

Haleakala Silversword Update - 2010

Forest Starr and Kim Starr

To learn more about the Haleakala Silversword or hinahina (*Argyroxiphium sandwicense* subsp. *macrocephalum*), and to keep a pulse on this park icon, each year the flowering silverswords are counted, and 11 silversword plots are monitored. This year the field work was done by Forest and Kim Starr. In short, it was a mid level year for flowering (520 blooms), and yet another year of decline (17%) in the plots, with 19 less silverswords.

FLOWERING CENSUS

The Haleakala silversword lives for many decades, flowers once, and then dies. The flowering census attempts to count all the flowering silverswords each year. The census was sporadically done from 1934 to 1962. Since 1969, the census has been done almost every year.

2010 was a medium flowering year, with 520 blooms, the 18th largest year out of 45 years on record. There were 158 blooms last year (2009). The largest flowering year ever was 1991 with 6,632 blooms. The smallest was 1970 with 0 blooms. The bulk of silverswords that flowered this year were located at Sliding Sands, Puu o Pele, and Puu o Maui.

The silverswords continue to bloom right on cue every summer (June - October), but the annual variation in numbers of blooms is quite dramatic, with no clear indication what triggers mass blooming events in this self-incompatible species. Thoughts on silversword bloom triggers have included ultraviolet levels, plant hormones, and precipitation, but to date no one has found a solid correlation, and what triggers silverswords to bloom remains a mystery.

PLOTS

The 11 silversword plots attempt to monitor a representative sample of the silverswords by mapping individual silverswords, measuring live crown diameter of each silversword, and noting life history changes (seedlings, flowered, death). The silversword plots were established in 1982 and have been monitored almost every year since then.

2010 was yet another year of decline. The total number of live silverswords in the plots declined 17% (19) in the last year from 110 to 91. Of the 19 that died this year, 1 flowered and then died and 18 died without flowering. The total number of live silverswords in the plots has dropped by 77% (307) since 1982, from 398 to 91. This steep decline has occurred since an all time high of 508 silverswords in the plots in 1990, with 15 of the last 16 years showing decline.

No new seedlings were recorded in the plots this year, nor the previous 3 years. Survival for the 3 seedlings from 2006 is now 0% (none alive), for the 25 seedlings from 2005 survival has been 12% (3 still alive), for the 127 seedlings from 2004 survival has been about 7% (9 still alive), for the 5 seedlings from 2001 and 2 seedlings from 2000 none (0%) are still alive.

Of the seedlings still alive, most are still small in size (<5 cm), though two seedlings located on Puu Nole are of reasonable size, one of the seedlings is from 2004 and is a whopping 24 cm in diameter, and the other is from 2005 and is 11 cm in diameter. Another 2004 seedling located on Puu Naue is now 7 cm in diameter.

One silversword located on Puu o Pele flowered in the plots this year. The most flowering silverswords ever recorded in the plots was 22 in 2004. This year's bloomer was first recorded as a seedling in 1986, making it 24 years old when it finally flowered.

27% (30 of 110) of the silverswords have been in the plots since 1982. In other words, about a quarter of the plants in the plots are at least 28 years old. The smallest of these old silverswords is a mere 5 cm in diameter, the largest is 34 cm. The largest silversword in the plots is currently from 1989 and measures 53 cm.

No one knows what is causing the steep decline in silverswords, but what seems to be occurring is that silverswords begin shrinking (decrease in live crown diameter) and eventually shrink to zero (dead). The most obvious cause would seem to be lack of moisture. The past couple decades have held an inordinate number of dry years, including a string of driest years on record. However, local scale measurements of weather within silversword habitat at Haleakala during this period do not exist, and there have been silversword declines in wet years. Other environmental factors that have been proposed for the marked silversword decline include increased temperature, a more stable inversion layer, and a greater number of trade wind days.

ADDITIONAL RESEARCH

Given the dire news the plots seem to report, folks have questioned whether the 11 non-randomly selected plots are representative of the entire crater population, last estimated at 50,000 in 2001. Anecdotally there appears to be a lot of death beyond the plots, a walk along the Silversword Loop is pretty gut wrenching if you know what to look for. That said, populations along Sliding Sands and the Crater rims seem to be doing better.

In an attempt to determine whether all the silverswords are declining, or not, more detailed mapping was started this year by Forest and Kim Starr in collaboration with Paul Krushelnycky and Lloyd Loope. Initial findings seem to show similar downward trends, though there are areas that seem to be doing better (highest elevations). The data will be much more able to provide concrete trends after it is repeated in future years.

Along with our ramped up silversword monitoring, a series of weather stations have been placed throughout the silversword range by Paul. It is hoped this local scale

environmental data from within the diverse silversword habitat will shed some light into what makes the silversword tick.

All this silversword work currently requires boots on the ground, but it is hoped someday some of these tasks can be accomplished through remote sensing. There are many reasons this would be desirable, though previous efforts have not been able to get beyond 5 cm resolution, which is not yet where it needs to be.

DON DRAKE'S WORK

Additional work by Don Drake and others (Cliff Morden, Chuck Chimera, Vickie Caraway, and Tim Motley), which is focused near the summit, is showing a similar short term decline, but in stark contrast to the plots in the Central Crater, is showing a slight long term increase. The area Don et al. are tracking started with 118 plants in 1993, peaked at around 175 in 2001 and was back down to 135 this year.

Not counting 3 original plants that flowered the first year (1993), the findings include:

- 118 plants at the start, plus
- 133 new seedlings, which makes a total of
- 251 plants studied, including
- 73 plants that have died without flowering, plus
- 43 plants that flowered and died, leaving
- 135 plants still alive

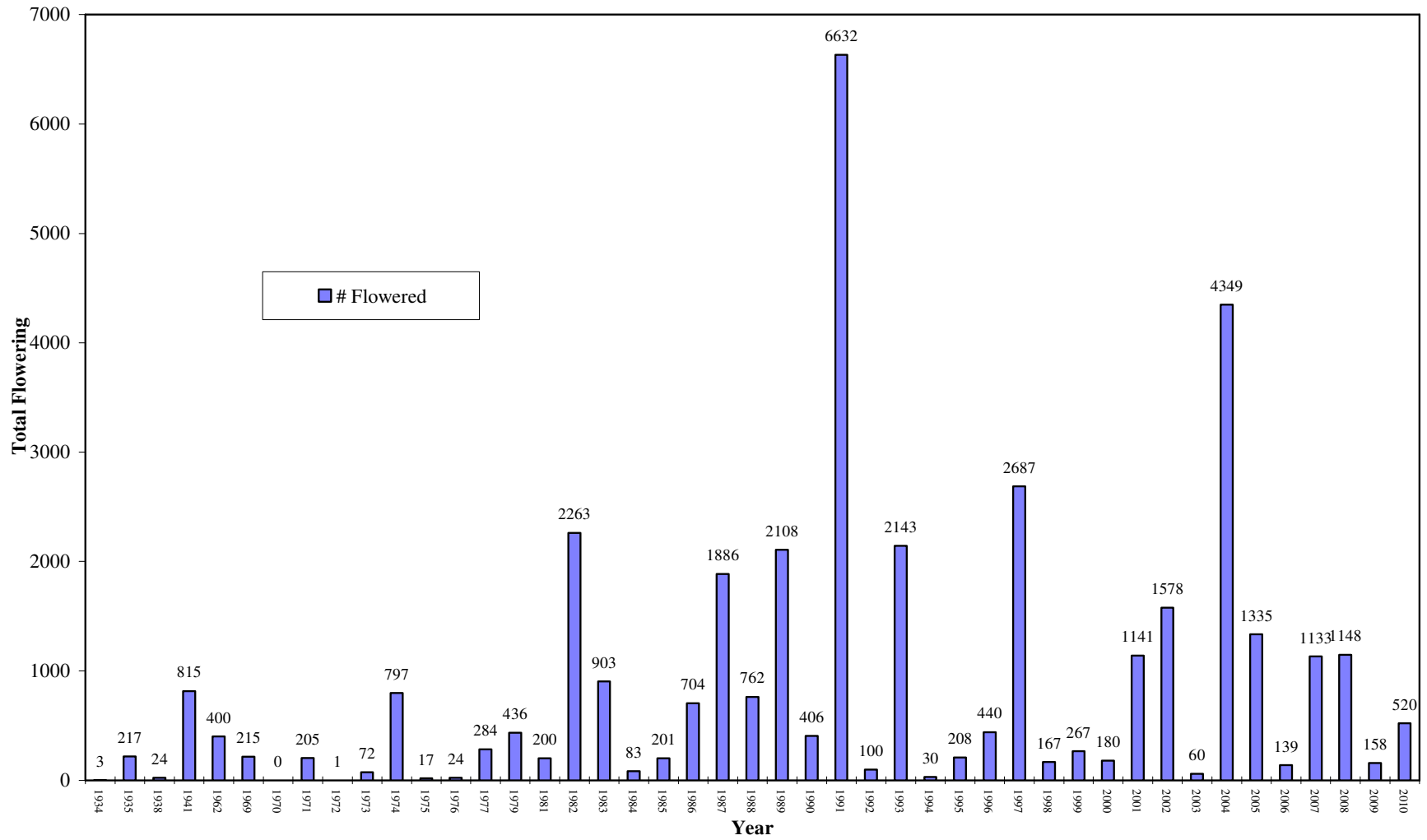
During 2008 and 2009, there was no flowering and quite a few very small seedlings died. This year there were 3 new seedlings, 3 plants flowered, and 9 plants died without flowering. Two of the plants that flowered began as seedlings in 1994 and 1995, the first of the recorded recruits that have flowered. This puts the flowering age for these individuals at 14 and 15 years, which is on the low end of the scale compared to what has been seen in the Central Crater.

There was an apparent trend this year of plants <30 cm shrinking a bit and plants >30 cm growing a bit. There are some clear size trends among the plants that flower or die without flowering, but there is a lot of variation in size- or age-specific growth rates and life expectancy. Don says they need more data there, and depending on how things go, may try to publish something at the 20 or 25 year mark (2013 or 2018).

SUMMARY

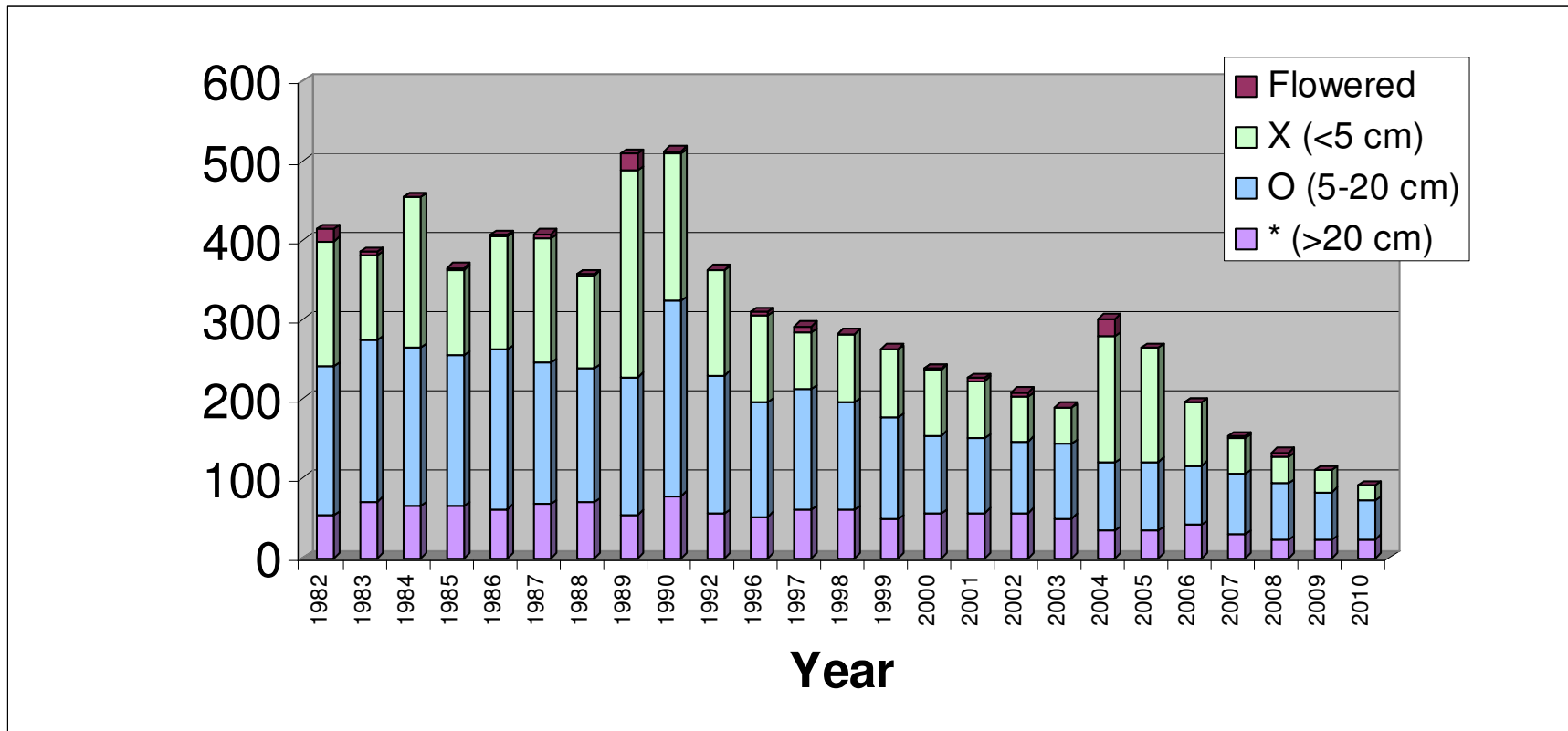
The Haleakala Silversword remains an enigma. We get occasional glimpses of insight into the biology and life history, but many questions remain unanswered. One of the biggest surprises is that some of the plots set up to showcase this conservation success seem to actually be documenting its slow demise. Though it still hasn't been determined why this is occurring, or the extent of the silversword range affected, through expanded mapping, collaboration between a broad range of disciplines and individuals, and passage of time, we hope to better understand the status and trends of this park icon.

ANNUAL HALEAKALA SILVERSWORD FLOWERING CENSUS 1934-2010



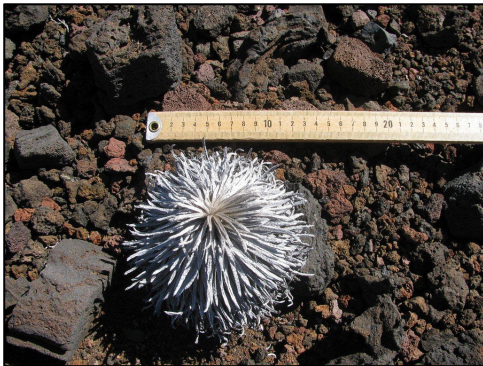
PLOT TOTALS 1982-2010

Size Class	1982	1983	1984	1985	1986	1987	1988	1989	1990	1992	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
X (<5 cm)	157	106	190	108	142	157	118	260	185	132	110	71	87	86	83	72	56	45	159	143	79	45	33	27	18
O (5-20 cm)	187	203	198	190	200	177	168	173	245	174	143	151	134	128	98	94	90	94	86	86	75	75	71	60	49
* (>20 cm)	54	71	66	65	62	68	70	55	78	56	52	61	61	48	56	57	57	50	34	35	41	30	23	23	24
Flowered	16	5	0	2	3	6	1	20	4	1	5	9	0	1	1	3	6	1	22	1	0	3	6	1	1
Total #	414	385	454	365	407	408	357	508	512	363	310	292	282	263	238	226	209	190	301	265	195	153	133	111	92
Total Live	398	380	454	363	404	402	356	488	508	362	305	283	282	262	237	223	203	189	279	264	195	150	127	110	91



A TALE OF THREE SWORDS

Below are images taken this year of a few of the silverswords in the plots. Also included is the historical annual live diameter for each. Data from these three example swords highlight the recent shrinkage and death, and though not representative of all the swords, provide a rare glimpse into the life history of these plants over the past three decades.



This silversword from Ka Moa o Pele, which died this year, was at least 28 years old, as it was in the plots when they were established in 1982. It began shrinking in recent years, presumably from drought, and perished this year.

Annual Live Diameter (cm):

<5, <5, <5, <5, <5, <5, ?, ?, 5-20, ?, 10, ?, ? ?, 12, 14, 15, 12, 14, 15, 13, 14, 14, 14, 15, 16, 10, 8, Dead



This silversword from Puu Naue is 17 years old, it has been in the plots since 1993. Though still alive, without more rain it likely will be dead next year (month?). It had seemed to be previously stable, and we're not sure exactly what happened, but the drought this summer hit Haleakala particularly hard.

Annual Live Diameter (cm):

5, 7, 7, 5, 5, 6, 5, 8, 7, 10, 12, 12, 10, 12, 1



This petite silversword was 14 years old. It had been in the plots since 1996, and yet attained a maximum live diameter of only 5 cm. It seemed relatively stable, but never did attain great size, declined a bit last year, and perished this year.

Annual Live Diameter (cm):

S, 1.5, 1.5, 2.5, 2, 2, 2, 3, 3, 4, 5, 4, 5, 5, 3, Dead

2010 SILVERSWORD BLOOM

One of 520 blooms from this year. This one had lots of pinks and reds in it. It was just outside a plot on Ka Moa o Pele.

