PGMNH MONARCH MONITORING PROJECT

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PROJECT BACKGROUND

The Monarch butterfly makes its famous migration in two unique routes in North America. Considered an 'Endangered Phenomenon' (Malcolm 1993), the migratory patterns of these insects has been under intensive academic study and increasingly, public awareness and advocacy. As their natural habitat becomes fragmented and subject to human impacts, ongoing monitoring of overwintering and migratory population trends becomes an increasingly important tool for monarch conservation.

The need to monitor monarchs across multiple years and overwintering sites has created a unique opportunity for academic institutions, non-profit organizations, private donors and the public to partner to benefit monarchs. The importance of these partnerships has been recognized both within the United States and across North America to cover the full life-cycle and migration of monarchs. The North American Monarch Conservation Plan, drafted by scientists and resource managers from Canada, the United States and Mexico, outlines the current status of the species, causes of the population decline and outlines a plan for research and conservation efforts. Among the recommendations are on-going monitoring of monarch populations and increasing public awareness- two objectives that are complimentary in communities near overwintering sites and have been brought to light because of the pending endangered species list application for the monarch butterfly.

The Pacific Grove Museum of Natural History is working to connect members of the public with the importance of data collection. College interns and community members are trained in standards techniques for counting monarch overwintering populations, observe behaviors and assess habitat and climate information. All data is then reported into a central database where the data can then be analyzed at the end of the overwintering season to begin to look at population movement over the course of the overwintering season.

In this report, data from the 2014-2015 overwintering season is presented including overwintering population data and tagging and parasite sampling effort including any results received to date from academic partners.

METHODS

Intern Recruitment and Training

- Interns were actively recruited from CSU Monterey Bay, Monterey Peninsula College and Hartnell College. The Museum was able to successfully recruit participants from CSUMB, a recent UC Berkeley graduate and the local community to take part in monarch population monitoring for Monterey County.
- Interns participated in a hands-on training with Jessica Griffiths, California Polytecnic University's Monarch Alert Program Coordinator, and Pacific Grove Museum of Natural History staff members on data collection and data entry. Skills covered include count techniques for accuracy, measuring cluster height, categorizing non-clustering behavior (nectaring, mating, flying, sunning), observations of mortality, identification of host trees and general habitat assessment. Interns also learned how to use instruments for climatic measurements (temperature, cloud cover, wind speed and direction).
- Interns were assigned, in pairs, to visit 12 overwintering sites in Monterey County. Sites were visited bi-weekly over the course of the overwintering season unless there were two successive monitoring events where no monarchs were found.

Monarch Tagging and Parasite Sampling

- Volunteers were recruited from the Pacific Grove Museum of Natural History's Monarch Docent program and from the California Naturalist class.
- Volunteers were trained on tagging and parasite procedures by Museum staff that have been trained and participated in monitoring with California Polytechnic University and the University of Georgia. Training covered proper technique for holding monarch butterflies, tagging location on the monarch wing, parasite sampling methods on the abdomen and procedures for changing and cleaning gloves to prevent cross-contamination of parasites between individual monarchs.
- All three tagging and parasite sampling events were supervised by Museum staff. Museum staff were in charge of netting all monarchs and transferring them to bags for the volunteers to begin processing with tags and parasite sampling. Before each sampling event volunteers went through a review of process to allow for the safest and most accurate data collection.

Data Analysis

- Data are visualized as time series data records (abundance through time) for each overwintering site and a maximum population for each site. Variation in both overall abundance and trends through time are discussed, and available to compare with previous and future years.

2014-2015 OVERWINTERING SEASON TRENDS

Monarch Maximum Abundance by Site, 2014-2015 Overwintering Season

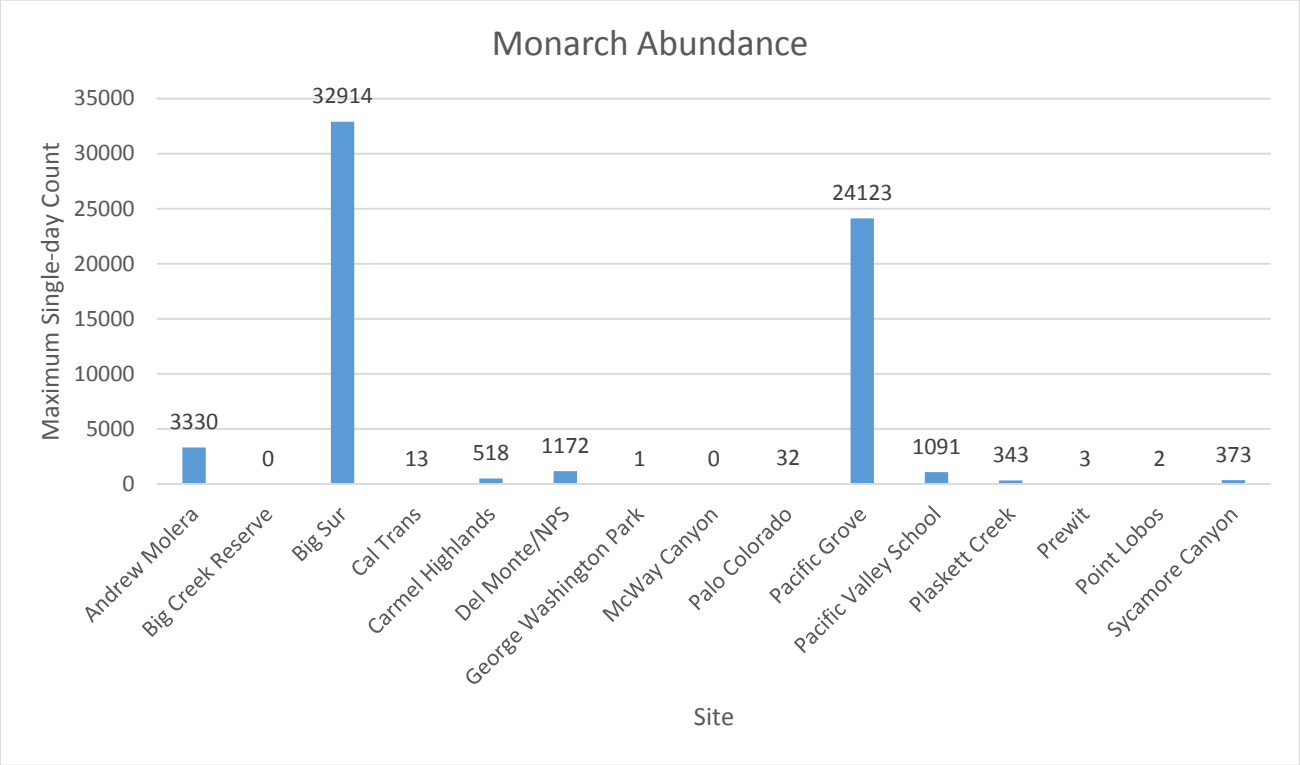

Figure 1. Maximum single-day counts for monarch butterflies at each Monterey County overwintering site. Extensive variation in abundance between sites is clear.

<u>Site Populations through Time</u>

The following figures show abundance of monarch butterflies through time at overwintering sites with consistent populations: Andrew Molera, Big Sur, Del Monte/NPS, and Pacific Grove. Note that the y-axis scales vary by site.

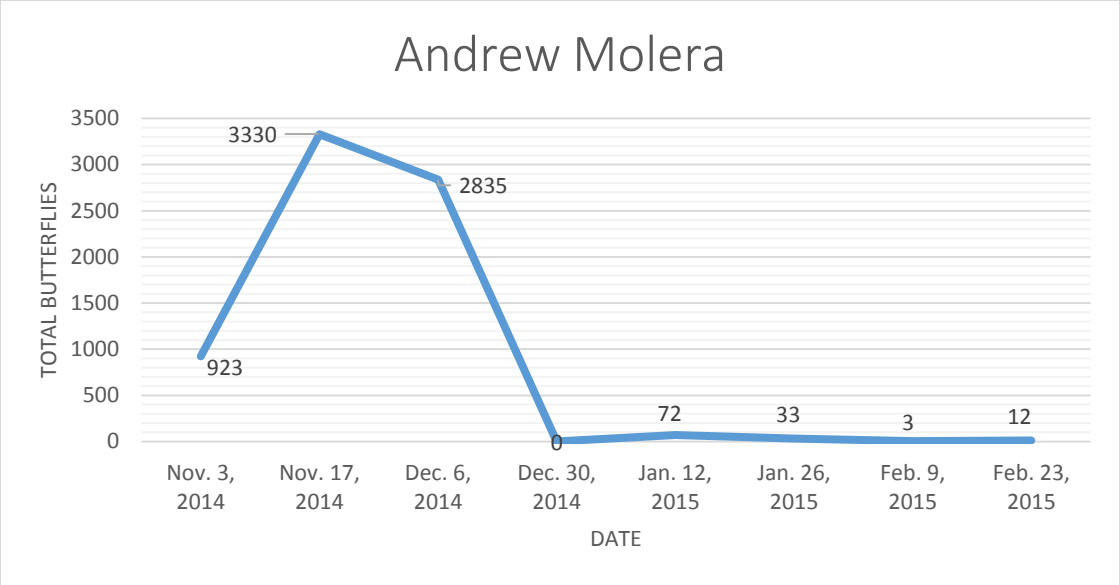

Figure 2. Andrew Molera State Park

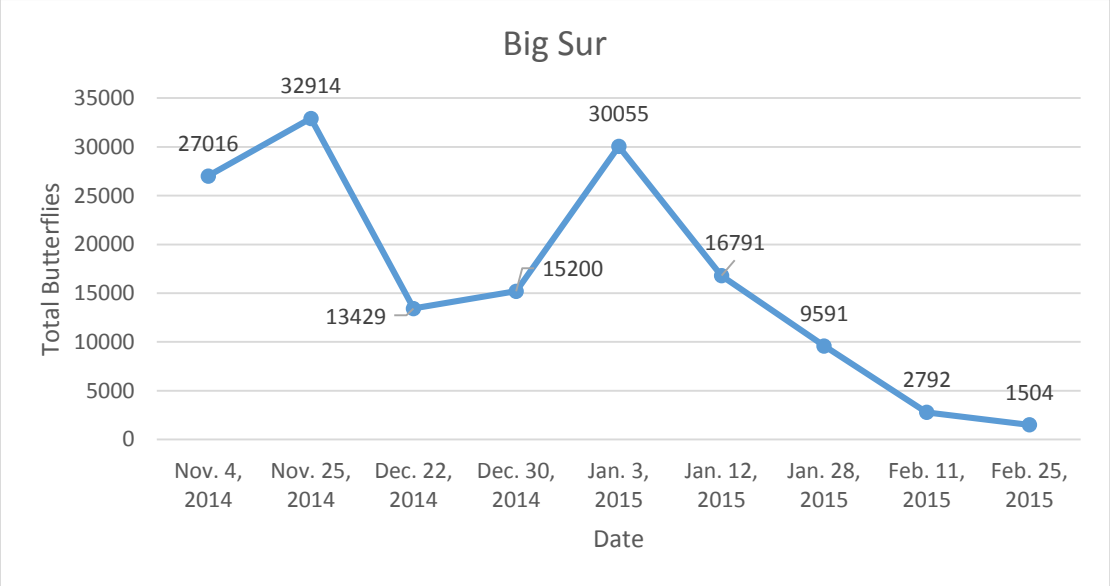

Figure 3. Big Sur Private Property

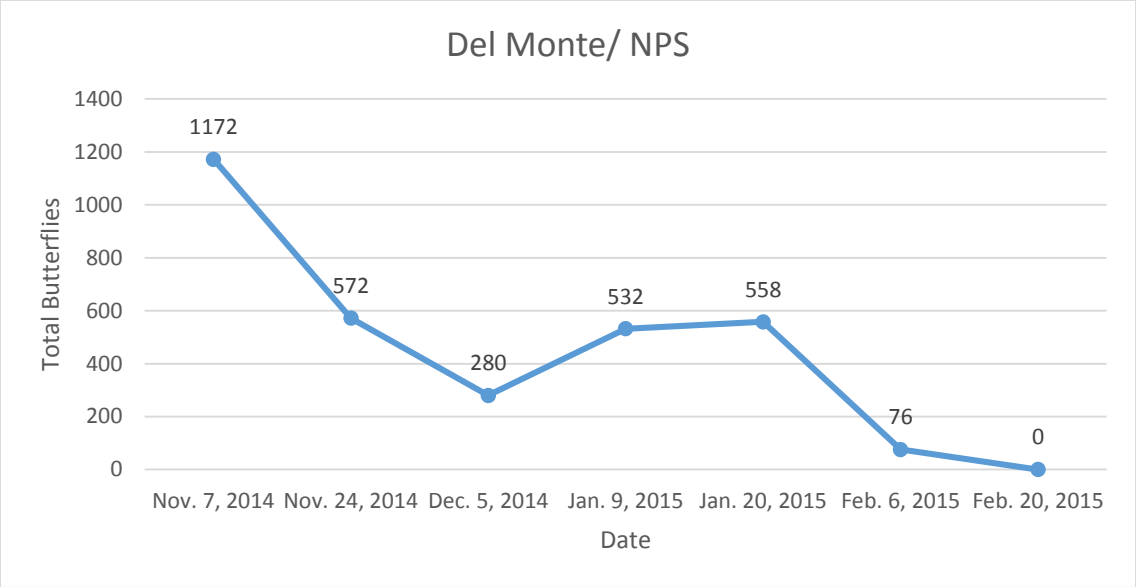

Figure 4. Del Monte/ Naval Postgraduate School

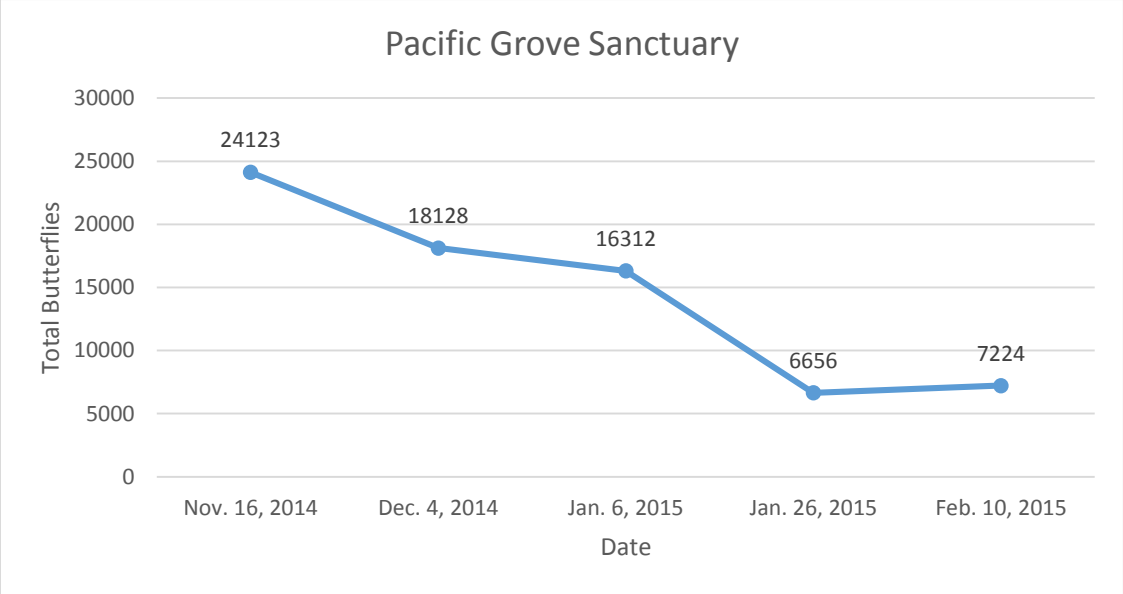

Figure 5. Pacific Grove Monarch Sanctuary

TAGGING AND PARASITE SAMPLING

Monarch butterflies were tagged and sampled for the *Ophryocystis elektroscirrha* (O.e.) parasite at three overwintering sites in Monterey County- Pacific Grove Monarch Sanctuary, Andrew Molera State Park and a private property site in Big Sur.

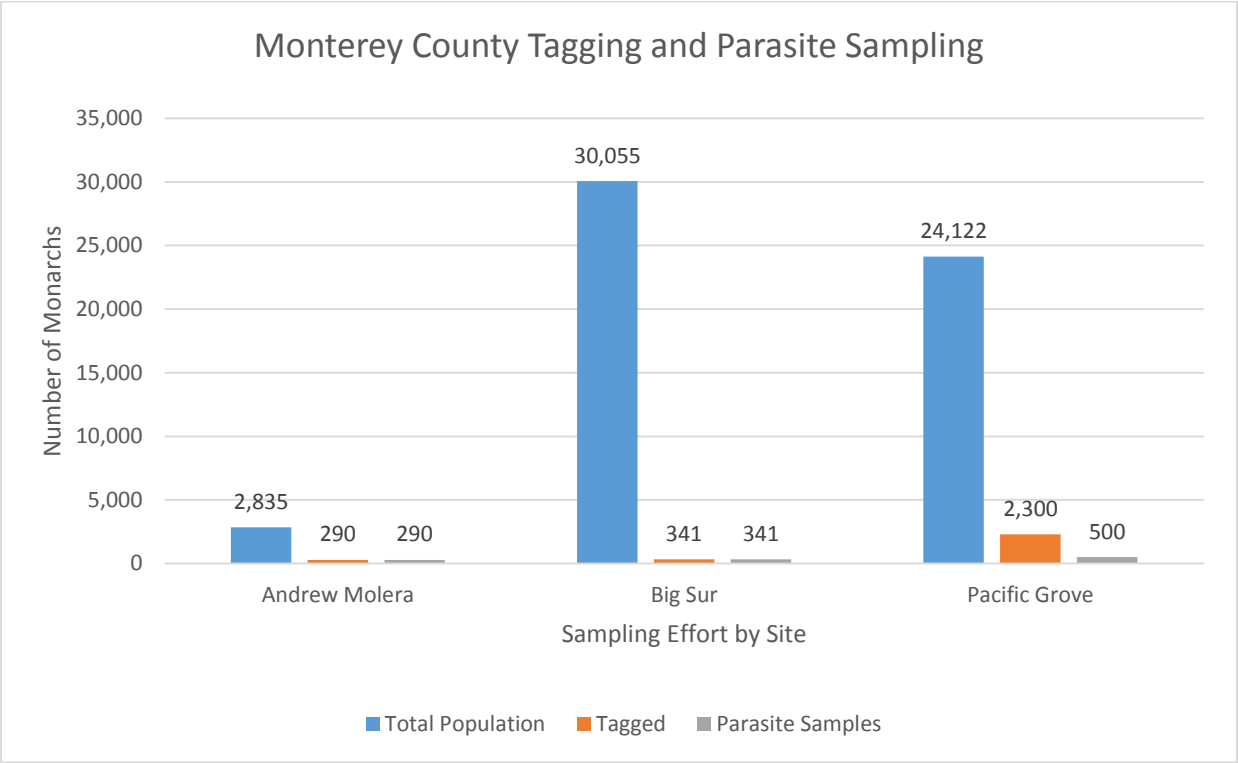

Figure 6. Number of total monarchs, monarchs tagged and sampled for parasites during each tagging event.

The monarch tagging and parasite sampling events were met with varying levels of success. At the Pacific Grove Sanctuary, sampling conditions were ideal and the monarch clusters were at a low enough height to attain the number necessary to have a representative sample. At Andrew Molera State Park and the private property in Big Sur, the monarchs were clustering so high that large numbers of monarchs were not able to be collected for tagging and parasite sampling. This resulted in low sample numbers and in the case of the Big Sur site, a sample size not fully representative of the sites population.

For tagging, the goal was to tag 2,000 butterflies or 10% of the site population, whichever was greater. These goals were set based on conversations with Dr. Francis Villablanca at Cal Poly's Monarch Alert program who is coordinating statewide monarch tagging efforts.

For parasite sampling, it was requested that 500 samples from each overwintering site be collected per the protocols of the University of Georgia's Monarch Health Lab protocols. While this number was met at the Pacific Grove Sanctuary, it was not met at Andrew Molera or the Big Sur site. These samples will help inform parasite infection rates in the Western Monarch population.

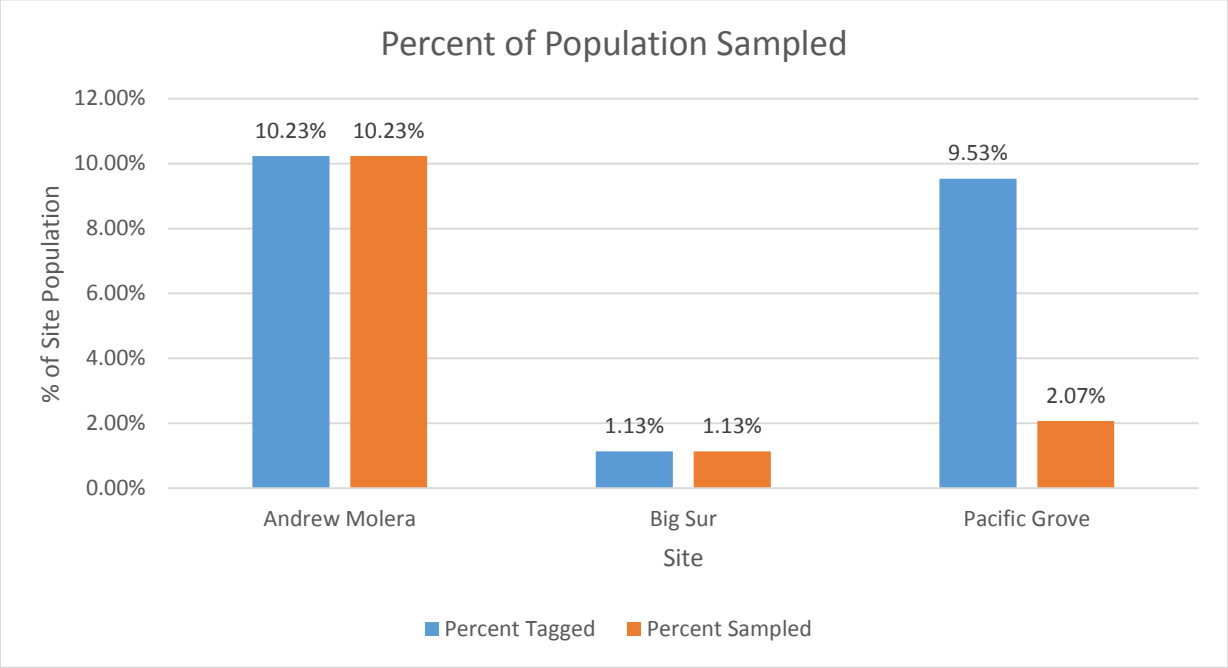

Figure 7. Percent of Total Site Population Tagged and Sampled for Parasites.

Tag Recovery Map

Map Credit: Rebecca Jaffe

Figure 8. Recovery locations of Monarchs tagged at the Pacific Grove Monarch Sanctuary

Date	Tag #	City/town Recovered	Location Details	Gender	Tag Distribution City/State
4/3/2015	50813	Sparks, NV	10 mi. N of Sparks on Pyramid Hwy		Pacific Grove, CA
3/29/2015	51650	Pacific Grove, CA	Golf course		Pacific Grove, CA
3/20/2015	52266	Pacific Grove, CA	Chesnut & Laurel		Pacific Grove, CA
3/15/2015	56611	Huntington Beach, CA	Springdale/ Chateau/Bolsa		Pacific Grove, CA
3/14/2015	52702	Pacific Grove, CA	Near Lighthouse		Pacific Grove, CA
3/12/2015	56613	Huntington Beach, CA		Female	Pacific Grove, CA
3/11/2015	50827	Pacifica, CA	Francisco & Pacific		Pacific Grove, CA
3/8/2015	50802	Piedmont, CA			Pacific Grove, CA
3/5/2015	50247	Pacific Grove	500 Block Evergreen		Pacific Grove, CA

2/14/2015	50372 52624 51688	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
2/13/2015	63484	Big Sur Private Property			Pacific Grove, CA
2/11/2015	31508	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
2/13/2015	50943	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
2/12/2015	51991	Pacific Grove	Monarch Grove Inn		Pacific Grove, CA
2/11/2015	51776	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
2/9/2015	51742	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
1/30/2015	63223	Big Sur	Andrew Molera Park		Pacific Grove, CA
1/21/2015	63401	Big Sur Private Property			Pacific Grove, CA
1/21/2015	64401	Los Angeles	University of Southern CA		Pacific Grove, CA
1/18/2015	63407	Warm Springs Creek	Highway 1, 10 mi. N of Lucia		Pacific Grove, CA
1/1/2015	59023 59073 59066 59080 59137 59183 59021 59281 58979 58994 58982 59102	Big Sur	Andrew Molera Park		Pacific Grove, CA
12/9/2014	50827	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
11/28/2014	52696	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
11/28/2013	51003	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA

11/29/2014	50172	Santa Cruz	Lighthouse Field		Pacific Grove, CA
11/22/2014	51207	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
11/21/2014	50829 52396 50991 50778 51826 51827 51718 50270 51082/62	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA
11/18/2014	52696	Pacific Grove	Monarch Sanctuary		Pacific Grove, CA

Parasite Infection Rates

Count of OE score	***OE Score***								
Sampling Site	**0**	**1**	**2**	**3**	**4**	**5**	**NA**	**Grand Total**	Prevalence Rate
Andrew Molera State Park	166	21	56	4	9	9		265	6.79%
Big Sur	246	34	43	4	14	5	2	348	6.65%
Pacific Grove	299	56	95	1	16	7	4	478	4.85%
Grand Total	**711**	**111**	**194**	**9**	**39**	**21**	**6**	**1091**	**5.53%**

Figure 9. OE parasite infection rates by site

OE score	# spores
0	0 spores
1	1 spore
2	2-20 spores
3	21-100 spores
4	101-1000 spores
5	>1000 spores

Figure 10. *Oe* parasite scores representing the amount of spores found on each monarch.

ACKNOWLEDGEMENTS

The Pacific Grove Museum of Natural History's Monarch Report would not be possible without the help of:

1) Countless volunteers who helped with tagging and parasite sampling,
2) PG Museum monarch interns who performed bi-weekly overwintering counts during the season,
3) Tama Olver for reporting all of the monarch tagging data,
4) Dr. Francis Villablanca at the California Polytechnic University- San Luis Obispo, for his scientific expertise and providing the monarch tags and
5) Dara Satterfield at the University of Georgia's Monarch Health Lab for analyzing all of the parasite samples and preparing all of the parasite data