been taken at Ballona. It is unlikely to occur at Ballona because the foodplant is not dense, nor are there enough individual plants robust enough to support more than a few larvae. Even with the anticipated restoration of foodplant densities, the number of suitable plants would be incapable of supporting a viable population of the moth. Evidence at hand indicates the moth is sand obligate as the foodplant is found over a wide geographic area and range of plant communities, while the moth is only found on coastal sand dunes. This hypothesis may be tested at such time that the foodplant may become widely established on the Ballona Bluffs. The *Phacelia* presently grows on the bluffs, at least across sections west of Lincoln Boulevard. It is not a common plant, however, and may naturally remain in a low density if and when historic flora values are re-established.

4. *Coelus globosus.* Globose dune beetle. A detritivore tenebrionid that is rare even on the LAX dunes system. During a one year trapping program at LAX only 28 were taken by comparison with 88 of the related *Coelus ciliatus.* Both species are sand obligate and at LAX were most abundant at undisturbed sites. In the monitoring program at Ballona *C. ciliatus* has been taken only once on the relatively native dune fragment. *C. globosus* has never been found, but if so would occur on the sand dunes. Nothing is known of the life history of these beetles.

5. *Cicindella hirticollis gravida.* This tiger beetle is a sand obligate species restricted to undisturbed barrier dunes above the strand line. It has not be observed at the LAX dunes and the habitat at Ballona is in all likelihood unsuitable for its persistence. Although recorded historically (1906) from along the strand from Playa del Rey to Santa Monica, there are no recent records. The species would not be expected in the Playa Vista area.

6. *Cicindella senilis frosti.* A tiger beetle species known historically only from the Manhattan Beach area. Not taken on the LAX dunes. Presumably extirpated from the site, if it ever occurred.

7. *Onychobaris langei.* Lange's El Segundo dune weevil is known from a few specimens taken on the LAX dunes and from the sand dune area of Ballona. The Ballona specimens were taken both by Nagano et al. (1981) and our last collection from a pitfall trap on the sand dune/salt marsh ecotone. Nothing is known of the life history except a note of being associated with the roots of *Camissonia chieranthifolia* (Sleeper, pers. comm.). Collecting records are from May through September. The most recent take at LAX was in 1986 . None were obtained during the LAX survey in spite of special efforts to locate the animal. Barine weevils as a group are not well studied.

8. *Trigonoscuta dorothea dorothea.* Dorothy's El Segundo dune weevil. The species is one of the most abundant weevils on the dunes, both at LAX and Playa del Rey. It is usually found at the base of the dunes bush lupine and is commonly found in pitfall traps. It is the 15th most common insect trapped in pitfalls. A sand obligate species taken over most of the year. In traps at Playa del Rey it has been taken under iceplant and in the salt marsh interface to the dunes. There has been questions of taxonomic validity of the subspecies (Miller, pers. comm.), but the total of all populations of the species are sand obligate in California and thus merit concern.

9. *Brennania belkini.* Belkin's dune tabanid fly. A sand obligate species that is one of the few tabanids not requiring a blood meal for successful egg production. As adults they are taken on flowers during the flight time of late May to early July. Larvae are burrowing predators with undetermined hosts, most likely beetle larvae. The species occurs on dunes areas from the Los Angeles area south to Ensenada. Because of land conversion of other dune sites, including massive development to Ensenada, the species should be considered threatened. Taken at Playa del Rey in 1980. The population at LAX provided 40 individual sightings in 1989. None were seen across the Ballona transect in 1990, and it was rare at LAX during 1990 as well.

<u>Intertidal and wetland species</u>

1. *Panoquina panoquinoides errans.* The saltmarsh skipper. The species is restricted to upper salt marsh habitat where its sole natural foodplant, Saltgrass, *Distichlis spicata,* is found. The skipper appears highly sedentary and has an adult flight period from April through October in most years. In the Ballona wetland, the species is found throughout the area where the foodplant occurs. At present

saltgrass is distributed at the interface of pickleweed and the large masses of iceplant. The skipper is relatively abundant and is regularly counted along the transect established to monitor visually identifiable insects. Quantitative information is available and can be continuously updated to monitor population status. Removal of the exotic iceplant will result in an expansion of the saltgrass resource to which the skipper populations would correspondingly respond. Because of the foodplant, the insect is probably drought insensitive by comparison with most Lepidoptera. The chief nectar sources are *Heliotropium* and *Frankenia*. Maintenance of high reproductive success will require that these plant species be expanded as well.

During the current survey another species of skipper butterfly(Hesperiidae) has been sighted that appears exclusively associated with *Distichlis*: *Polites sabuleti sabuleti*. Results of the transect counts validate this hypothesis (table 3 and above). Three additional species, *Hylephila phyleus, Ochlodes sylvanoides,* and *Paratrytone melane* may also share this same food resource. The latter three species also use other grasses, although this aspect of their life histories is not well investigated. The transect data for the species is unclear as they are not common.

In addition to the above taxa from the NDDB, several unrecognized species of special interest are expected to occur and most likely occurred prior to denaturation of the Ballona area. These species are sand obligate endemics found at LAX and Ballona. Since all were found on the adjacent dune system, they are briefly cited for completeness.

Sands dunes/ sand obligate species

1. *Ebo undescribed species.* El Segundo crab spider. A species in one of the better studied groups of crab spiders. Apparently dunes restricted, found chiefly on the flowers of *Haplopappus ericoides*. The dunes fragment at Playa del Rey should support a population of this very small species, although it has not been found at the site.

2. *Scythris undescribed species*. Two distinct species occur on the LAX dunes. They are members of a very large genus of micro moths that are usually endemic and restricted to specialized localities in sandy areas. Because of dependence on native plants in undisturbed landscapes, their occurrence has not been established at Ballona. Nothing is known of the life histories, but larvae usually make distinctive silk tunnels at the base of their perennial foodplants.

3. *Comadia intrusa.* El Segundo dunes cossid moth. A large species known only from the El Segundo dunes. Apparently biennial, flying in even numbered years during late June and early July. Larvae feed on bush lupine (*Lupinus chamissonis*) with a large plant required to satisfy nutritional needs of a dozen larvae. Persistence at Playa del Rey problematical because of the small area and hence low number of potential host plants. No evidence of their occurrence, but they can be easily monitored.

4. *Psammobotys fordii.* Bob Ford's dune pyralid. A small dayflying moth only known from the type series collected at the LAX dunes March 8, 1955. Apparently globally extinct, as it has not been seen since and is not known from any other localities. Nothing is known of its life history.

5. *Carolella busckana busckana.* Busck's gall moth. Fish and Wildlife Service category 2 candidate species. A formerly widespread species in sandy areas and known from the LAX dunes. The *Encelia californica* foodplant will be reintroduced at Playa del Rey dunes, but the moth species is presumably extirpated at nearby LAX. The only remaining populations could be on the upper Santa Ana river drainage, but no moths have been sighted at any locality for many years.

6. *Stenopelmatus undescribed species 1.* El Segundo jerusalem cricket. The species is restricted to the Playa del Rey and LAX dunes where it occurs together with a more widespread species that is also undescribed. Mature specimens found at both localities in the fall, immatures year round. Restoration of the dunes may augment the populations, but they are found, as generalist omnivores, under any vegetation. Monitored by pitfall trapping. Casual observation indicate that the species has been substantially reduced in numbers during 1990 from previous seasons. The reductions may be draught related. This, and a second undescribed Ballona species that is widespread, will be described in the near future by David Weissman, expert in the group.

7. *Exoprosopa* undescribed subspecies of, or species near *arenicola.* El Segundo beefly. For a current study to provide a field guide of the beeflies of the Los Angeles basin, Rick Rogers, field entomologist for this project, determined that the beefly he earlier classified as *E. butleri* was in fact misidentified and is part of a species complex heretofore unrecognized. The new species occurs on the LAX dunes in the fall and is expected at Ballona. *Exoprosopa* has several species groups which contain narrowly distributed species. Such species are valuable for ecosystem assessment.

8. *Bombylius* undescribed species near *flavipilosus.* This species has not yet been found at Ballona, but is common on the LAX sand dunes. Nothing is known of

its life history. The species flies in the spring. Our 1990 transect study was started too late in the season to find the species.

Saltwater marsh, saltflat and mudflat dwelling species

Although the mudflats and saltflats are harsh and highly specialized habitats, there are several insects highly adapted to them. At Ballona the Insect families of Coleoptera, Hemiptera, and Diptera provide most of these specialized species. Species we particularly looked for have all decreased in density or disappeared since from the 1980 survey. None of these species have been listed in the NDDB.

1. *Cicindella trifasciata sigmoidea*. The western mudflat tiger beetle occurs in most, if not all, estuaries in southern California that have not been totally degraded. The adults have a longevity of several months and can be found from late winter through early fall. At Ballona we have sighted less than a dozen individuals, all on the mud banks of the channel adjacent to the dunes area. The following two tiger beetles were present in the mudflat of lower Ballona Channel in 1980. We were unable to find them in 1990. The reason for the apparent population declines is not clear, but should be viewed with concern.

2. *Cicindella haemorrhagica haemorrhagica*.The red belly tiger beetle.

3. *Cicindella oregona oregona*. The Oregon tiger beetle.

4. *Dolichopodidae*. Long legged flies. Two unidentified species were found to be common by Nagano in 1980. Dolichopod flies are usually common in salt marsh habitats, along with a few other specialized flies as the brine flies, Ephydridae. However, although the brine flies remained very common during our survey, Dolichopodids were scarce, numbering in the tens at any one place on any day. The apparent decline cannot be interpreted given current knowledge. The case is another matter of lack of experts and insufficient support for research for invertebrates.

5. *Saluda species* . Shore bugs. According to Polemus (1985) four species should be found. Nagano et al. (1981) listed two species, but the more recent revision makes the earlier conclusions questionable. Although we periodically observed shore bug activity in the salt marsh areas, we did not collect *Saluda* species.

Riparian and upland coastal sage community species

There is only one species associated with these plant communities at Ballona that can be considered a rare or narrow endemic. A camel cricket of the genus *Ceuthophilus*, apparently undescribed, has been found exclusively in the freshwater marsh near Hastings canyon. Specimens will sent to the expert in this group for further evaluation. It is clearly different from the related C. *californianus* that

commonly occurs on the sand dunes. Presence of what may be a unique species re-emphasizes the very high value of the small freshwater marsh.
There are a number of insect species feeding in several guilds in the willow community. Although the riparian areas were not intensively surveyed, a rich community of both herbivorous Lepidoptera and Coleoptera plus some members of virtually every insect order is associated with riparian species, especially willows. The willows were not specifically inventoried, but would no doubt yield lower diversity than is to be found in the relatively undisturbed communities of the Santa Monica mountains. A re-introduced set of freshwater fish will depend on high insect productivity for sustenance. Although Dragonflies are not uncommon, mayflies (Ephemerida) that occurred in the 1930's, have disappeared.

Both the extinct Ballona cinquefoil and the Ventura milk vetch probably hosted several endemic herbivores each as these plants are in groups well known for their rich dependent herbivores. A cascade of extinctions could have followed the loss of these two plants. Both were associated with the freshwater marsh, as are their extant sister species today

Monarch butterflies

Monarch butterflies are found as overwintering residents because of the presence of a blue gum grove in area B. Whether the butterfly roosts were natural is unknown, but certainly were dependent on native tree species had they been so. Usually the species rests on native pines, as at the famous Monterey grove. This spectacular butterfly depends on coastal winter rooting sites and populations have apparently been decreasing in recent years in part because of roost destruction.

DISCUSSION

Additional species may well be of concern, but limited systematic information on their taxonomic relationships and distributions make assessment difficult at this time. The dwindling corps of taxonomists who can deal competently with the identification of arthropod species, particularly in obscure groups, seriously limits studies of community structure and ecological interactions. The absence of simple taxonomic evaluations and concurrent biological data in turn leaves estimation of environmental significance tentative for a large number of taxa. The best that can be hoped for is that the better known threatened and endangered species, listed or candidate, will provide an umbrella to preserve the multitude that remains unrecognized. Care must therefore be taken in remedial actions to emphasize restoration of general ecosystem values and not only conditions that benefit target species.

Quantitation of degradation of the entire site is reflected by known changes in both flore and fauna of the area, including the status of Arthropods as only a part of the whole. For the case with flowering plants, 75 native sand dunes species were originally recorded from the El Segundo sand dunes (The Ballona dunes are a northern extension of this dunes system). Of these, 51 survive today on the 370 acre LAX fragment while only 14 survive at Ballona, representing 81% species loss at the latter site, assuming the entire suite was present historically. The flora of the bluff face and alluvial extentions of the former coastal prairie and coastal sage communities has not been formally calculated, but must be of the same order of magnitude. The salt water marsh has an expected 20 plant species of which only 10, or 50% have persisted. Among animals, 18 native mammals are expected, but no more than 6 remain, a 67% loss. The six species of (coastal sage) scrub obligate birds are no longer present, all now only memories. The Arthropods have likewise not faired well, but precise estrimates are impossible except for butterflies and possibly beeflies, data for which are given above.

The utimate causes of these losses in natural biodiversity are complex. but primarily involve substrate disturbance and consequent massive invasions by opportunistic exotic plants and animals that destroyed historic ecosystem functions. Changes in arthropod populations have not escaped these negative impacts as all species are related. The ecosystem has also clearly not stabilized, but remains in flux as the exotics are expanding with new relationships being established. Thus the red fox expansion has eliminated those species dependent on the many small mammals formerly extant. The rapidly expanding Mediterranean chrysanthemum, pampas grass, iceplant and *Myoporum* have co-opted native food webs. Recent flooding of the brackish water channels by freshwater from a de-watering project has further insulted any aquatic remnants. The details of these changes must be addressed in a more than superficial manner.

IMPACT ANALYSIS

Direct and indirect impacts

By community

Arthropod populations across all areas and biotic communities of the Playa Vista project are depauperate compared with communities of similar habitats nearby. The effect is reflected by reduced numbers of native species, numbers of individuals, and biomass. This degradation correlates with high densities of non-native vegetation and is further manifest by several introduced insects as the commonest species. However, natural successional changes are occurring that may lead to increases in the natural vegetation densities, as evidenced by the increasing cover of sage, sumac and coyote bush in areas A, C, D, and the earlier farmed eastern section of B. On the other hand, at present open accessibility of most areas to foot traffic, domestic animals, trail bikes, encampments by the homeless, off road vehicles, and even illegal dumping unfortunately promotes continuing disturbances that provide habitat to alien species at the expense of natives. In places human impact is sufficiently severe to overcome beneficial succession processes.

Riparian

Except the sections of Centinela creek that lie in area D, all significant riparian and freshwater marsh fragments are in area B and will not be effected by proposed development of structures. During the course of habitat restoration extant riparian values, at least in area B, must be maintained so that the remaining arthropod populations species are not lost through mitigation processes in order to achieve other objectives. Presence of the ornate shrew, and its arthropod prey, wholly depend on keeping the marshes intact. Similarly, the richest riparian fragments of area D, slated for total modification, should be retained intact to provide an inoculum of riparian animals during proposed construction.

Sand dunes

The sand dunes are wholly located where they will not be disturbed by any construction activity. Furthermore, the dunes restoration plan is predicated on no disturbance of native plants. Native biomass here is so low that dependent arthropods must all be in danger of chance extinction. The proposal of adding fill sand to augment the dunes configuration must be conducted with care to minimize losses of fossorial species.

Bluffs/coastal sage community

The bluffs are not involved in any development process and hence will be free from disturbance of construction. Nevertheless, substantial negative impact will result from inproperly conceived mitigation. Accordingly, the proposal presented for restoration does not take into account the fundamental biological requirements of animals, nor does it recognize patch phenomena of the whole biota. Revegetation of the bluffs must be restricted to replacement of exotic plants taking care to minimize disturbance effected by clearing and the use of chemicals. The proposed high density use of exotic species does not merit comment.

Salt marsh

The remaining primary salt marsh fragments are restricted to portions of area B that will not be subjected to development activity. Available proposals for salt marsh revegetation do not recognize present values, however, and the extensive recontouring these proposals suggest will have serious negative impacts on the already poor arthropod species encountered. A significant quantity of pickleweed stand will be lost. In spite of the low apparent species densities in this habitat, the large area may preclude irreversible losses of species adapted to these sites.

Impacts to Area A

The substrate of this area is wholly dredge spoil that was placed over the native salt marsh across what was a tidal zone (Schreiber 1981) and see figure 1. The elevation was raised to about 8 ft. msl. A mixed community of native (*Rhus, Baccharis*, etc.) and exotic (*Cortaderia, Carpobrotus, Myoporum*, etc.) plants has become established over part of the area. The only known arthropod of interest on the site would be the wandering skipper, *Panoquina errans*. Elimination of its small population here, which exists on the mix of larval saltgrass foodplant, *Distichlis spicata*, and a few nectar sources, would not be significant to survival of the metapopulation of area B.

Conversion of area A to use as a marina would not impact any known arthropod species of special interest. All species would be expected to originate from native metapopulations that are now restricted to area B or the Ballona bluffs, as the wandering skipper exemplifies.

However, because of the indirect value of a healthy and diverse population of arthropods, especially insects, in both aquatic and terrestrial food webs, restoration of area A to approximate historic values would provide a greater buffer to preserve denser populations of all vertebrates and enhance their probability of survival.

Impacts to area B

This area provides the centerpiece of the Ballona wetland ecosystem. Virtually all natural values are restricted to the site. It serves as the major source of populations upon which the entire ecosystem depends. Apart from Phase 1 impacts, discussed separately below, extensive modifications have been proposed in attempting to "restore" the tidal salt marsh, lagoon, and mud and salt flats that were historically found on area B (figure 1).

A restoration plan for the sand dune of area B has been approved by the California Coastal Commission. Work to be undertaken is simple and straightforward, allowing three years for the complete removal of the extensive (about 90% cover and increasing) non-native plant cover, restocking and re-introduction of native plants. The three year period for restoration was predicated on replacement planting cycles that would permit the ground dwelling arthropods to re-establish populations. Only about 6 acres, or 2%, of area B is involved. In the meantime the dunes area is being heavily impacted by trampling because of failure to reduce accessibility (as noted above). Implementation of the plan will be positive. Native plant cover will exceed 90% after five years with insect species and population sizes increasing five fold if LAX dune restoration results are applied.

The other terrestrial sites are the bluffs and the Hastings Canyon alluvial wash. At the foot of the latter formation lies the largest freshwater marsh, and contiguous willow grove, of the entire property. These two communities have over 90% native plant cover, although pampas grass is rapidly invading both as well as the alluvial wash itself. The impact of pampas grass is to produce a virtual desert as no animals use this plant except European rats prefer them for nests.

At Playa Vista the *Eucalyptus* grove will most likely die when tidal action is restored. A plan to provide an appropriate roosting grove on higher ground, preferably involving native trees, would be highly desirable. Since several organizations are attacking the general problem of monarch conservation, a cooperative effort should be established to provide the optimal solution. The bluff revegetation plan includes augmenting populations of the milkweed foodplant for monarch larvae. Milkweed has greatly reduced numbers in the urban area from a few decades ago and larvae are now rarely seen where they were formerly commonplace. Foodplant provision may be trivial compared with the value of the roosting sites, however.

Tide land restoration: mid or full tidal?

All the arthropod data show that the richest habitats, in both individuals and species density, are the ecotone between dunes and pickleweed stands and the freshwater marsh associated with Centinela Creek. With respect to both terrestrial and halophyllic aquatic insects, the optimal management program for diversity and probably productivity would unquestionably be a mid-tidal system. The mid-tidal scenario would provide the greatest extent of edge or ecotone, as well as a larger area of upper salt marsh. Grading must be minimal in all natural areas. The keystone plants in the zone would be *Frankenia, Distichlis, Heliotropium* and *Atriplex*. Some tidal activity is necessary for not only plant reproduction (Zedler & Beare, 1986), but for saltmarsh insect communities (Cameron, 1972, 1976).

Channel formation in the tidal areas must be accomplished by natural erosion from tidal flows as far possible to avoid killing the mud dwelling species across such sites. Particularly, existing pickleweed beds, mud flats and salt pannes should not be tampered with by heavy machinery. Sites of the old agriculture fields and berms of iceplant cover have been sufficiently disturbed that recontouring can be legitimately undertaken in these areas. These precautions are required because of the scarcity of the mud flat tiger beetle and reduction of Dolichipodid fly populations. Decreases of these indicator species imply all is not well and restoration efforts in the wetland proper must be implemented with care.

A full tidal system would not provide the expanses of ecotone and would also cause loss of the freshwater marsh at the base of Hastings Canyon and a substantial part of Centinela Creek. Not only would this be historically improper, but would substantially reduce all terrestrial ecological values.

Impacts to area C

Area C was originally encompassed the area that was the mouth of Ballona Creek as it discharged into the lagoon system (figure 1). The groundwater at this point was probably quite close to the surface. With a year round flow of Ballona Creek this area of the marsh was probably freshwater. Today there are no traces of the historic community with over 95% of the cover non-native plants. The arthropod populations are probably equally poor with the only native species secondary and trivial. The area could be restored to marsh or alluvial coastal shrub, in which case there would be rich arthropod habitat. Area C is surrounded by barriers, however, including major highways, Ballona channel, and dense housing. The relatively small size of the area coupled with its isolation leave it the least appealing site to preserve. Loss of the area by conversion would remove open space. Biological resources, as native species biomass of both plants and animals, would be mitigated by restoration of the more appropriate areas.

Impacts to area D

Area D is the second most valuable biological resource area on the Playa Vista site. In addition to providing the channel of Centinela Creek, now represented by a ditch re-aligned from it's historic course, there are over 30 acres of the Ballona bluff and several acres of alluvium at the base of the bluff along the south-west corner. The proposed phase 1 plan will seriously impact this habitat. It is discussed in detail below. The alluvium is covered by a fairly rich native coastal sage community occupied by several keystone plants that are foodplant to a number of species of insects. The few specimens of rattlepod, *Astragalus leucopsis*, suggests this micro site has remained relatively undisturbed. Rattlepod has been extirpated at the LAX dunes. It is a keystone plant with a number of insects dependent upon it.

Development of area D into housing will remove a large open space acreage from the area. It will also permit easy access by residents, their children and pets, to the remnant native bluff biota. Although there are no identifiable arthropod species of special interest across area D, the bluff portion is covered with coastal sage scrub, a suggested endangered plant community (Westman, 1987).

Impacts of Phase 1

The phase 1 development includes a presumptive habitat augmentation scheme with mitigation value. Centerpiece is a freshwater marsh extending along the west side of Lincoln Blvd and covering some 20 acres. Ancillary to this marsh is a re-aligned and partially concreted channel for Centinela Creek extending along the toe of the bluff from the easternmost project boundary to Lincoln.

In addition to providing questionable functional service, phase 1 implementation will be a disaster for the populations of ground dwelling arthropods destroyed during construction. The plan involves completely clearing and contouring the land for both structures. Later re-planting will presumably "restore" riparian communities. Revegetation is the simplest part of "restoration" with almost guarantied success. Replacing lost animal populations, even of most insects, is extremely difficult (Ehrlich, 1989, Mattoni, unpub.). The land to be cleared involves all freshwater habitat on the project site. Any manipulations of this habitat can only intelligently be accomplished by minimal interruption by heavy machinery.

The lined and contoured Centinella channel would also not be protected from local residents, but then it is designed for heavy maintenance. The effect is that the channel will be an artificial landscape with few and superficial native resources. The freshwater marsh likewise qualifies only as a engineering phenomenon. The marsh will not function in any way as the historic marsh did, which was as a broad conduit to the lagoon that supported not only its own biota, but provided regular freshwater flow that permitted persistence of the lagoon plants and probably many animal species as well. Ecological function will be precluded as the marsh serves as a flood control structure, its spillways quitely awaiting a 50 year storm event, while providing superb habitat for mosquitoes and weedy plants.

Restoration by destruction of native habitat it is an oxymoron.

Cumulative impacts: effects of development

The major negative cumulative impact will be reduction of potential habitat size by the Playa Vista project. The animals most affected by this reduction have, unfortunately, already been impacted. Scrub obligate birds are essentially eliminated, and most reptiles and mammals are only memories. The flip side of open habitat reduction will be economic resources that will permit restoration of the best of the degraded remainder. The degradation may be more severe among the arthropods because of massive replacement of native by exotic plant species. In the process of plant extinction and extirpation their dependent herbivore animal species no doubt also disappeared. Comparative data from ground dwelling species to those of the El Segundo dunes and vicinity underscore this loss of nature.

At the present time fairly large stands of native flora survive in the Baldwin Hills and on the El Segundo sand dunes at LAX. To the extent that corridors remain, at least for volant animals, there is a positive impact. These situations may be reduced in value, however, with increasing urbanization and denaturation of their habitat value.

In conclusion I return to the opening quote of Aldo Leopold. The primal goal of the project must be to save all the cogs and wheels and not be romanced by tinkering. For both plants and animals more than a third of the native species have been lost, with even greater proportional native biomass, across the ecosystem encompassed by the Playa Vista project. Impacts of certain parts of the mitigation plans will reduce resident biodiversity further. At this time, additional biological data gathering is not necessary as an alternative to planning that involves input of informed conservation biologists armed with data gathered for this report.

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Table 1

List of arthropod species from the Ballona vicinity given on the background of the comprehensive database of arthropod species from the adjacent El Segundo sand dunes and coastal prairie. The basic database includes species noted in the surveys of 1938-1939 and 1987-1988 at El Segundo. Species now extant are numbered, species not noted in recent years unnumbered and followed by the notation ext. Numbers in parentheses after species names are the identification number for pitfall trapped species.

Species found at Ballona/Playa del Rey sand dunes only are indicated by underlining. Species found in other than dune habitat at Ballona/Playa del Rey only are listed in the last section of this table .

Two data sets from Ballona/Playa del Rey are summarized: Nagano et al. in 1980 and this survey in 1990-1991. Presence in 1980 and /or 1990 from the current survey indicated by X under the proper year. Species or groups not sampled, sampling not comparable, or identification not available indicated by NS. See text for further explanation.

Higher systematics follow Borror, et al. 1981. Phyla, classes, and orders indicated. Family and subfamily names in bold face italics. The systematics of the Lepidoptera follows Hodges (1985), except the ordination has been changed.

MOLLUSCA GASTEROPODA	1980	1990
1. *Helix aspersa*		X
2. *Otala lactea*		X
3. *Helminthoglypta traskei*		
Vertigo trinotata		
Vertigo californica		
ARTHROPODA DIPLOPODA		
Spirobolida		
1. *sp. no. 1* (71)	X	
2. *sp. no. 2* (107)		
CHILOPODA		
Geophilomorpha		
1. *sp. no. 1* (106)		
Lithobiomorpha		
1. *Lithobius sp.* (105)		
MALACOSTRACA		
Isopoda		
Bathytropidae		
1. *Alloniscus peronvexus* (72)		
2. *Mauritanicus littorinus* (114)		
Porcellionidae		
3. *Armadillium vulgare* (146)	X	
4. *Porcellio dillitatum* (113)		
5. *P. laevis* (113)	X	
ARACHNIDA (det. Hebert)		
Scorpiones		
Vejovidae		
1. *Paraoroclonus silvestri* (68)		
Pseudoscorpiones		
1. *Garypus californicus* (67)		

Solfugae		
1. *Eremobates sp.* (66)	X	X
Opiliones		
1. *Protolophus* nr. *singularis* (102)		X
Acari		
Trombididae		
1. *Trombidium sp.* (69)		
2. *sp. no. 2* (70)		
3. *sp. no. 3* (103)		
4. *sp. no. 4* (104)		
Family		
5. *sp. no. 5* (122)		
Araneae		
Ctenizidae		
1. *Apostichus simus* (108)	X	X
Zodariidae		
2. *Lutica sp.* ( )	X	X
Oonipidae		
3. *Scapiella hesperus* (97)	X	X
4. *Opopaea sp.*		
Oecobiidae		
5. *Oecobius sp.*	X	
Dysderidae		
6. *Dysdera crocata* (57)	X	X
Clubionidae Sac spiders		
7. *Chiracanthium inclusum* (62)	X	X
8. *Trachelis sp.*		
9. *Castianeira sp. no. 1* (100)		X
10. *Castianeira sp. no. 2* (163)		X
<u>*Phrurotimpus sp.*</u>	X	
Agelenidae Sheetweb or grass spiders		
11. *Hololena curta n ssp.?* (62)		X
12. *Calilena angelina*		
13. *Calymmaria sp.*		
14. *Agelenopsis sp.*		X
Theridiidae Cobweb spiders		
15. *Theridion sp.*		
16. *Tidarron sp.*		
17. *Steatoda grossa* (98)		X
18. *S. fulva*		
19. *Crustulina sp.*		
20. *Latrodectus hesperus* (65)	X	X
Thomasidae Crab spiders		
21. *Misumenoides formosipes*		
22. *Misumenops rothi*		
23. *Xysticus gulosus* (63)		X
24. *X. montanensis*		
Philodromidae Crab spiders		

25. *Ebo pepinensis*		
26. *Ebo n. sp.*		
27. *Tibellus nr. californicus* (147)		
Araneidae Orbweaver spiders		
28. *Argiope argentata*		
29. *Eustala conchlea*	X	
30. *Neoscona oaxacensis*		X
31. *Cyclosa turbinata*		
32. *C. conica*		
33. *Tetragnatha sp.*		
Lycosidae Wolf spiders		3 unident. species
34. *Allocosa sp.*		
35. *Alopecosa sp.*		
36. *Pirata sp.*		
Salticidae Jumping spiders		
37. *Habronnatus sp. no. 1* (173)		X
38. *Habronnatus sp. no. 2*		
39. *Metacybra sp.*		
Phidippus johnsoni		X
Anyphaenidae		
40. *Anyphaena sp.*	X	
Gnaphosidae Running or mouse spiders		2 unident. species
41. *Zelotes sp. no. 1*	X	
42. *Zelotes sp. no. 2*		
43. *Herpyllus propinquis*	X	
44. ?*Trachyzelotes sp.*		
45. ? *Gnaphosa sp.*		
46. *Micaria sp.* ?		
47. *Mimetus hesperus*	X	
<u>*Poecilochroa oscellata*</u> (162)		X
Pholcidae		
48. *Psilochorus sp.* (58)		X
Oxyopidae Lynx spiders		
49. *Oxyopes sp no. 1*		
50. *Oxyopes sp. no. 2 (?different)*		
51. *Peucetia viridens*		
Linyphiidae		
52. *gen. sp. no. 1*		
53. *gen. sp. no. 2*		
at least one more sp.		
Filistatidae		
54. *Filistatinella sp.*		

HEXAPODA Class Insects

Collembola Order Springtails (det. P. Bellinger) sampling by both Nagano et al and ourselves was not comparable

Entomobryidae		1 unident. species
1. *Entomobrya atrocinta*		
2. *E. multifasciata*		
3. *E. unostrigata*		
4. *E. californica*		

5. *Xenylla wilsoni*	X	
Thysanura Order Silverfish		
Lepismatidae		
1. *Lepisma sacharina*		
Allacrotelsa spinulata	X	
Microcoryphia Order Jumping Bristletails		
Machilidae		
2. *Sp. no. 1* (35)	X	X
3. *Sp. no. 2* (36)		X
Ephemeroptera Order Mayflies		
Family & species undet. coll by Pierce 1939 ext		
Odonata Order Dragonflies and Damselflies		
Aeshnidae		
1. *Aeshna multicolor*	X	X
2. *Anax junius*	X	X
Libellulidae		
3. *Tarnetrum illotum*		
4. *T. corruptum*	X	X
5. *Tramea onusta*		X
Pantala hymenea	X	X
P. flavescens	X	X
Coenargionidae		
6. *Sp. no. 1*	X	X
Enallagma sp.	X	X
Orthoptera order Grasshoppers, crickets, mantids, cockroaches (det. D. Weissman)		
Acrididae		
1. *Conozoa texana*		
2. *Trimeritropis californica*	X	X
3. *T. pallidipennis*	X	X
4. *Schistocerca vaga*		
5. *Melanoplus devastator*	X	X
6. *Psoloessa thamnogaea*		
Tettigonidae		
7. *Scudderia mexicana*	X	X
8. *Neduba morsei*	X (? [illegible])	
Nebuda new species		X
9. *Brachyinsara hemiptera*		
10. *Ideostatus aequalis*		X
Gryllidae		
11. *Gryllus integer*	X	
12. *Oecanthus argentinus*	X	
13. *Cycloptilum distinctum*		
13a. *Acheta assimilis* (42)		X
Myrmycophila sp. (166)		X
Stenopalmatidae		
14. *Stenopalmatus n. sp.* I, Weissman	X	X

15. *Stenopalmatus n. sp.* II, Weissman	X	X
Raphidophoridae		
16. *Ceuthophilus californianus*		X
Phasmatidae		
17. *Parabacillus hesperus*		
Mantidae		
18. *Litaneutria minor*		
19. *Stagmomantis californica*		
20. *Iris oratoria*		
Polyphagidae		
21. *Arenivaga n. sp.* Nickel	X	X
Mogoplistidae		
Hoplosphyrum boreale	X	
Dermaptera Order Earwigs		
Forficulidae		
1. *Forficula auricularia*	X	X
Isoptera Order Termites		
Rhinotermitidae		
1. *Reticulotermes hesperus*		
Psocoptera Order Psocids		
Sp. no. 1.	X	X
Thysanoptera Order Thrips (det. W. H. Ewart)		
Phlaeothripidae	NS	NS
1. *Haplothrips robusta*		
2. *H. clarisetis*		
Thripidae	NS	NS
3. *Apterothrips apteris*		
4. *Neohydatothrips moultoni*		
5. *Limothrips cerealum*		
6. *Aphanothrips obscurus*		
7. *Frankliniella minuta*		
8. *F. occidentalis*		
9. *Taeniothrips sp. 1*		
10. *Thrips madronii*		
11. *T. tabaci*		
Hemiptera Order Bugs		
Corixidae		
1. *Sp. no. 1*		
Reduviidae		
2. *Zelus sp.*	X	X
3. *Rhinocoris ventralis* ext		
Alydidae		
4 *Stachyonemus sp.*		
5. *Alydus sp.* (152)		
Lygaeidae		
6. *Geocoris sp.* (25)		X
7. *Emblethis vicarius* (21)		

8. *Lygaeus kalmii*
9. *L. reclivatus* ext
10. *Melanopleuris bicolor* (20)
11. *Nysius ericae*

Coreidae

13. *Stachyocnemus* (23)
14. *Scolopocerus sp*
15. *Narnia inornata* ext

Rhopalidae

16. *Arhyssus*
17. *Liorhyssus ?hyalinus* (22)

Miridae

18. *Lopidea nigridea*
19. *L. marginata*
20. *Lygus hesperius*
21. *Closterocoris amoenus*
22. *Zelus sp.*
23. *Dacurla sp.* (27)
24. *Sp. no. 124*
25 *Sp. no. 125*
26. *Sp. no. 128*
27. *Sp. no. 129*

Largidae

28. *Largus cinctus*

Pentatomidae

29. *Petidia uhleri*
30. *P. sayi*
31. *Acrosternum hilari*
32. *Banasa sp.*
33. *Thyanta custator accerra*
34. *Chlorochroa congrua* ext
35. *T. rugulosa* ext

Eurygaster alternata ext

Scutellaridae

36. *Acanthoma sp.*
37. *Sp. no. 1 138* (26)
38. *Sp. no. 2 139* (28)
39, *Euptychodera corrugata* ext

Cydnidae

40. *Pangaeus bilineatus* (24)
41. *Sp. no. 1* (153) X

Nabidae

42. *Nabis sp* ext

Veliidae

43. *undet sp.* ext

HomopteraOrder Cicadas, Leafhoppers, Aphids, Scales, Whiteflies Not sampled by Nagano et al.

Dictyophoridae

1. *Orgerius triquestra complex* (29) X

Cicadellidae (30) & (31) XX unident.

2. *Aceratagallia pallida* ext

3. *Alconeura necopinata*
4. *Amblysellus grex* ext
5. *Amphigonalia bispinosa*
6. *Balclutha sp.* ext
7. *Ballana sera*
8. *Ballana sp.*
9. *Carneocephala fulgida* ext
10. *Circulifer tenellus* ext
11. *Calladonis geminatus*
12. *Dikrania carneola*
13. *Empoasca cerea* ext
14. *Exitianus exitiosus*
15. *Friscanus friscanus*
16. *Giprus angulata*
17. *Lystidea nuda*
18. *Momoria rufoscutella*
19. *Osbornellus n. sp?* ext
20. *Osbornellus sp.*
21. *Penestragania robusta*
22. *Ponana punctipennis*
23. *Prairiana sp.*
24. *Scaphytopius sp.* ext
25. *Texananus sp.*
26. *Tiaja interrupta*
27. *Xerophloea brunnea*
28. *X. vanduzeei*
29. *X. peltata*

Cixiidae

30. *Oliarus sp.*

Membracidae

31. *Stictocephala bubalis*
32. *Tortistylus albidosparsus*

Delphacidae

33. *Stobaera sp.*
34. *Stobaera muiri*
35. *Toya propinqua* ext

Cercopidae

36. *Clastoptera brunnea* ext

Margarodidae

37. *Icerya purchasi*

Coccidae

38. *Pulvinaria sp.*
39. *Saissetia hemispherica*
40. *S. oleae*
41. *Odonaspis ruthae*
42. *Sp. no. 1* (33)

Psyllidae

43. *Calophya californica*

Paratrioza lavaterae *Foodplant extirpated* ext

Flatidae

44. *Mistharnophantia sonorana*

Issidae

45. *Danepteryx robusta* ext		
Pseudococcidae		
46. *Pseudococcus maritimus*		
47. *P. eriogoni*		
48. *P. citri*		
49. *P. aurilanatus*		
Eriosomatidae		
50. *Sp. no. 1*		
Aphididae (32) unident. species		X
51. *Uroleucon katankae*		
52. *U. rudbeckiae*		
53. *Acrythosiphon kondoi*		
54. *A. pisum*		
55. *Myzus persicae*		
56. *Cryptomyzus ribis*		
57. *Aphis eriogoni*		
58. *A. helichrysi*		
59. *A. medicaginis*		
60. *Brevicoryne brassicae*		
61. *Macrosiphon albifrons*		
62. *M. ambrosiae*		
63. *M. sp.*		
64. *Rhopalosiphon lactucae*		
65. *Capitophrus glandulosis*		
66. *Lipaphis pseudobrassicae*		
67. *Myzus convolvulae*		
68. *M. persicae*		
Neuroptera Order Lacewings, Antlions		
Myrmeleontidae		
1. *Myrmeleon arizonicus*	X	
2. *Brachynemurus brunneus*	X	
Hemerobiidae		
3. *Hemerobius pacificua*	X	
4. Sp. no. 2		
Chrysopidae 1 unident. species		
5. *Chrysoperla ploribunda*		
6. *Eremochrysa punctinervis*		
<u>*Chrysopa carnea*</u>	X (misiden?)	
Coleoptera Order Beetles		
Cicindelidae		
Cicindella hirticollis gravida ext		
Carabidae		
1. *Calosoma semilaeve* (120)	X	
2. *Pterostichus californicus* (75)	X	X
3. *Amara californica* (76)	X	X
4. *Calathus ruficollis* (77)	X	X
5. *Tanystoma maculicolle* (78)	X	
6. *Agonum crenistrictum*	X	
7. *A. californicum*	X	
8. *Bembidium nr. quadrulum*	X	X
9. *Tachys corax*	X	

10. *Anisodactylus californica*	X	
11. *Bradycellus sp.*	X	
12. *Stenolophus sp.*	X	
13. *Apristus laticollis*	X	
Histeridae not adequately sampled		
14. *Xerosaprinus fimbriatus* (7)	X	X
15. *Geomysaprinus pasminosus*		
16. *Spilodiscus sellatus* (150)		
17. *Hypocaecus lucidolis*		
Saprinus discoidalis (=bigemmeus Pierce det.) ext		
Scarabaedae		
17. *Parathyce palpalis*	X	X
18. *Diplotaxis sp.*		
19. *Serica sp.* (16)		X
20. *Aegialia convexa*		
21. *Psammodius mcclayi*		
22. *Aphodius rugatus* (80)	X	X
23. *A. militaris*		
24. *A. fuscosus*	X	
25. *A. lividus*	X	
Ligyrus gibbosus (Haplopappus) ext		
Dichromina dimidiata (Datura) ext		
Heteroceridae		
26. *Heterocerus gnatho*		
Buprestidae		
27 *Acmaeodera fenyesi*	X	
Agrilus lacustris (Croton) ext		
Elateridae NS		
28. *Hypolithus sp.* (81)		
29. *Anchastus cineripennis*	X	
30. *Sp. 1* (82)		X
31. *Sp. 2* (83		X
32. *Sp. 3*		
Aeolus sp. (160)		X
Cantharidae		
33. *Cantharis consors*		
Dermestidae		
34. *Dermestes sp.* (124)	X	X
Anthrenus lepidus ext	X	
Anthrenus verbasci	X	
Anobiidae		
Megorama viduum (Corethrogyne stems & roots) ext		
Ptinidae		
35. *Ptinus fur*	X	X
Gen. sp. 1	X	
Melyridae 1 unident. species		
36. *Collops cribrosus* (84)		
37. *C. marginicollis*	X	
38. *Attalus lobulatus*		
39. *Sp. no. 1*		
40. *Trichochrous squalidus*		
41. *T. antennatus*		

Dasytastes bicolor ext		
Eschatocrepis constrictus ext		
Coccinellidae		
42. *Rodolia cardinalis*		
43. *Crytolaemus montrouzieri*	X	
44. *Oila v-nigrum*	X	
45. *Psyllobora taedata*		
46. *Cycloneda munda* (138)		X
47. *C. polita*		
48. *Coccinella californica* (137)	X	X
49 *Hippodamia convergens* (139)	X	X
50. sp. 1 Hawks (19)		
51. sp. 2 Hawks		
Scymnus marginicollis ext		
Chilocorus bivulnuris	X	
Colydiidae		
52. *Anchomma costatum* (11)	X	X
53. *Rhagodera ? tuberculata*		
Tenebrionidae (John Doyen)		
54. *Metaponium convexicolle*		
55. *Eleodes omissa* (6)		
56. *E. gracilis* (5)	X	X
57. *E. nigropilosa* (13)	X	X
58 *E. littoralis* ext		
59. *Blapstinus sp.* ext		
60. *Nyctoporis carinata* (118)		X
61. *Cratidus osculans* (14)	X	X
62. *Helops blaisdelli*		
63. *Stenotrichus rufipes* ext		
64. *Coelus globosus* (12)		
65. *C. ciliatus* (8)	X	X
66. *Coniontis affinis* (10)	X	
67. *Hylocrinus longulus* (15)		
Epantius obscurus	X	X
Staphylinidae NS		
68. *Sepedophilus sp.* (125)		X
69. *Sp. no. 1* (9)		X
70. *Sp. no. 2* (79)		
71. *Sp. no. 3*		
72. *Sp. no. 4*		
Alleculidae		
73. *Isomira sp.*		
Mordellidae		
74. *gen &sp* (139)	X	X
Cerambycidae		
75. *Ipochus fasciatus* (17)	X	X
Bruchidae		
76. *Stator limbratus*		
77. *S. pruininus*		
Chrysomelidae		
78. *Exema conspersa*		
79. *Lema trilineata daturiphila*		

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80. *Diabrotica undecimpunctata*	X	X
81. *D. soror (Curcubita)* ext		
82. *Cryptocephalus sanguinicollis*		
83. *C. sprucus*		
84. *C. confluentus*		
85. *Altica obliterata*	X	
86. *Altica sp. no. 1*		
87. *Diachus auratus*	X	
88. *Microrhopala rubrolineata (Heterotheca)* ext		
Curculionidae		
89. *Cleonus cristatus (Chaenactis stems and roots)* ext		
90. *C. sparsus (Erysimum stems and roots)* ext		
91. *Cleonidius pericollis* (88)		
92. *Apion proclive*	X	
93. *Pantomorus cervinus (Lupinus chamissonis)* ext pest		
94. *Rhigopsis effracta* (86)		X
95. *Listeroderes obliquua*	X pest	
96.. *Sitona cylindricollis* (87)	X	
97. *Trigonoscuta dorothea* (18)	X	X
98. *Trichobaris compacta*		
99. *Onychobaris langei*	X	
100. *Smicronyx calaenus*	X	
101. *S. cuscutiflorae*		
102. *S. elsegundis(Cuscuta flowers)* ext ?		
103. *Baris sp.*		
104. *Cylindrocopturus sp.* (123)	X	
Pselaphorhynchites aeratoides (Eriogonum parvifolium) ext		
Scolytidae		
105. *Phloeosinus sp.*		
106. *Chaetophloeus hystrix (Rhus integrifolia leaves)* ext		
undet. fam.		
107. *Octinodes sp.*		
Dinocleus albovestitus		ext

Lepidoptera Order (det. R. Leuschner)

GEOMETROIDEA Superfamily

Geometridae

Ennominae

1. *Elpiste marcesaria*
2. *Semiothisa californiaria*
3. *S. napensis*
4. *S. irrorata*
5. *Animomyia morta*
6. *Pero macdunnoughi*
7. *Anacamptodes fragilaria*
8. *Neoterpes edwardsata*
9. *Sabulodes aegrotata*

Geometrinae

10. *Nemoria leptalea*
11. *Dichorda illustraria*
12. *Synchlora aerata liquoraria*
13. *Chlorochlamys appellaria*

13.1 *Cheteoscelis faseolaria*	X	
Sterrhinae		
14. *Cyclophora nanaria*		
15. *Idaea microphysa*		
Larentiinae		
16. *Archiroe neomexicana*		
17. *Perizoma custodiata*	X	X
18. *Spargania magnoliata*		
19. *Euphyia implicata multilineata*		
20. *Zenophleps lignocolorata*		
21. *Orthonama obstipata*		
22. *Eupithecia misturata*		
23. *E. miserulata zela*		
24. *E. maestosa*		
SPHINGOIDEA Superfamily		
Sphingidae		
25. *Manduca sexta*		
26. *Hyles lineata*	X	X
NOCTUOIDEA Superfamily		
Arctiidae		
27. *Apantesis proxima*		
28. *Estigmene acrea*	X	
29. *Arachnis picta*		
Leptarctia californiae ext		
Notodontidae		
30. *Furcula scolopendrina*		
31. *F. cinerea cineriodes*		
Lymantridae		
32. *Orgyia magna*		
Noctuidae		
Herminiinae		
33. *Tetanoleta palligera*		
Hypeninae		
34. *Hemeroplanis finitima*	X	
Catocalinae		
35. *Caenurgia togataria*		
36. *Zale lunata*		
Plusiinae		
37. *Autographa californica*	X	X
38. *A. biloba*		
39. *Trichoplusia ni*		
Nolinae		
40. *Nola apera*		
Acontiinae		
41. *Eumicremma minima* n.ssp?		
Tarachidia candefacta ext		
Heliothinae		
42. *Heliothis virescens*		
43. *H. zea*		
44. *H. phloxiphagus*	X	

45. *Schinia scarletina*		
46. *S. pulchripennis*		
Noctuinae		
47. *Agrotis ipsilon*		
48. *A. subterranea*		
48. *Peridroma saucia*		
49. *Copeblepharon sanctaemonicae*		
50. *Xestia adela*		
51. *Hemieuxoa rudens*		
52. *Spaelotis havilae*		
53. *Euxoa messoria*		
54. *E. septentrionalis*		
55. *E. (wilsoni) riversii*		
Hadeninae		
56. *Lacinipolia stricta ssp?*	X	
57. *L. leucogramma*		
58. *L. quadrilineata*		
59. *L. vicina acutipennis*		
60. *Zosteropoda hirtipes*	X	
61. *Leucania oaxacana*		
62. *Protorthodes alfkeni*		
63. *P. melanopis ssp?*		
64. *P. rufula*		
65. *Pseudaletia unipuncta*		
66. *Dargida procincta*		
<u>*Discestra chartaria*</u>	X	
Cuculiinae		
67. *Stylopoda cephalica*		
Amphipyrinae		
68. *Platypergia extima*		
69. *P. mona*		
70. *Apamea cinefacta*		
71. *Spodoptera exigua*		
72. *Prodenia ornithogalli*		
73. *Catabena esula*		
PYRALOIDEA Superfamily		
Pyralidae		
Odontinae		
Psammobotys fordi ext		
Glaphyriinae		
74. *Abegesta remellallis*		
74.1 *Stega salutalis riparialis*		
75. *Dicymolomia metaliferalis*		
75.1 *Hellula rogatalis*		
Pyraustinae		
76. *Uresiphita reversalis*	X	X
77. *Loxostege immerans*	X	X
78. *Udea profundalis*		
78.1 *Pyrausta laticlava*		
79. *Lineodes integra*		
80. *Nomophila nearctica*		
81. *Diastichtis fracturalis*		

82. *Achyra occidentalis*
Crambinae
83. *Tehama bonifatella*
84. *Crambus sperryellus*
85. *Euchromius ocelleus ocelleus*
Chrysauginae
86. *Arta* n. sp. nr.*epicornalis*
Epipaschiinae
87. *Jocara trabalis*
Galleriinae
88. *Alphaias transferrans*
Phycitinae
89. *Etiella zinckenella*
90. *unident. n. sp./genus nr. Etiella*
91. *Adelphia ochripunctella*
92. *Heterographis morrisonella* misident of 92.2?
92.1 *Staudingeria albipenella*
92.2 *Hulstia undulatella*
93. *Phycitodes albatella mucidella*
94. *Ephestiodes gilvescentella*
95. *Vitula edmondsii bombylicolelis*
96. *Elasmopalpus lignosellus*

PTEROPHOROIDEA Superfamily
Pterophoridae
Platyptiliinae
97. *Platyptilia williamsi*
98. *Anstenoptilia marmarodactyla*
Pterophorinae
99. *Oidaematophorus* nr. *grisescens*

TINEOIDEA Superfamily
Tineidae
100. *Opogona omoscopa*
101. *Opogona* sp.
102. *Amydria* sp.
102.1 *Tinea sp*

SESIODEA Superfamily
Sesiidae
Synanthedon polygoni ext

COSSOIDEA Superfamily
Cossidae
102.2 *Comadia intrusa*

YPONOMEUTOIDEA Superfamily
Heliodinidae
103. *Lithariapteryx abroniella*
104. *Heliodines* sp.
Plutellidae
105. *Plutella xylostella*

TORTRICOIDEA Superfamily

Tortricidae

Olethreutinae

106. *Eucosma hennei*
Endemic, LAX dunes
107. *Bactria verutana chrysea*
108. *Phaneta apacheana*
109. *Anapina triangulana*

Tortricinae

110 *Argyrotaenia citrana*
111. *Platynota stultana*

Cochylidae

112. *Lorita scarfica (abornana)*
Carolella busckana busckana ext

GELECHIOIDEA Superfamily

Blastobasidae

113. *Holcocera sp.*

Coleophoridae

114. unident.

Oecophoridae

114.1 *Pressariodea gracillis*
Martyhilda gracilis X

Momphidae

115. *Mompha sp.*

Cosmopterigidae

116. *Walshia miscecolorella*
117. *Pyroderces badia*
118. *Telodoma helianti*

Scythrididae

119. *Scythris* sp. 1
120. *Scythris* sp. 2

Gelechiidae

121. *Gelechia paraplutella*
122. *Anacampsis lacteusocrella*
123. *Aristotelia argentifera*
124. *Chionodes mediofuscella*
125. *C. lophocella*
126. *Syncopacma nr nigrella*
127. *S.* n. sp.
128. *Aroga nr, unifasciella*
129. *Rifseria fuscotaenirella*
Dichomeris baxa (endemic?)

PAPILIONOIDEA

Papilionidae

130. *Papilio zelicaon*	X	X
131. *P. rutulus*		
132. *Battus philenor philenor*	(rare migrant)	

Pieridae

133. *Pieris rapae*	X	X
134. *P. protodice*	X	X

135. *Anthocharis sara sara ext*		
136. *Colias eurytheme*	X	X
137. *C. hardfordii ext*		
138. *Phoebis sennae marcellina* (periodic migrant)		X
139. *Eurema nicippe* (periodic migrant)		X

Nymphalidae

140. *Nathalis iole* (periodic migrant)		
141 *Coenonympha tullia california* ext		
142.*Danaus gilippus strigosus*	X	X
143.*D. plexippus*	X	X
144. *Agraulis vanillae incarnata*	X	X
145. *Chlosyne gabbii gabbii* ext.		
146. *Vanessa atalanta rubria*		X
147. *V. cardui*	X	X
148. *V. anabella*	X	X
149. *V. virginiensis*	X	X
150. *Nymphalis antiopa*	X	X
151. *Precis coenia*		X

Lycaenidae

152. *Apodemia mormo* nr. *virgulti*	X	ext
153. *Strymon melinus*	X	X
154. *Callophrys augustus iroides*	1984 (RR)	
155. *C. perplexa*	X	X
156. *Brephidium exilis*	X	X
157. *Leptotes marina*	X	X
158. *Everes amyntula* ext.		
159*Plebejus acmon acmon*	X	
160. *Glaucopsyche lygdamus australis*	X	X
161. *Euphilotes battoides allyni ext*		

HESPEROIDEA

Hesperidae

162. *Polites sabuleti sabuleti*		X
163. *Hylephila phyleus*	X	X
164. *Pyrgus albescens*		X
165. *Erynnis funeralis*	X	X
166. *Panoquina errans*	X	X
167. *Paratrytone melane*		X
168. *Lerodea eufala*		X
169. *Atalopetes campestris*		X

Strepsiptera Order Stylops

Halictophagidae

1. *Diozocera comstocki* ext

Diptera Order Flies

Tipulidae

1. *Tipula sp. 1* (111)
2. *Tipula beatula*
3. *Gonomyia flavibasis*
4. *Limonia communis*

Psychodidae

5. *Sp. no. 1*		
Culicidae		
6. *Culex sp.*		
7. *Culiseta sp.*	X	
8. *Aedes squamiger*	X	
Chironomidae NS, identification		
9. *Chironomus stigmaterus*		
10. *Crictopus sp.*		
11. *Dicrotendipes sp.*		
Simulidae NS, identification		
12. *Gen.& sp. no.1*		
Bibionidae		
13. *Bibio hirtus*		
Bibio albipennis	X	X
14. *Gen.& sp. no.1*		
15. *Gen.& sp. no.2*		
Sciaridae NS, identification		
16. *Gen.& sp. no.*		
Cecidomyiidae NS, identification		
17. *Asphondylia sp.*		
18. *n. gen. n. sp.1*		
Stratiomyidae		
19. *Nemotelus sp.*		
Nemotelus arator	X	
Tabanidae		
20. *Brennania belkini*	X	**ext.**
Therevidae		
21. *Cromolepidia sp.*		
22. *Psilocephala aldrichi*	X	
23. *Thereva sp. 1*	X?	
24. *Thereva sp. 2*	X?	
25. *Gen.& sp. no.1*		
Thereva nebulosa **ext?**	X	X
Scenopinidae		
26. *Scenopinus sp.*		
Apioceridae		
27. *Rhaphiomidas terminatus terminatus* **ext**		
Mydidae		
28. *Nemomydas pantherinus*	X	X
Asilidae		
29. *Metapogon pictus*		
30. *Ablautus coquilleti* (132)	X	X
31. *Stenopogon brevisculus*	X	
32. *Cophura clausa*	X	
33. *Mallophora fautrix*	X	
34. *Proctocantha coquilleti*		
35. *Asilus sp.*		
36. *Nicocles sp.*		X
37. *Leptogaster sp.*		X
38. *Saropogon luteus*		X
Acroceridae		
39. *Opsebius diligens*		

40. *Ogcodes sp.*		
Turbopsebius diliogens	X	
Bombyliidae		
41. *Conophorus collinius*		X
42. *C. fenestratus*		X
43. *C. cristatus*		
44. *Villa atrata*	X	X
45. *V. lateralis*	X	X
46. *V. molitor*		X
47. *Ligyra gazophylax*		X
48. *Poecilanthrax arethusa*	X	X
49. *Thyridanthrax hugator*		X
50. *Lepidanthrax homologus*	X	X
51. *L. oribates*		
52. *L. agrestis*		
53. *Neodiplocampta mira*		X
54. *Bombylius new species*		
55. *Exoprosopa doris*		X
56. *Exoprosopa nr. arenicola*		
57. *Exoprosopa sp. np. 1*		
58. *Paravilla syrtis*		
59. *Poecilognathus loewi*		
60. *Acreophthiria similis*		
61. *Phthiria sp. no. 1*		X
62. *Phthiria sp. no. 2*		X
63. *Geron nigripes*		X
64. *Geron New Sp. no. 23*		
65. *Mythicomyia pictipes*		
66. *Mythicomyia sp.*		
67. *Anastoechus melanohalteralis*		X
67 a. *Chrysanthrax sp.*		X
Heterostylum robustum		X
Dolichopodidae 2 unident. species		
68. *Gen.& sp. no.1*		
69. *Gen.& sp. no.2*		
70. *Gen.& sp. no.3*		
71. *Gen.& sp. no.4*		
72. *Gen.& sp. no.5*		
Phoridae		
73. *Gen.& sp. no.1*		X
74. *Gen.& sp. no.2*		
Pipunculidae NS		
75. *Pipunculus sp.*		
Syrphidae		
76. *Copestylum mexicana*	X	X
77. *Volucella tau*		X
78. *Syrphus sp.*		X
79. *Metasyrphus sp.*		
80. *Eristalis tenax*	X	X
E. aenus	X	X
81. *Sphaerophoria sp.*		
82. *Syritta pipiens*		
83. *Allograpta micrura*		

84. *A. obliqua*		X
85. *Scaeva pyrastri*	X	X
86. *Eupeodes volucris*	X	X
87. *Baccha clavata*	X	X
88. *Paragus tibialis*	X	X
89. *Carposcalis sp.*		
Copestylum marginatum ext		
Conopidae		
91. *Physocephala texana*		X
Otitidae		
92. *Melieria occidentalis*	X?	
93. *Gen.& sp. no.1*		
Tephritidae		
94. *Euaresta bellula*		
96. *Proceidochares minuta*		
97. *Trupanea signata*		
98. *T. jonesi*		
T. californica	X	
99. *Tephritis sp.*		
Coelopidae NS		
100. *Gen.& sp. no.1*		
Lauxaniidae NS		
101. *Calliopium sp 1*		
102. *Calliopium sp.2*		
Chamaemyiidae NS		
103. *Leucopis sp.*		
Piophilidae NS		
104. *Gen.& sp. no.1* ext?		
Lonchaeidae NS		
105. *Gen.& sp. no.1*		
Ephydridae		
106. *Gen.& sp. no.1*	X	X
Drosophilidae		
107. *Drosophila melanogaster*		
Chloropidae NS		
108. *Gen.& sp. no.1*		
109. *Gen.& sp. no.2* ext?		
Agromyzidae NS		
110. *Melanagromyza sp. 1*		
111. *Gen.& sp. no.1*		
Heleomyzidae NS		
112. *Gen.& sp. no.1* (46)		X
113. *Gen.& sp. no.2*		
Trixoscelididae NS		
114. *Gen.& sp. no.1*		
Asteiidae NS		
115. *Gen.& sp. no.1*		
Anthomyiidae NS		
116. *Gen.& sp. no.1* (91)		X
117. *Gen.& sp. no.2* (92)		X
118. *Gen.& sp. no.3* (110)		X
119. *Gen.& sp. no.4*		
120. *Gen.& sp. no.5*		

121. *Gen.& sp. no.6*
122. *Gen.& sp. no.7*

Muscidae
123. *Musca domestica*
124. *Stomoxys calcitrans*
125. *Gen.& sp. no.1*

Calliphoridae NS

126. *Calliphora sp. 1* (89)	X
127. *Calliphora sp. 2* (95)	X
128. *Luciliini Gen.& sp. no.1* (96)	X

Sarcophagidae NS

129. *Sarcophaga sp. 1* (47)	X
130. *Sacrophaga sp. 2* (48)	X
131. *Sarcophaga sp. 3* (93)	X
132. *Eumacronychia sp.* (49)	X
133. *Eumacronychia sp.* (90)	X
134. *Miltogrammini:Gen.& sp. no.1* (94)	X

Tachinidae NS
135. *Ptilodexia sabroskyi*
136. *Archytas california*
137. *Peleteria texensis*
138. *Deopalpus gemminatus*
139. *Chaetogaedia vilis*
140. *Eriothrixini Gen.& sp. no.l*
141. *Gonia sp*
142. *Microglossa hesperidarum*
143. *Gen.& sp. no.1*
144. *Gen.& sp. no.2*
145. *Gen.& sp. no.3*
146. *Gen.& sp. no.4*
147. *Gen.& sp. no.5*
148. *Gen.& sp. no.6*
149. *Gen.& sp. no.7*

Hymenoptera Class Wasps, Bees, Ants, Sawflies
The identification of this order was largely performed by R. Snelling for both the 1980 Ballona study and the LAX study. There is sufficient disagreement among these two studies as to question the validity of comparisons in some groups without further study.

Braconidae NS
1. *Apanteles thurberi*
2. *A. nr. aristoteliae*
3. *Diadegma sp.*
4. *Campoplex sp.*
5. *Opius sp.*
6. *Agathis sp.*
7. *Aphidinae Gen.& sp. no.1.*
8. *Aphidinae Gen.& sp. no.2*
9. *Aphidinae Gen.& sp. no.3*
10. *Gen.& sp. no.1*
11. *Gen.& sp. no.2*
12. *Gen.& sp. no.3*

13. *Gen.& sp. no.4*		
14. *Gen.& sp. no.5*		
15. *Gen.& sp. no.6*		
16. *Gen.& sp. no.7*		
Ichneumonidae NS		
17. *Ichneumona sp. no. 1* (126)		
18. *Gen.& sp. no. 1*		
19 *Gen.& sp. no. 2*		
20 *Gen.& sp. no. 3*		
21 *Gen.& sp. no. 4*		
22 *Gen.& sp. no. 5*		
23 *Gen.& sp. no. 6*		
24 *Gen.& sp. no. 7*		
25 *Gen.& sp. no. 8*		
26 *Gen.& sp. no. 9*		
27 *Gen.& sp. no. 10*		
28 *Gen.& sp. no. 11*		
29 *Gen.& sp. no. 12*		
30 *Gen.& sp. no. 13*		
Trichogrammatidae NS		
31. *Trichogramma nr. minuta*		
32. *Trichogramma sp.*		
Eulopidae NS		
33. *Necremnus sp.*		
34. *Chrysocharis sp.*		
Encyrtidae NS		
35. *Homalotylus sp.*		
36. *Anysotylus sp.*		
Eupelmidae NS		
37. *Anastatus*		
Bradynobaenidae NS		
38. *Chyphotes petiolatus*		
Torymidae NS		
39. *Podagrion sp.*		
40. *Megastigmus sp.*		
41. *Torymus sp.*		
Pteromalidae NS		
42. *Gen.& sp. no.1*		
Eurytomidae NS		
43. *Eurytoma sp.*		
Chalcididae NS		
44. *Spilochalis sp.*		
Figitidae NS		
45. *Gen.& sp. no.1*		
Cynipidae NS		
46. *Gen.& sp. no.1*		
Scelionidae NS		
47. *Gen. & sp. no.*		
Dryinidae NS		
48. *Gen.& sp. no.1* (116)		X
Formicidae		
49. *Pogonomyrmex californicus* (1)	X	X
50. *Iridomyrmex humilis* (2)	X	X

51. *Conomyrma sp.* (3)		
52. *Formica piliformis* (4)		
53. *Monomorium minimum* (53)		
Pheidole hyattii extirpated		
Camponotus clarathorax extirpated		
Tiphiidae		
54. *Gen.& sp. no.1* (141)		X
55. *Gen.& sp. no.2* (142)		X
Mutillidae		
56. *Dasymutilla californica*		
Dasymutilla sackeni ext		
57. *Sphaeropthalma sp. 1* (51)	NS	
58. *Sphaeropthalma sp. 2* (52)		
Scoliidae		
59. *Campsomeris tolteca*		X
60. *Crioscolia alcione*		
Pompilidae		
61. *Ageniella blaisdelli*		
62. *Aporus hirsutis*		
63. *A. luxus*		
64. *A. sp.*		
65. *Episyron snowi*		
66. *E. quinquenotatus hurdi*		
67. *Pepsis chrysothemis*		
69. *Evagetes hyacinthus*	X	
70. *Tachypompilus unicolor*		X
71. *Aproenellus medianus*		
72. *A. yucatanensis*		
73. *Pompilus angularis*		
Vespidae NS		
74. *Polistes aurifer*		X
Sphecidae NS		
75. *Tachysphex amplus*		
76. *T. ashmeadi*		
77. *T. texanus*		
78. *T. sp.*		
79. *Clypeadon californicus*		
80. *Larropsis tenuicornis*		
81. *Sphex ichneumoneus*		
82. *Isodontia elegans*		
83. *Ammophila azteca*		X
84. *A. pruinosa*		
85. *A. cleopatra*		X
86. *A. aberti*		
87. *Microbembix californica* (55)		X
88. *Bembix americana comata*		X
89. *Steniola duplicata*		
90. *Plenoculus sp.*		
91. *Mimesia cahuilla*		
92. *Mimesia sp.*		
93. *Miscophis sp. no. 1*		

94. *Miscophis sp. no. 2*		
95. *Tachytes distinctus*		
96. *Prionyx parkeri*		
97. *P. atratus*		
98. *Astata sp.*		
Colletidae		
99. *Colletes angelica*		
100. *C. slevini*	X	X
101. *C. hyalinus gaudialis*	X	X
Halictidae		
102. *Lasioglossum sisymbrii*		
103. *L. pavonotum*		
104. *Agapostemon texanus* (129)	X	X
105. *A. femoratus*		
106. *Dialictus pilosicaudis*		
107. *D. microlepoides*		
108. *D. perichlarum*		
109. *D. brunneventis*		
110. *D. sp. 3*		
Andrenidae		
111. *Andrena oenothera*		
Melittidae		
112. *Hesperaspis fuchsi*		
Megachilidae		
113. *Anthidium palliventre*		
114. *Megachile lippae*		
115. *Osmia integra*		
116. *Osmia sp.*		
O. clarescens	X	X
Anthophoridae		
117. *Habropoda tristissima*		
118. *Micranthophora curta*	X	
119. *Peponapsis pruinosa*		
120. *Anthophora urbana*	X	X
121. *Melissodes lupina*	X	
122. *M. moorei*		
123. *Emphoropsis sp.*		
Apidae		
124. *Apis mellifera*	X	X
125. *Bombus sonorus*	X	X
126. *B. crotchii*	X	
127. *B. californicus*	X	X
128. *B. vosnesenskii*	X	X
B. edwardsii	X	X

Species found by Nagano et al.(1981), but not in the sand dunes community. Species location in Quad A and/or B indicated by the appropriate letter. Phenology , abundance and plant association given. Collection in 1990 indicated.

Theridiidae Cobweb spiders
Dipoena sp. Willow, B, summer, occasional
Anyphaenidae
Teudis sp. Salicornia, B, winter, occasional
Gnaphosidae Running or mouse spiders
Poecilochroa sp . Saltflat, B, summer, occasional
Orodrassus sp. Salicornia, B, summer, occasional
Mircryphantidae
gen. sp. 1 Willow, B, spring, very common
Dictynidae
gen. sp. 1 Willow, B, spring, very common
Araneidae Orbweaver spiders
Argiope aurantia Freshwater marsh, summer, common
A. trivitata Freshwater marsh, fall, common

Dermaptera Order Earwigs
Labiduridae
Euborella annulipes Freshwater marsh, B, summer, common (1990)

Isoptera Order Termites
Kalotermitidae
Incistermes minor Willow, B, summer, occasional (1990)

Orthoptera
Raphidophoridae
Ceuthophilus sp. Freswater marshs, willow , year round, occassional. This was probably confused with *N. morsei* by Nagano. (1990)

Hemiptera Order Bugs
Corixidae
Trichocorixa reticulata, Saltmarsh, salt and mudflat, Salicornia, B, year, very common indicator of hypersaline conditions (1990)
Saldidae
Saluda pallipes, mudflat,Vicinity, rare

Homoptera
Flatidae 1 unidentified common species on *Salicornia*

Coleoptera Order Beetles
Cicindelidae
Cicindellaoregona oregona Ballona Flood Control Channel mud, Feb-Oct, occassional not found 1990
C. haemorrhagica haemorrhagica Ballona Flood Control Channel mud, Feb-Oct, common not found 1990
C. trifasciata sigmoidea Mud and salt flat, A B, Feb-Oct., common (rare, 1990)
Carabidae
Agonum multicolle Salicornia, B, spring, rare (1990)
Calosoma cancellatum. Freshwater marsh, fall, rare, local, 1990 only

0107

Dytiscidae
  Rhanus gutticollis Salicornia, B, summer, occasional
Hydrophilidae
  Tropisternus sp. Salicornia, A B, summer,occasional
  Enochrus sp. Salicornia, A B, summer,occasional
Staphylinidae
  Bledius strenus Salicornia, mud-, saltflat, A B, summer fall, common
  B. sp., Salicornia, mud-, saltflat, A B, summer fall, common
  Philothonus sp. 1. Salicornia, A, summer, rare
Oedemeridae
  Nacerdes melanura Saltflat, A, summer, common
Chrysomelidae
  Cryptocephalus castaneus Willow, A, fall, very common
  Stenopodius flavidus (Malva) fields,A, rare
  Pachybrachus sp. Willow, A, Feb-Jul, common
Coccinellidae
  Psyllobora viginmaculata Willow, A, summer, occasional
Bostrichidae
  Gen sp. Interface, Salicornia litter, A, summer, rare
Cleridae
  Phyllobaenus subfasciata Fields, A, summer, rare

Lepidoptera
Pterophoridae
  Aqdistis americana Salicornia, B, spring, occasional
Sessidae
  Paranthene robinae Willows, B, summer, occasional
Hesperiidae
  Ochlodes sylvanoides Coastal sage, B, summer, rare (1990 first recd)

Diptera
Tephritidae
  Eutreta angusta Willows, B, summer, occasional
Ephydridae
  Ephydra riparia Salt marsh, Salicornia, A B, all year, very common
  E. sp. Salt marsh, Salicornia, A B, all year, very common

Hymenoptera
Formicidae
  Leptogaster andrei. Willow, Interface, B, Mar-Sept, rare
Pomplilidae
  Hemipepsis texana. (172) marshes, bluffs, summer, common

Table 2. List of insects visually identified and counted during the transect traverses across the Ballona Wetlands (map as figure 3). Species expected but not observed are also noted.

Lepidoptera

L-1 Glaucopsyche lygdamus
L-2 Callophrys perplexa
L-3 Pieris rapae
L-4 P. protodice
L-5 Leptotes marina
L-6 Danaus plexippus
L-7 Brephedium exilis
L-8 Vanessa cardui
L-9 Strymon melinus
L-10 Perizoma custodiata
L-11 Polites sabuleti
L-12 Noctuid, unident
L-13 Nymphalis antiopa
L-14 Hylephila phyleus
L-15 Panoquina panoquinoides
L-16 Pyrgus albescens
L-17 Loxostege immerans
L-18 Paratrytone melane
L-19 Precis coenia
L-20 Danaus gillippus
L-21 Synanthedon sp.
L-22 Lerodea eufala
L-23 Atalopetes campestris
L-24 Ochlodes sylvanoides
L-25 Papilio zelicaon I
L-26 Vanessa carye I
L-27 V, atalanta I
L-28 Eurema nicippe
L-29 Phoebis sennae
L-30 Nathalis iole I
L-31 Colias eurytheme

Diptera

D-1 Coniophorus collini
D-2 C. fenestrata
D-3 Thyridanthrax nugator
D-4 Lepidanthrax sp.
D-5 Poecilanthrax arethusa
D-6 Villa lateralis
D-7 V. atrata
D-8 V. molitor
D-9 V. agrippina
D-10 Heterostylum robustum
D-11 Paravilla fumosa
D-12 P. edititoides*
D-13 Anastoechus melanohalteris
D-14 Exoprosopa doris
D-15 Ligyra gazophylax
D-16 Hemipenthes lepidota
D-17 Systoechus sp.
D-18 Chrysanthrax sp. I
D-19 Eristalis tenax
D-20 Sarcophaga sp.
D-21 Brennania belkini*
D-22 Thereva nebulosa
D-23 Scavia pyraste
D-24 Ablautus coquilleti
D-25 Sarapogon luteus
D-26 Volucella tau
D-27 V. mexicana
D-28 Neomydas pantherinus
D-29 Metapogon pictus I
D-30 Baccha clava I
D-31 Geron sp.
D-32 Neodiplocampta mira

Hymenoptera

H-1 Bombus vosnesinskii
H-2 B. sonorus
H-3 B. californicus
H-4 B. edwardsii
H-5 B. crotchii*
H-6 Megachilid sp
H-7 Osmia sp
H-8 Ammophila sp. 1
H-9 Ammophila sp. 2 1
H-10 Anthophorid sp.
H-11 Bembix comata
H-12 Anthophora urbana
H-13 Apis mellifera I
H-14 Hemipepsis texanus
H-15 Campsomeris tolteca
H-16 Agapostemon texanus

Orthoptera

G-1 Melanoplus sp.I
G-2 Scuddaria mexicana 1

Arachnids

A-1 Psidius johnsoni
A-2 Argiope trivitata
A-3 A. aurantica

Odonata

O-1 Tarnetrum corruptum
O-2 Pantala flavescens
O-3 Tramea onusta
O-4 Anax junius

* indicates species expected but not yet observed (Sept. 1990)
O indicates species observed but not on transect
1 indicates species observed only once (singleton)

Table 3. Distribution and abundance of all species visually identified across the transect segments defined on the map in figure 3. Key to species cited given in table 2. This table contains 8 pages.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
1	Subsites	length m																										Diptera											
2	Date III 20 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
3	Dunes 1	105	1	2								1						1										3	1										
4	Dunes 2	113	1						1	1	1																												
5	D/SM In	486	1	1									1															1	1										
6	SM 1	437										4		1																									
7	SM 2	243							1			1	2																										
8	SM 3	259			2			4				10			2	1																							
9	SM 4	275										6																											
10	FM 1	154																	1																				
11	Hastings	211	27	6							2						1																						
12	FM 2	518			3					1		1			1																								
13																																							
14	Date IV 17 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
15	Dunes 1	105	2	1	1																							1											
16	Dunes 2	113	2	1					1					2				3																					
17	D/SM In	486										3				3																							
18	SM 1	437							1																														
19	SM 2	243																																					
20	SM 3	259			3			6																															
21	SM 4	275										1																											
22	FM 1	154																																					
23	Hastings	211	20	2																																			
24	FM 2	518																																					
25																																							
26	Date V 8 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
27	Dunes 1	105					2				3																			1		1							
28	Dunes 2	113																																					
29	D/SM In	486									1		7						6																				
30	SM 1	437										3																											
31	SM 2	243																																					
32	SM 3	259																																					
33	SM 4	275																																					
34	FM 1	154																		1																			
35	Hastings	211					5						1																										
36	FM 2	518																																					
37																																							
38	Date V 25 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
39	Dunes 1	105					5				4																					1							
40	Dunes 2	113																	2																				
41	D/SM In	486									1		3						11																				
42	SM 1	437										4																											
43	SM 2	243																																					
44	SM 3	259																																					
45	SM 4	275																																					
46	FM 1	154																		1																			
47	Hastings	211					12				2																					1							
48	FM 2	518			1																																		
49																																							
50	Date VI 15 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
51	Dunes 1	105					3													3															5				
52	Dunes 2	113																																					
53	D/SM In	486										2	1	1	1				7																				
54	SM 1	437										1	1						1																				2
55	SM 2	243																																					
56	SM 3	259							1				1						2													4				2			3
57	SM 4	275															2															6							
58	FM 1	154			3										1		2			2	1																		
59	Hastings	211					3				1						2													1					1				
60	FM 2	518			1																1																		
61																																							
62	Date VI 30 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
63	Dunes 1	105																																					
64	Dunes 2	113																																					
65	D/SM In	486											5						11													2	1			2			
66	SM 1	437										3																											
67	SM 2	243																																					
68	SM 3	259																														1		1					3
69	SM 4	275															1															2							1
70	FM 1														1		4			1	1																		
71	Hastings						6				2																												1
72	FM 2																				1																		

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
73	Date: VII 17 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
74	Dunes 1	105					1													1						1									3				
75	Dunes 2	113																	15																				
76	D/SM in	486				1			2				12						38													1							
77	SM 1	437			1								2						2																				
78	SM 2	243			2								2																										
79	SM 3	259							1										20					3								2							1
80	SM 4	275											2																										
81	FM 1	154									1						2			3		1			3														
82	Hastings	211					4		2												1														44				1
83	FM 2	518			2																2		2											2			6	3	
84																																							
85	Date VIII 3 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
86	Dunes 1	105			1										1					2												2			3				
87	Dunes 2	113																																					
88	D/SM in	486							16				7						56											1									
89	SM 1	437							1				1																						1				2
90	SM 2	243				1	3												20		2									1		1			1	1			
91	SM 3	259																																					
92	SM 4	275																																					
93	FM 1	154																																					
94	Hastings	211																			1																		
95	FM 2	518																			1														1		1		1
96																																							
97																																							
98	Date: VIII 20 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
99	Dunes 1	105																																	1				
100	Dunes 2	113																																	1				
101	D/SM in	486							95		3								13											1		1	1		3				
102	SM 1	437													1				3		3																1		
103	SM 2	243																																					
104	SM 3	259																																					
105	SM 4	275																													1	1							
106	FM 1	154															5																						
107	Hastings	211																																	3				
108	FM 2	518												1							3										2			1					
109																																							
110	Date: IX 4 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
111	Dunes 1	105														1															1							1	
112	Dunes 2	113									1	3							15																			1	
113	D/SM in	486							200				16						34												3	6						1	
114	SM 1	437										1																											
115	SM 2	243																	15		1	3		1							1								
116	SM 3	259																				1																	
117	SM 4	275																													1								
118	FM 1	154															7																						
119	Hastings	211															3				1										10				1	1		3	
120	FM 2	518						1													2										3					1		3	
121																																							
122	Date: IX 17 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
123	Dunes 1	105																		1											3							1	
124	Dunes 2	113			1						1								12																				
125	D/SM in	486							100		1		3						36																				
126	SM 1	437							100			7							2												1								1
127	SM 2	243						1					2						·10												3					1			
128	SM 3	259																	2																				
129	SM 4	275																																					
130	FM 1	154						1									3																						
131	Hastings	211																			1										1				2			1	
132	FM 2	518													1						1																		
133																																							
134	Date: X 5 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
135	Dunes 1	105																																					
136	Dunes 2	113																																					
137	D/SM in	486						3	80			1	1			1			3		1																		
138	SM 1	437																	2		2																		
139	SM 2	243						3																															
140	SM 3	259																																					
141	SM 4	275																	2																				
142	FM 1	154								1																													
143	Hastings	211																													1					1			
144	FM 2	518																			2																		

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
145																																							
146	Date : X 15 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
147	Dunes 1	105														1				1																			
148	Dunes 2	113																																					
149	D/SM In	486					2	2	75										19																				
150	SM 1	437										2							2																				
151	SM 2	243						500					2						10		1																		
152	SM 3	259							1												1																		
153	SM 4	275										1					7				3																		
154	FM 1	154								1										1											1								
155	Hastings	211																																					
156	FM 2	518																																					
157																																							
158	Date: XI 21 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
159	Dunes 1	105																																					
160	Dunes 2	113																																					
161	D/SM In	486						1	50			2							1																				
162	SM 1	437																																					
163	SM 2	243						5000				2																											
164	SM 3	259																	1																				
165	SM 4	275						1									1																						
166	FM 1	154											2				3				2										1								
167	Hastings	211																																					
168	FM 2	518																																					
169																																							
170	Date XII 14 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
171	Dunes 1	105																																					
172	Dunes 2	113											2						20																				
173	D/SM In	486						6	4			4	1																										
174	SM 1	437						1													2																		
175	SM 2	243						4													2																		
176	SM 3	259																			1																		
177	SM 4	275															3		5																				
178	FM 1	154																													1								
179	Hastings	211																																					
180	FM 2	518																			1																		
181																																							
182	Date: I 23 91		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
183	Dunes 1	105																																					
184	Dunes 2	113																																					
185	D/SM In	486										1																											
186	SM 1	437										2																											
187	SM 2	243						500													1																		
188	SM 3	259																																					
189	SM 4	275																																					
190	FM 1	154																																					
191	Hastings	211																																					
192	FM 2	518							1																														
193																																							
194	Date: II 15 91		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
195	Dunes 1	105																																					
196	Dunes 2	113																																					
197	D/SM In	486			2			2			7	2																											
198	SM 1	437			1			1				2																											
199	SM 2	243										1	1					0																					
200	SM 3	259										12																											
201	SM 4	275																																					
202	FM 1	154													1																								
203	Hastings	211	6	1			1				4																												
204	FM 2	518						1													1																		
205																																							
206	Date: III 16 91		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
207	Dunes 1	105	2																									25											
208	Dunes 2	113																																					
209	D/SM In	486									4	2																											
210	SM 1	437										1																											
211	SM 2	243																																					
212	SM 3	259																																					
213	SM 4	275	2	1								3																											
214	FM 1	154																																					
215	Hastings	211																																					
216	FM 2	5																																					

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	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
217	Summary		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-16	L-17
218	Dunes 1	105	5	3	2	0	11	0	0	0	7	1	0	0	1	2	0	1
219	Dunes 2	113	3	1	1	0	0	0	2	1	3	3	2	2	0	0	0	3
220	D/SM in	486	1	1	2	1	2	14	622	0	17	17	57	1	1	4	0	0
221	SM 1	437	0	0	2	0	0	2	102	0	0	30	4	1	1	0	0	0
222	SM 2	243	0	0	2	1	3	6008	1	0	0	4	9	0	0	0	0	0
223	SM 3	259	0	0	5	0	0	10	3	0	0	22	1	0	2	1	0	0
224	SM 4	275	2	1	0	0	0	1	0	0	0	11	2	0	0	0	14	0
225	FM 1	154	0	0	3	0	0	1	0	2	1	0	2	0	3	0	26	0
226	Hastings	211	53	9	0	0	31	0	2	0	11	0	1	0	0	0	6	0
227	FM 2	518	0	0	7	0	0	2	1	1	0	1	0	1	2	0	0	0
228	Totals		64	15	24	2	47	6038	733	4	39	89	78	5	10	7	46	4

	A	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI		AK	AL	AM
217	Summary	L-15	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D	-14	D-11	D-8
218	Dunes 1	0	8	0	0	0	0	0	1	0	29	1	1	4	4	0	0	12	0	0	2	0
219	Dunes 2	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
220	D/SM in	237	0	1	0	0	0	0	0	0	1	1	2	3	10	2	0	3	2	0	1	0
221	SM 1	12	0	7	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	5
222	SM 2	55	0	7	3	0	1	0	0	0	0	0	1	4	1	0	0	1	2	0	0	0
223	SM 3	25	0	2	1	0	3	0	0	0	0	0	0	0	7	0	1	0	2	0	0	7
224	SM 4	7	0	3	0	0	0	0	0	0	0	0	0	2	11	0	0	0	0	0	0	1
225	FM 1	1	9	4	1	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0
226	Hastings	0	0	4	0	0	0	0	0	0	0	0	1	14	1	0	0	51	2	0	4	2
227	FM 2	0	0	15	0	2	0	0	0	0	0	0	0	5	0	0	3	1	1	7	6	1
228	Totals	401	17	43	5	2	4	3	1	0	30	2	5	34	34	2	4	70	9	8	14	16

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	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY
1															Hymen																Spiders							
2	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
3															28	2			2	1																		
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12																					1									1								
13																																						
14	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
15															3	1	1			1																		
16															1																							
17										3	1																											
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23										5							1																					
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25																																						
26	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
27												1		1		1	1	1			1	2	1				1											
28																																						
29														1																								
30																															1							
31																																						
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33																																						
34																																						
35																9		2																				
36																																						
37																																						
38	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
39																1	2																					
40																																						
41																						1																
42																															1							
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47			2												5	5																						
48																																						
49																																						
50	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
51													1		1												1											
52																																						
53																																						
54																						2																
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56				2											5																							
57	1																																					
58															1																							
59															1						1																	
60																																						
61																																						
62	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
63																																						
64																																						
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67																																						
68	1						7																															
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	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW		BY
73	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	O 1	C-1	A 1	A 2	A 3	O 2	O 3	O 4	L 29	
74																																						
75																						8																
76							3								1						1	10			1							1						
77																																						
78																																						
79	1				5		3								5							10							1									
80																										1												
81																																						
82	5																																					
83		1			1										20	3						2				1												
84																																						
85	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	O 1	C-1	A 1	A 2	A 3	O 2	O 3	O 4	L 29	
86													2																									
87													1													1												
88						1									1	1					1					1												
89																																						
90	3					2																			3													
91																																						
92																										2												
93															5																							
94																																						
95															5	5										2												
96																																						
97																																						
98	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	O 1	C-1	A 1	A 2	A 3	O 2	O 3	O 4	L 29	
99																																						
100	1																																					
101																5						27																
102	2				1																				3													
103																																						
104																																						
105																																						
106																																						
107																																						
108															20	18										1												
109																																						
110	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	O 1	C-1	A 1	A 2	A 3	O 2	O 3	O 4	L 29	
111																																						
112																																						
113																					8																	
114																																						
115																																				1		
116			1																																			
117																																						
118																																1	3					
119		1				5																																
120																30																	1					
121																																						
122	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	O 1	C-1	A 1	A 2	A 3	O 2	O 3	O 4	L 29	
123																																						
124																1																						
125																																						
126																													1									
127																																						
128																2																						
129																													1									
130																																1	1					
131						2										2																						
132																																						
133																																						
134	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	O 1	C-1	A 1	A 2	A 3	O 2	O 3	O 4	L 29	
135																																						
136																3																						
137																																						1
138																													1								1	
139																3																						
140																													1									
141																2																2						
142																																3						
143																14																						
144																																						

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	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY
145																																						
146	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
147																																						
148																																						
149																5																						
150																																						
151																													1							1		
152																													1							3		1
153																													6									
154																																4						
155																																						1
156																																						
157																																						
158	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
159																																						
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162																																						
163																													1									
164																													1									
165																																						
166															1																							
167																											1											
168																																						
169																																						
170	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
171																																						1
172																																						
173																1																			1		1	
174																																						
175																																						
176																													1									
177																																						
178																																						
179																																						
180																1																						
181																																						
182	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
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190															2																							
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192																																						
193																																						
194	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
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202																																						
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204																																						
205																																						
206	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
207															1												1											
208															1																							
209																																						
210																																						
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212																																						
213															1																							
214																																						
215																																						
216																																						

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	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ
217	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28
218	0	0	0	0	0	0	0	0	0	0	0	1	3
219	1	0	0	0	0	0	0	0	0	0	0	0	1
220	0	0	0	0	0	1	3	0	0	3	1	0	0
221	2	0	0	0	1	0	0	0	0	0	0	0	0
222	3	0	0	0	0	2	0	0	0	0	0	0	0
223	2	0	1	2	5	0	10	0	0	0	0	0	0
224	1	0	0	0	0	0	0	0	0	0	0	0	0
225	0	0	0	0	0	0	0	0	0	0	0	0	0
226	6	1	2	0	0	7	0	0	0	5	0	0	0
227	0	1	0	0	1	0	0	0	0	0	0	0	0
228	15	2	3	2	7	10	13	0	0	8	1	1	4

	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM
217	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14
218	1	33	5	4	1	2	2	1	2	1	0	0	0
219	0	4	4	0	0	0	0	0	8	0	0	0	1
220	1	4	14	0	0	0	0	10	48	0	0	1	1
221	0	0	1	0	0	0	0	0	2	0	0	3	0
222	0	0	5	0	0	0	0	0	0	0	0	3	0
223	0	10	2	0	0	0	0	0	10	0	0	0	0
224	0	2	2	0	0	0	0	0	0	0	0	0	3
225	0	9	0	0	0	0	0	0	0	0	0	0	0
226	0	7	30	1	2	0	0	1	0	0	0	0	0
227	0	45	57	0	0	0	0	1	2	0	0	0	4
228	2	114	120	5	3	2	2	13	72	1	0	7	9

	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW		BY
217	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
218	3	0	0	0	0	0	0	0	0	0	0	154
219	0	0	0	0	0	0	0	0	0	0	0	106
220	0	0	0	0	0	1	0	0	1	0	1	1093
221	0	0	2	0	2	0	0	0	0	0	1	183
222	0	0	2	0	0	0	0	0	0	2	0	6120
223	0	0	5	0	0	0	0	0	0	3	0	142
224	0	0	7	0	0	2	0	0	0	0	0	72
225	0	0	0	0	0	9	4	0	0	0	0	79
226	1	0	0	0	0	0	0	0	0	0	0	255
227	0	0	0	1	0	0	1	0	0	0	0	169
228	4	0	16	1	2	12	5	0	1	5	2	8373

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TABLE 4. SPECIES ABUNDANCE IN PITFALL TRAPS LOCATED AMONG SIX GENERAL BIOLOGICAL COMMUNITIES ACROSS THE BALLONA WETLANDS: SM =SALT MARSH, SF=SALTFLAT, M=FRESH WATER MARSH, W2=WILLOW GROVES ALONG CENTINELA CREEK, AF=HASTINGS ALLUVIAL WASH. THE SAND DUNE SITES ARE GIVEN UNDER TOTAL, WHICH INCLUDES N="NATIVE" DUNE, W=WILLOW GROVES, C=ICEPLANT CARPETS AND I=ECOTONE BETWEEN ICEPLANT AND PICKLEWEED. IDENTIFICATION GIVEN IN TABLE 5.

Species Number	N	W	C	I	Subtotal	SM	SF	M	W2	AF	Total
1	2				2					10	12
2	65	90	357	310	822	28	30	95	162	160	1297
5		1	4		5	1	4	5	2	30	47
7	93			8	101					1	102
8	6				6						6
9	2	1		2	5						5
10	2				2						2
11	1				1				1	1	3
13	39	30	17	1	87				4	197	288
14	3	2			5				1	2	8
15		5	2	2	9		1		3	7	20
16	4				4					3	7
18	45		96	2	143						143
22			1		1						1
24		3	1	4	8						8
25	1		1	8	10		1				11
26	2				2						2
28			1		1						1
29	3				3						3
30	2	3			5					1	6
31				2	2						2
32				5	5		1	2			8
34		15	13		28		1	3		12	44
35	111	20	8	43	182	7	5	1			195
36	24	87	37	3	151				1		152
37	4				4			1			5
38		1	2	2	5	1					6
39	18				18					1	19
41		3		1	4					5	9
42	4	37	64	96	201	128	14	1	2	1	347
45	42				42				2	1	45
46	2	1	7	1	11	8			2	55	76
47	6	2		3	11	3	3			2	19
48	99	38	26	61	224	34	39	7	20	144	468
49	59	6	1	1	67	3	5			51	126
50	6	3		2	11	3		3	4	7	28
51				1	1						1
54	4	3	3	5	15	5	4				24
56	1	4	4		9						9
57	3	19	55	95	172	10	2	13	20	4	221
58	1	8	2	2	13			1	1	13	28
59	9	12	1	2	24	6	5	1			36
60	9	63	22	85	179	4	3	34	68	3	291
61	5	2	1	1	9			1		4	14
62	2			3	5						5
63		13		2	15				3	1	19
64	1				1						1
65	1	2			3	1	6				10
66	38	2			40	1				3	44
67	2			1	3					2	5
69	4				4						4
71	1	3			4			1	12		17
73	10	1			11						11
74	1				1					6	7
75	2	94	76	168	340	176	1	1	2	1	521
76				1	1						1
77	1	11	4	12	28	6		15	134	203	386
78					0					3	3
80	1				1						1

Species Number	N	W	C	I	Subtotal	SM	SF	M	W2	AF	Total
82		28	23	23	74		1	2	5		82
83			1		1						1
84			1		1						1
85					0					1	1
86					0					4	4
89				1	1	1			7		9
90	8				8						8
91	3	3	1	32	39	27	1	2		30	99
92				1	1		2	3	5	2	13
93	55	4	6	14	79	8	3		4	1	95
94	2			1	3						3
95					0				1		1
96	1	1			2				1		3
97	13		1		14		4			3	21
98				1	1						1
99			13		13						13
100	5	25	42	77	149	96	17	3	1		266
101	2	1	2	1	6		3	1	5	1	16
102				1	1					4	5
105		2			2						2
108	3	2			5						5
112	2	2	4		8				1		9
113	12	103	14	7	136	2	5	192	10	1	346
116		4	4	4	12				1	1	14
118					0			1	1		2
123				1	1						1
124	2				2						2
125		94	2		96						96
128	1				1						1
135	4	3		1	8						8
136	1				1						1
139	3	1	1	2	7		3				10
145				4	4						4
146	1	223	51	22	297		3	192	35	10	537
149				1	1		3				4
153	2	2			4				2		6
154	12	9	2	1	24				1	2	27
155	2		11	15	28	1	7	3			39
156			3	393	396	3	3	1			403
157			1	4	5		11	1			17
158			19	21	40	3	1				44
159		2	6	8	16	2			4	4	26
160			2	19	21	2					23
161				8	8						8
162		36	2	24	62					1	63
163		4	2	10	16	4	1	1			22
164		2	3		5	1					6
165		1	2	3	6	2					8
166	2			1	3		2				5
167				4	4			2			6
168			2		2			21			23
169					0				1	3	4
170	16		1	1	18					1	19
171					0			4			4
172	1				1			2			3
173	7	5	6		18		2				20
Totals	901	1142	1034	1641	4718	577	197	616	529	1003	7640

Table 5. List of all species collected in pitfall traps across all sites in the Ballona wetlands. Each taxa identified to order and family of insects and class and family of arachnids. Genus and species names cited where classifiable. Non-identified species classified by labelled exemplars in the permanent collection.

Species Number	Family	Order	Genus	Species
1	Hymenoptera	Formicidae	*Pogonomyrmex*	*californica*
2			*Iridiomyrmex*	*humilis*
5	Coleoptera	Tenebrionidae	*Eleodes*	#1
7		Histeridae	*Xerosaprinus*	#1
8		Tenebrionidae	*Coelus*	*ciliatus*
9		Staphylinidae		#1
10		Tenebrionidae	*Coniontis*	#1
11			*Anchomma*	*Costatum*
13			*Amphidora*	*Nigripilosa*
14			*Cratidus*	*Osculans*
15				#1
16		Scarabaeidae		#1
18		Curculionidae	*Trigonoscuta*	*dorothea*
22	Hemiptera	(Coriscid)		#1
24		(Cydnid)		#1
25		Lygidae	*Geocoris*	#1
26		Scutelleridae	*Small Black*	#1
28		Scutelleridae		#2
29		Fulgoridae	*Orgerius*	*triquesteris*
30		(Cercopid)		#1
31		Cicadellidae		#1
32		Aphididae		#1
34	Collembola			#1
35	Thysanura	Machilidae		#1
36				#2
37				#3
38	Dermaptera	Forficulidae	*Furficula*	*auricularia*
39	Orthoptera	Polyphagidae	*Arenivaga*	
41		Gryllicrididae	*Rhachocnemis*	*validus*
42		Gryllidae	*Acheta*	*assimilis*
45	Diptera	Bombyliidae		#1
46		Heleomyzidae		#1
47		Sarcophagidae		#1
48				#2
49			*Eumacronychia*	#1
50		Phoridae		#1
51	Hymenoptera	Mutillidae	*Sphaeropthalma*	#1
54		Pompilidae		#1
56	Arachnida	Gnaphosidae		#1
57		Dysderidae	*Dysdera*	*crocata*
58		Pholcidae	*Psilochorus*	#1
59		Lycosidae		#1

60				#2
61				#3
62		Clubionidae	*Chiracanthium*	#1
63		Thomisidae	*Xysticus*	#1
64		Oxyopidae		#1
65		Theridiidae	*Lactrodectus*	*mactyans*
66		Erematobidae	*Eremobates*	#1
67	Pseudoscorpionids			#1
69		Trombidiidae	*Trombidium*	#1
70				#1
71		Spirobolidae		#1
73		Zodariidae	*Lutica*	#1
74	Lacertia			
75	Coleoptera	Carabidae	*Pterostichus*	#1
76			*Amara*	#1
77			*Calathus*	*ruficollis*
78			*Agonum*	*maculicolle*
80		Scarabaeidae	*Aphodius*	#1
82		Elateridae		#1
83				#2
84		Melyridae	*Collop*	#1
85		Tenebrionidae	*Epantius*	*obscurus*
86		Curculionidae	*Rhigopsis*	#1
89	Diptera	Calliphoridae	*Calliphora*	#1
90		Sarcophagidae	*Eumderomychia*	#1
91		Anthomyiidae		#1
92				#2
93		Sarcophagidae	*Sarcophaga*	#1
94			*Miltogrammimi*	#1
95		Callophoridae		#2
96				#3
97	Arachnida	Oonopidae	*Scaphiella*	#1
98		Theridiidae	*Steatoda*	*grossa*
99		Thomosidae	*Philodromus*	#1
100		Clubionidae	*Castianeira*	#1
101		Gnaphosidae		#2
102		Phalangiidae		#1
105		Lithobiomorphidae	*Lithobius*	#1
108			*Aptostichus*	*simians*
112	Psocoptera	Psocidae		#1
113	Isopoda		*Porcellio*	*laevis*
116	Hymenoptera	Dryinidae		#1
118	Coleoptera	Tenebrionidae	*Nyctoporis*	*carinata*
123		Curculionidae	*Cylindrocopturus*	*new species*
124		Dermestidae	*Dermestes*	#1
125		Staphilinidae	*Sededophilus*	#1
128	Diptera	Therevidae	*Ceromolepida*	#1
135	Coleoptera	Ptinidae	*Ptinus*	*fur*
136		Coccinelidae	*Hippodamia*	*convergens*

139		Mordellidae		#1
145	Neuroptera	Chrysopidae		#1
146	Isopoda		*Armadillium*	*vulgare*
149	Coleoptera	Anobeidae		#1
153	Hymenoptera	Cydinidae		#1
154	Orthoptera	Gryllacridae	*Stenopelmatus*	*dark*
155	Dermaptera		*Euberellia*	*annulipes*
156	Amphipoda			#1
157	Embioptera	Embiidae		#1
158	Coleoptera	Carabidae	*Pterostichus*	#1
159		Tenebrionidae		#2
160		Elateridae	*Aeolus*	#1
161		Carabidae		#1
162	Arachnida	Gnaphosidae	*Poecilochroa*	*ocellata*
163		Clubionidae	*Castianeira*	#1
164	Diptera	Therevidae	*Thereva*	*nebulosa*
165		Empidae	*Empis*	#1
166	Orthoptera	Myrmecophila		#1
167	Coleoptera	Carabidae		#2
168		Carabidae		#3
169		Tenebrionidae	*Eleodes*	*acuticauda*
170	Hymenoptera	Formicidae	*Leptothorax*	*andrei*
171	Coleoptera	Carabidae	*Calosoma*	*cancelatum*
172	Hymenoptera	Pompilidae	*Hemipepsis*	*texana*
173	Arachnida	Salticidae		#1

Table 6. List of species collected in pitfall traps for which the total number of individuals taken was ten or less. Listing as in table 5. Actual number taken given in the last colume

Species Number	Family	Order	Genus	Species	N
8		Tenebrionidae	*Coelus*	*ciliatus*	6
9		Staphylinidae		*#1*	5
10		Tenebrionidae	*Coniontis*	*#1*	2
11			*Anchomma*	*Costatum*	3
14			*Cratidus*	*Osculans*	8
16		Scarabaeidae		*#1*	7
22	Hemiptera	(Coriscid)			1
24		(Cydnid)		*#1*	8
26		Scutelleridae		*#1*	2
28		Scutelleridae		*#2*	1
29		Fulgoridae	*Orgerius*	*triquesteris*	3
30		(Cercopid)		*#1*	6
31		Cicadellidae		*#1*	2
32		Aphididae		*#1*	8
37				*#3*	5
38	Dermaptera	Forficulidae	*Furficula*	*auricularia*	6
41		Gryllicrididae	*Rhachocnemis*	*validus*	9
51	Hymenoptera	Mutillidae	*Sphaeropthalma*	*#1*	1
56	Arachnida	Gnaphosidae		*#1*	9
62		Clubionidae	*Chiracanthium*	*#1*	5
64		Oxyopidae			1
65		Theridiidae	*Lactrodectus*	*mactyans*	10
67	Pseudoscorpionids			*#1*	5
69		Trombidiidae	*Trombidium*	*#1*	4
74	Lizards				7
76			*Amara*	*#1*	1
78			*Agonum*	*maculicolle*	3
80		Scarabaeidae	*Aphodius*	*#1*	1
83			*Medium size*	*brown*	1
84		Melyridae	*Collop*	*#1*	1
85		Tenebrionidae	*Epantius*	*obscurus*	1
86		Curculionidae	*Rhigopsis*	*#1*	4
89	Diptera	Calliphoridae	*Calliphora*	*#1*	9
90		Sarcophagidae	*Eumderomychia*	*small*	8
94			*Miltogrammimi*		8
95		Callophoridae		*#2*	1
96				*#3*	3
98		Theridiidae	*Steatoda*	*grossa*	1
102		Phalangiidae		*#1*	5
105		Lithobiomorphidae	*Lithobius*	*#1*	2
108			*Aptostichus*	*simians*	5
112	Psocoptera	Psocidae		*#1*	9
118	Coleoptera	Tenebrionidae	*Nyctoporis*	*carinata*	2
123		Curculionidae	*Cylydrocopturis*	*new species*	1
124		Dermestidae	*Dermestes*	*#1*	2
128	Diptera	Therevidae	*Ceromolepida*	*#1*	1
135	Coleoptera	Ptinidae	*Ptinus*	*fur*	8

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136		Coccinelidae	*Hippodamia*	*convergens*	1
139		Mordellidae		*#1*	10
145	Neuroptera	Chrysopidae		*#1*	4
149	Coleoptera	Anobeidae		*#1*	4
153	Hymenoptera	Cydinidae		*#1*	6
161		Carabidae		*#1*	8
164	Diptera	Therevidae	*Thereva*	*nebulosa*	6
165		Empidae	*Empis*	*#1*	8
166	Orthoptera	Myrmecophila		*#1*	5
167	Coleoptera	Carabidae		*#3*	6
169		Tenebrionidae	*Eleodes*	*acuticauda*	4
171	Coleoptera	Carabidae	*Calosoma*	*cancelatum*	4
172	Hymenoptera		*Hemipepsis*	*texana*	3
174	Coleoptera	Curculionidae	*Onychobaris*	*langei*	1

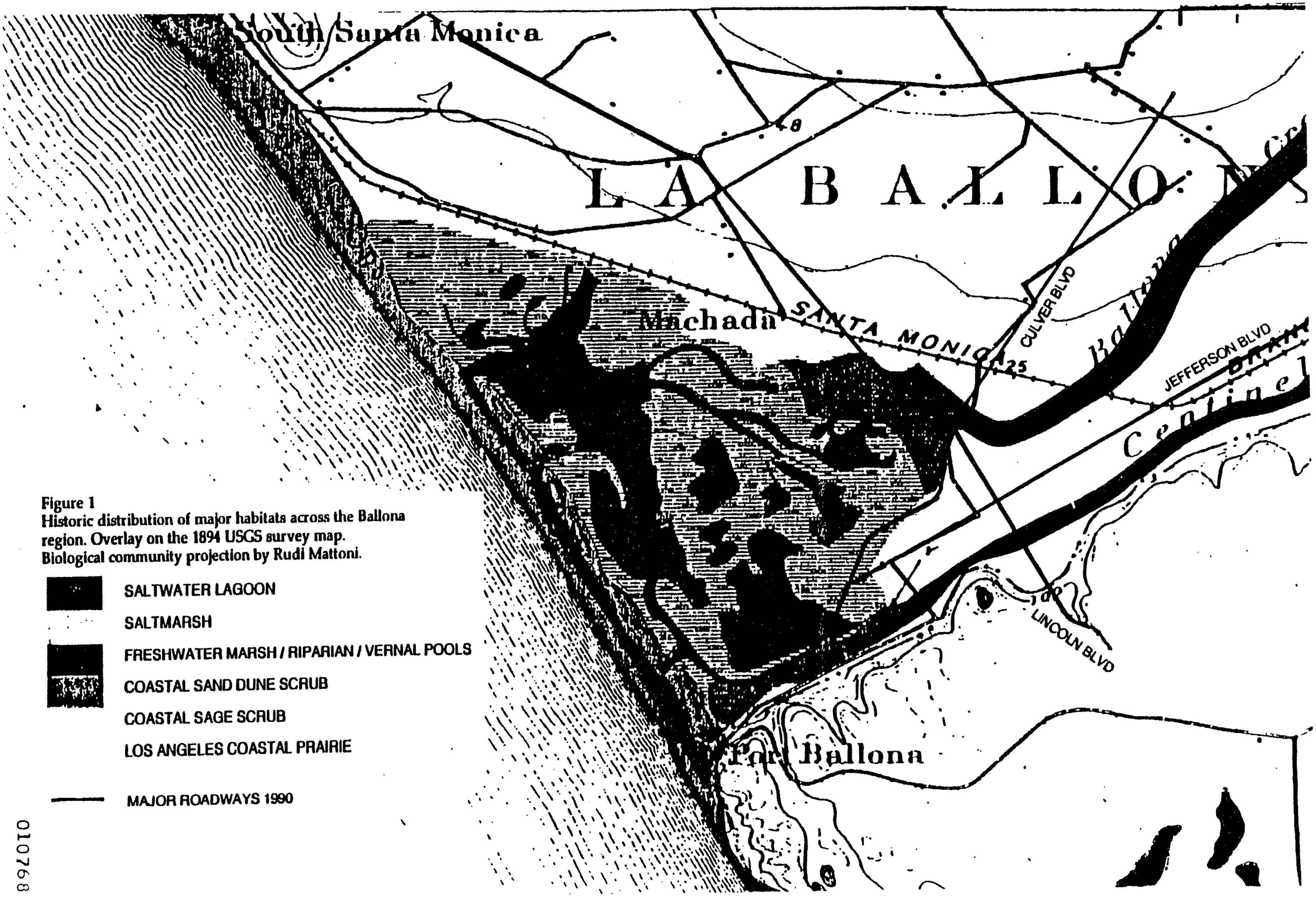

Figure 1
Historic distribution of major habitats across the Ballona region. Overlay on the 1894 USGS survey map. Biological community projection by Rudi Mattoni.

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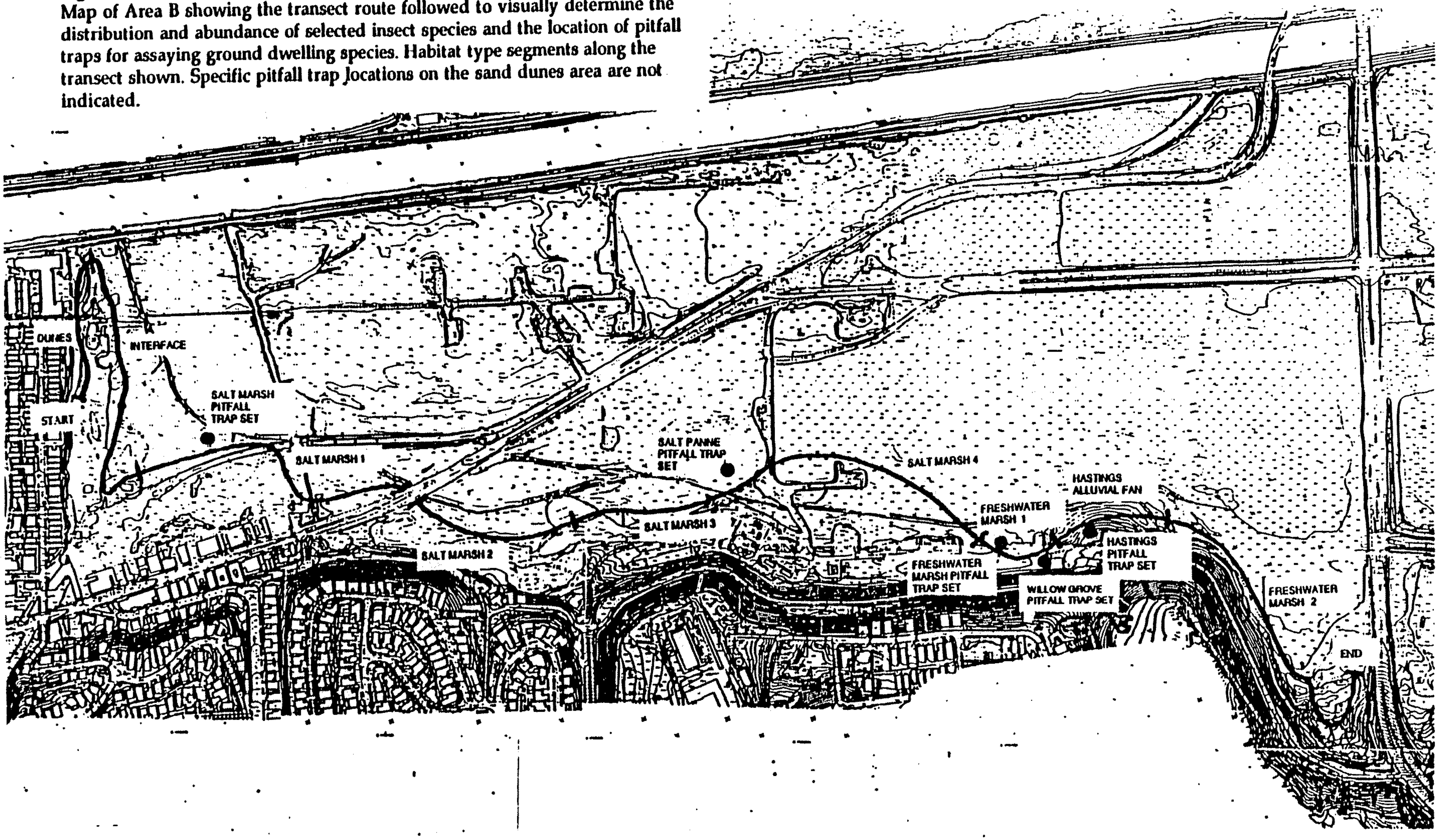
Figure 3.
Map of Area B showing the transect route followed to visually determine the distribution and abundance of selected insect species and the location of pitfall traps for assaying ground dwelling species. Habitat type segments along the transect shown. Specific pitfall trap locations on the sand dunes area are not indicated.



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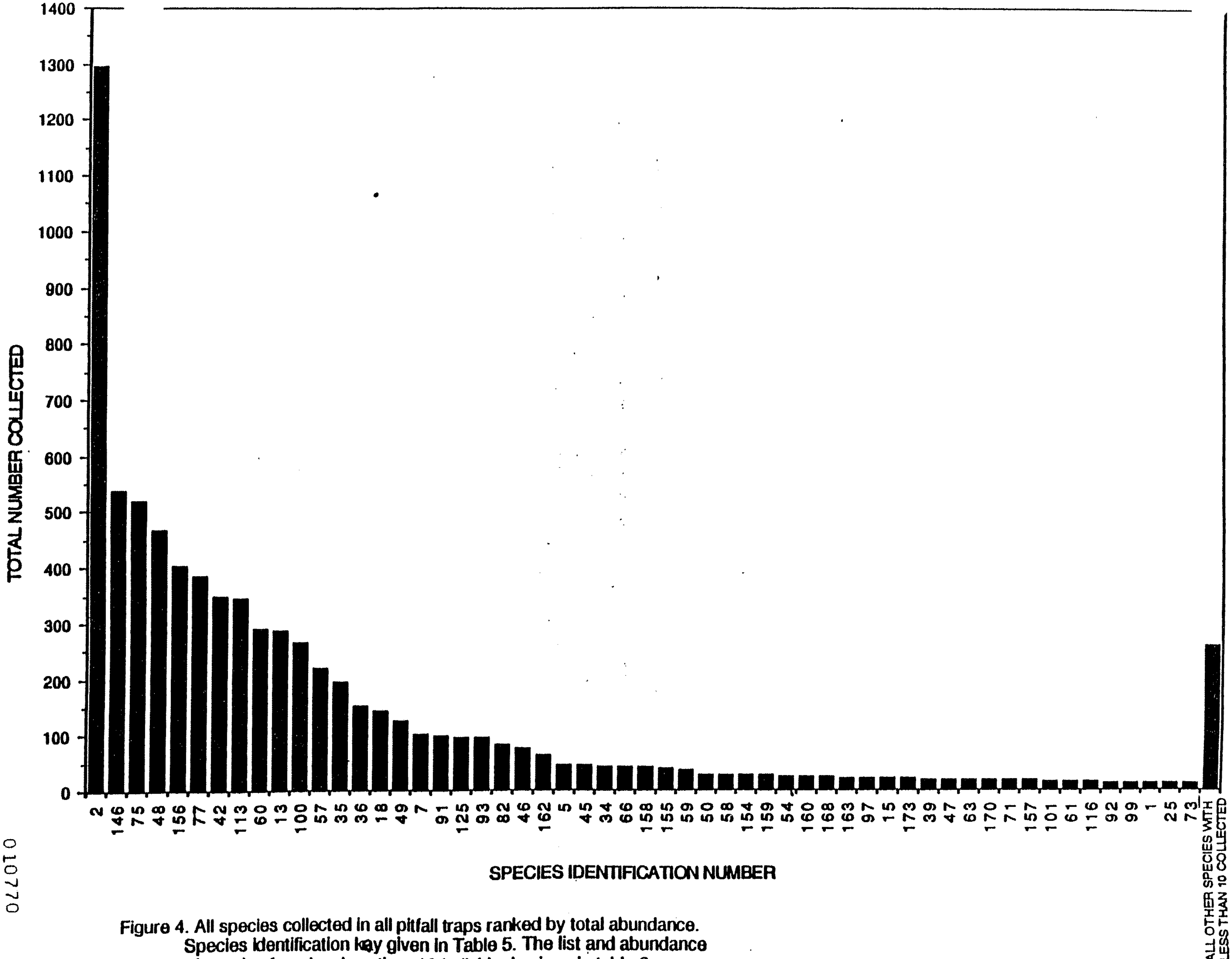

Figure 4. All species collected in all pitfall traps ranked by total abundance. Species identification key given in Table 5. The list and abundance of species found as less than 10 individuals given in table 6.

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