5-YEAR REVIEW
Fish Slough milkvetch (*Astragalus lentiginosus* var. *piscinensis*)

GENERAL INFORMATION:

Species: *Astragalus lentiginosus* var. *piscinensis* (Fish Slough milkvetch)
Date listed: October 6,1998
FR citations: 63 FR 53596–53615
Classification: Threatened

Astragalus lentiginosus var. *piscinensis* was listed as threatened in October 1998 without critical habitat (U.S. Fish and Wildlife Service [Service] 1998a). A recovery plan for the species was finalized in September 1998 as part of a recovery plan for multiple species in the Owens Valley area (Service 1998b). In 2005, critical habitat for *Astragalus lentiginosus* var. *piscinensis* was designated (Service 2005). A 5-year review was completed in January 2009 (Service 2009).

BACKGROUND:

1. Is there recent status review for the species? (e.g., listing document, 5 Year Review, 12-month petition finding, reclassification rule).
   No ___ (Then this form doesn't apply.)
   Yes __X_ **List that document and the date it was finalized here**:

   U.S. Fish and Wildlife Service (Service). 2009. *Astragalus lentiginosus* var. *piscinensis* (Fish Slough milkvetch) 5-year Status Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, California. January 14, 2009. 22 pp.

   We recommended no change in status.

2. When was this current 5-year review initiated (provide date and FR citation)?

   U.S. Fish and Wildlife Service (Service). 2021. "Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 76 Species in California and Nevada." *Federal Register* 86 (96): 27462.

3. Has all new information acquired since the last status review (as listed in 1. above) been evaluated?
   Yes, and any new information is in the record/our files _X__
   No ___ (Revisit this form after review of new information.)

   Staff at the Service's Reno Fish and Wildlife Office (RFWO) conducted this 5-year review by evaluating all new information acquired since the last status review. We solicited data from interested parties through a Federal Register notice announcing this review on May 20, 2021 (Service 2021) and also contacted partners including local, state, and Federal agencies, tribes, and private individuals through mail or email requesting information relevant to this

effort. We received information from three partners, which is included in the discussion below. Additionally, we conducted a literature search and a review of information in our files, such as scientific papers, survey results, and reports that the RFWO has developed or received.

4. Is there substantive new information since the last status review that is reasonably likely to indicate that a change in species status may be warranted, such as:
    - New conservation agreements in place
    - Significant change in numbers, population, habitat, and/or distribution
    - Change in threats (existing or expected in the future)
    - Information that changes our understanding of the species' needs or how the species is influenced by threats.
    - New taxonomic information

    Yes ___ (Then this form doesn't apply.)
    No _X__ **Provide a brief explanation here**:

    Below we discuss new information on the species since the 2009 5-year review (Service 2009). We do not reiterate information that has not changed since 2009, except in a few instances to provide context to new information. Based on this new information, there is nothing to indicate that a change in status is warranted.

    Recovery criteria for delisting includes the following:

    1. The Fish Slough vegetation communities are restored and are being managed to maintain conditions such as those described in the Natural Resource Conservation Service Ecological Site Descriptions (Natural Resource Conservation Service 1995), and Bureau of Land Management's (BLM) Desired Plant Community Definitions for springs and wet meadows and guidelines for riparian zone proper functioning condition (BLM 1993 and 1995);

    2. Colonies in the north, middle, and south regions of the Slough are secured from the negative effects of invasive nonnative species, livestock grazing, and other human-induced threats;

    3. Recruitment of new individuals into the populations and other demographic factors appear sufficient to ensure viability over time as determined by monitoring over a 10- to 15-year period; and

    4. Unless research and monitoring show otherwise, population targets for juvenile and adult plants should be a minimum of 2,100 plants in the north region of Fish Slough, 1,200 in the middle region of Fish Slough. These targets assume that habitat restoration will increase carrying capacity beyond 1992 population levels, and thus these targets have been set at 10 percent over those 1992 levels.

There is no duration for maintaining these targets included with the criteria. We have limited information regarding delisting criteria 1, 2, and 3 and thus cannot conclude that they have been met. Recovery criterion 4 has been met as the northern and middle regions currently meet those numbers based on the 2016 census (see Population section, Table 1 and bullet noting challenges on understanding census level of effort over time).

Change in population, habitat, distribution

Population

The range of *Astragalus lentiginosus* var. *piscinensis* within Fish Slough is divided into seven zones across three regions. These regions and their zones are as follows: northern region (Zones 6 and 7), middle region (Zones 1 [a and b] and 5), and southern region (Zones 2, 3, and 4). Plants in the northern region of Fish Slough are entirely on Los Angeles Department of Water and Power (LADWP) lands, while those in the middle and southern regions are on lands managed by both LADWP and BLM (See Figure 1.) Censuses of the populations have occurred in 1992, 2000, 2008, and 2016. Results of these surveys are provided in Table 1. Data for 2008 and earlier is the same as presented in the 2009 5-year review. Census methods have combined data for adult and juvenile plants and early census efforts did not collect seedling data.

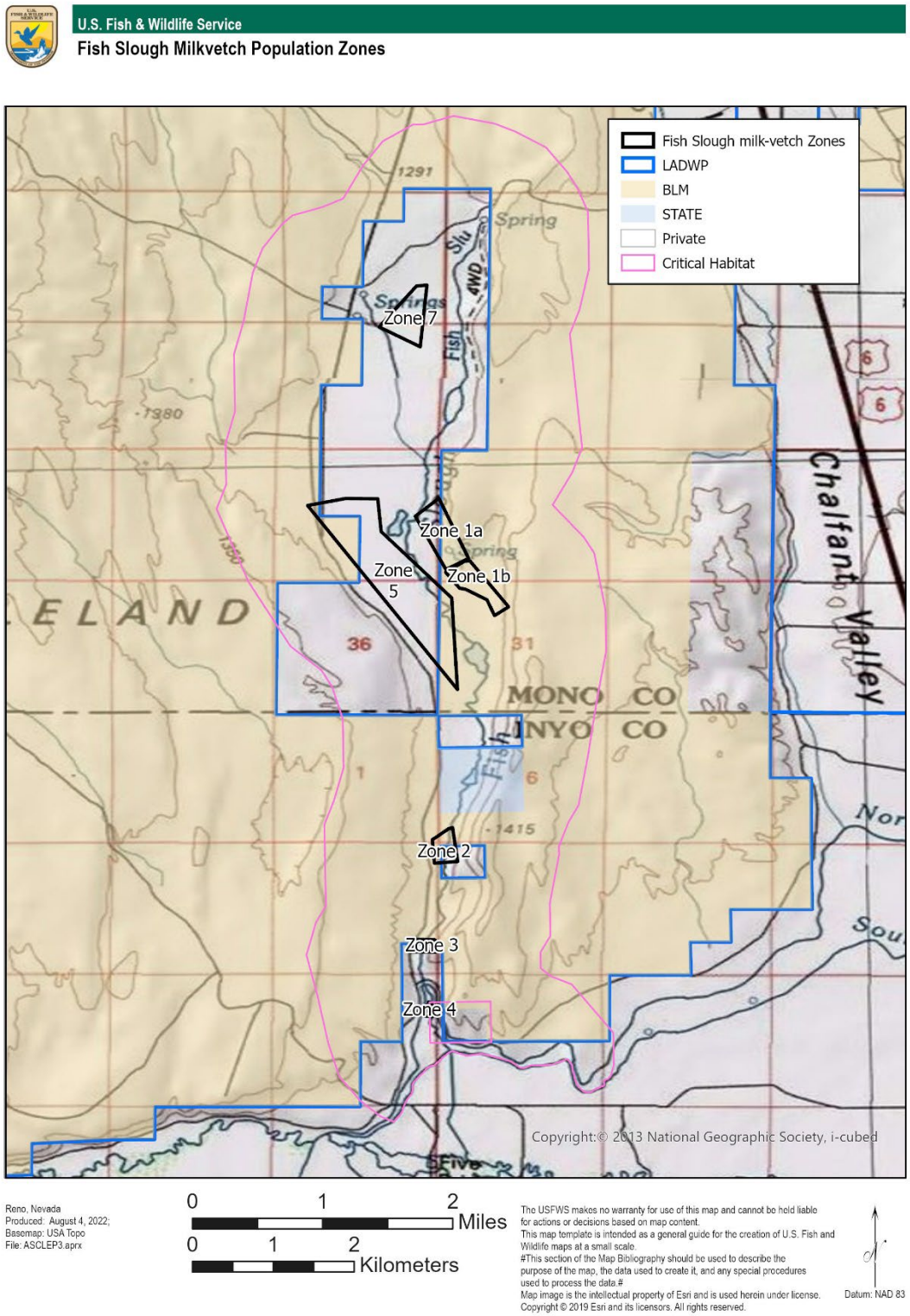

Figure 1. Map of *Astragalus lentiginosus* var. *piscinensis* zones, land management, and critical habitat.

Table 1. Number of adult and juvenile *Astragalus lentiginosus* var. *piscinensis* counted during each census (modified from U.S. Fish and Wildlife Service 2018).

Year	Northern Region	Middle Region	Southern Region	Total Number of Plants (Adults and juveniles)
1992	1,993	1,076	94	3,163
2000	717	747	79	1,543
2008	3,299	1,063	131	4,493
2016*	6,274	2,783	74	9,131
Recovery criteria	2,100	1,200	105	Not applicable

*The survey conducted in 2016 was not a true census since the survey did not cover the entire range of the species.

The fewest plants were observed in 2000 and the most were observed in 2016. There is little to no information on the censuses to compare how survey effort may have varied over time (Service 2018). Survey effort affects ability to accurately compare population counts across years.

In addition to census monitoring, trend plots established by LADWP and BLM in 1991 and 2014, respectively, have been monitored consistently since their establishment, up to and including 2021. The trend plots were established to look at trend in key locations and not to measure population level changes. These data are included in Appendix 1 and 2.

Willoughby (2018) completed a population viability analysis (PVA) on data obtained for the species through 2018. This included both the census data and trend plot data from LADWP. The BLM data did not yet have a long enough time series to be included in that effort. The PVA calculated extinction probabilities for each trend plot individually, by spatial grouping (such as northern and middle regions), and by grazing management (within or outside an existing grazing exclosure). Key summaries from that report include the following:

- Four of the six trend plots for which lambda could be calculated were less than one, which indicates a likelihood of extinction of 100 percent, and the timeframe within which that may occur ranged from 9 to 424 years. Lambda equal to or greater than one represents a stable to increasing population.

- For the spatial groupings, most combinations of plots, again, found lambda less than one and timeframe to extinction of 7 to 656 years.

- Probability of extinction at 50 years for the northern region was 0.232 and for the middle region was 0.698.

- The probability of extinction for the two northern plots (plots 4 and 5) outside the grazing exclosure was higher (0.631) compared to inside the exclosure (0.355). This may indicate positive effects of grazing on the species.

- All that said, the author provided caveats on most of the results, specifically noting that the results have wide ranges in the 95 percent confidence intervals, often overlapping both negative and positive lambda values. He noted that this is likely due to the wide variation in numbers of seedlings each year which can result in rather large differences in the numbers of adult plants between years. Also, the trend plots are not well distributed across populations, and they are likely too small to give a realistic index of trend at the population level.

- A statistical comparison of the census counts in 1992, 2000, 2008, and 2016 to the trend plot counts in those year shows that trend plot counts do not track well with the census counts, suggesting that the trend plots may not provide a realistic assessment of the viability of Fish Slough milk-vetch and thus could not serve as an approach in lieu of the census technique.

- In addition, the author noted that information on level of effort for the censuses over time is lacking or unclear, making it difficult to know if a true, complete census was accomplished in each of those years. USFWS (2018) also noted this challenge.

- No consistent, meaningful correlations between precipitation and plant numbers were found, which suggests that plants do not clearly respond to precipitation patterns.

- The report concludes with recommendations for future monitoring approaches that may improve ability to assess trend at the population level, given lack of clear results of the PVA for the trend plots and the cost/time to conduct a complete census.

Based on the recommendations in the report, the RFWO is working with BLM, LADWP, and CDFW to improve monitoring of the species to be able to better estimate population and trend. In addition, the monitoring approach is looking to include other management considerations such as invasive species and herbivory.

Habitat and distribution
No information indicating a change in extent or quality of habitat or distribution for the species has been reported.

Change in Threats
Below we discuss updated information on genetic stochasticity, changes in groundwater and surface water levels, and climate change. Beyond these, we have no new information about threats outlined previously in listing document, recovery plan, critical habitat rule or 2009 5-year review (Service 1998a, 1998b, 2005, 2009), and no new threats have been reported.

Genetic stochasticity

In our 2009 5-year review, we stated that because of its small population size, Fish Slough milkvetch is vulnerable to genetic stochasticity. Lack of genetic diversity impairs the species' ability to adapt to changes in its environment and contributes to inbreeding depression (*i.e.*, loss of reproductive fitness and vigor). However, Harrison *et al.* 2019 completed genetic analyses on *A. lentiginosus*. var. *piscinensis* and found that the three regions of Fish Slough (northern, middle, and southern) came out as three genetically distinct groups, despite being spatially proximate (less than 1 kilometer between regions). Harrison *et al.* (2019) hypothesized that the genetic grouping is due to habitat-associated local adaptation, specifically due to differences in soil composition across Fish Slough. They recommended that genetic structure be considered for any outplanting efforts and greenhouse studies be conducted to better understand species' responses to various soil conditions. In addition, Harrison *et al.* (2019) found low levels of inbreeding and suggested this may be due to larger effective populations sizes than other *A. lentiginosus* varieties. They also noted that Mazer and Travers (1992) thought that *A. lentiginosus* rarely self -pollinates and that insect pollination would likely facilitate increased genetic variation. All that being said, the spatial extent of the species remains small and thus stochastic events that decrease population size could result in genetic bottleneck effects in the future.

Groundwater Conditions

There have been documented declines in spring flows that support Fish Slough and its vegetation communities since the 1920s, which may be related to increased groundwater pumping in the neighboring valleys referred to as the Tri-Valley area (Service 2005, CDFW 2020, Owens Valley Groundwater Authority [OVGA] 2021). The Tri-Valley area includes the Benton Valley approximately 20 miles (32 kilometers) north, Hammil Valley 9 miles (14 kilometers) north, and the Chalfant Valley approximately 2 miles (3 kilometers) to the northeast of Fish Slough. These three valleys in addition to Fish Slough make up the service area of the Tri-Valley Groundwater Management District. In California, groundwater withdrawal must be managed and monitored in those basins that have been adjudicated or are required to develop and implement a Groundwater Sustainability Plan (GSP) under the Sustainable Groundwater Management Act (SGMA; SB 1168, SB 1319, and AB 1739, effective January 1, 2015). The Tri-Valley area is the northernmost extension of the Owens Valley groundwater basin and Fish Slough is identified as a subbasin (California Department of Water Resources 1975). Because the aquifer in the Tri-Valley area has not been adjudicated and is part of a basin that has been classified as low-priority under SGMA, groundwater withdrawals in this basin are not currently subject to limits pursuant to a court decree or GSP.

Additional information supporting the hydrologic connection between Fish Slough and the Tri-Valley aquifer, as well as documentation of continued declines in groundwater levels, has been summarized in several publications including the 2010 BLM report by Jayko and Fatooh titled "Fish Slough, a geologic and hydrologic summary" (Jayko and Fatooh 2010), the California Department of Fish and Wildlife (CDFW) Fish Slough Groundwater Monitoring Plan (CDFW 2020), and the recently completed Owens Valley Groundwater Basin GSP (OVGA 2021). These documents include the following points:

- Zdon *et al.* (2019) completed three different water chemistry investigations and found correlation of the chemical composition within the Northeast spring, located in Fish Slough, with the chemical signature within the Tri-Valley aquifer.

- Zdon *et al.* (2019) found that the chemical signature of the Northwest and BLM springs, located in Fish Slough, appear to be derived from a mix of the Tri-Valley aquifer and the Volcanic Tablelands to the north and northwest of Fish Slough.

- Recent data from wells (*i.e.,* since the early 2000s) located in Fish Slough and the Tri-Valley area show continued groundwater level declines at wells within the central and northern extents of those combined areas, while those in the southern extent appear to be stable or no clear trend (See Figure 8 of their report) (Jayko and Fatooh 2010, CDFW 2020, OVGA 2021). Those in the southern end may be separated from those to the north due shallow bedrock (Hollett *et al*. 1991)

- LADWP gauge data for discharge at the Northeast Spring, which is one of two places where spring flow is measured in northern Fish Slough, has shown a steady decline since measurements began in the 1990s (OVGA 2022). In June 2022, flow was sufficiently low such that the flow meter read zero, as current equipment is not set up to read such low discharge (LADWP pers. comm. 2022). It is anticipated that flows will become seasonal and eventually cease (CDFW pers. comm., 2022, LADWP pers. comm. 2022).

- CDFW (2020) concluded with a recommendation for a monitoring plan including additional monitoring wells in Fish Slough and Tri-Valley to further validate assumptions regarding groundwater connections in the Tri-Valley area with Fish Slough, characterize subsurface geology and aquifer characteristics, and to investigate the causal relationship of groundwater pumping to surface and groundwater levels in Fish Slough.

While surface and groundwater continue to decline in the area, we do not have sufficient information to understand the short- and long-term ramifications to this species.

Climate change

Information summarized in the 2009 5-year review remains valid. While we have no further locally predicted effects of climate change on the Fish Slough milkvetch, Klove *et al* 2014 completed a review of impacts to groundwater dependent ecosystems due to climate change. The conclusions indicate that, "Climatic variables influence hydrological processes, so any change in precipitation, evapotranspiration, snow accumulation and snow melt will influence recharge and groundwater formation… The impacts on ecosystems will vary depending on the type of ecosystem, amount of water input and changes in water input." (Klove et al. 2014).

Information on species needs and responses to threats

Below we discuss updated information on germination needs. Beyond that, we have no new information that changes our understanding of the species' needs or how the species responds to threats.

Murray and Sala (2003) proposed that the seeds of *Astragalus lentiginosus* var. *piscinensis* need some type of localized disturbance to germinate and thus germination would occur infrequently. In contrast, Willoughby (2018) suggested that the trend plot studies argue against the idea that seed germination occurs infrequently. Seedling counts in the trend plots are quite high in some years, and there are at least some seedlings each year. Thus, he suggested that seeds are breaking their physical dormancy in response to factors that are continuous (*e.g.*, heat/cold fluctuations) rather than periodic (*e.g.*, disturbance).

CONCLUSION:

After reviewing the best available scientific information, we conclude that *Astragalus lentiginosus* var. *piscinensis* (Fish Slough milkvetch) remains a threatened species. The evaluation of threats affecting the species under the factors in 4(a)(1) of the Endangered Species Act and analysis of the status of the species in our 2009 5-year review remains an accurate reflection of the species' current status.

RECOMMENDATIONS FOR FUTURE ACTIONS:

1. Improve the monitoring approach to be able to assess population trend and recruitment rates and to document progress toward meeting other recovery criteria, including restoration and maintenance of the vegetation community, achieving proper functioning condition of springs and riparian areas, and documenting/reducing threats such as invasive species, grazing, and groundwater pumping.

2. The RFWO and recovery partners may consider the need to re-evaluate the recovery criteria for population goals as outlined in the Recovery Plan (Service 1998) based on any modifications to the monitoring approach and best available science. Developing recovery benchmarks based on current threats to the species, the three R's (resiliency, redundancy, and representation), and the best available science will accurately represent recovery (Smith *et al*. 2018, entire).

3. Continue investigations of surface and groundwater patterns and structure within and around Fish Slough to understand future impacts on Fish Slough and Fish Slough milkvetch from groundwater pumping and climate change.

4. Continue implementation of recovery tasks as outlined in the 1998 recovery plan and 2009 5-year review (Service 1998b, 2009).

Field Supervisor, Reno Fish and Wildlife Office

Approve DANIEL COX Digitally signed by DANIEL COX Date: 2022.08.24 15:57:49 -07'00' Date _____

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Appendix 1

Los Angeles Department of Power and Water
Trend plot data 2016 to 2021

Los Angeles Department of Water & Power

BUILDING A STRONGER L.A.

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May 20, 2022

Ms. Lara Enders
Wildlife Biologist
U.S. Fish & Wildlife Service
1340 Financial Blvd., Suite 234
Reno, NV 89502
lara_enders@fws.gov

Dear Ms. Enders:

Subject: 2016 Through 2021 Fish Slough Milkvetch Trend Plot Data

This is in response to your email to Mr. Jeff Nordin requesting Fish Slough milkvetch trend plot data. The requested data was for the period of 2016 through 2021. Please refer to the table below containing the requested data that was collected by Los Angeles Department of Water and Power (LADWP) biologists on City of Los Angeles (City) property.

Trend Plot	Year	2016	2017	2018	2019	2020	2021
NBLM1	Mature	2	1	1	1	0	4
NBLM1	Immature	0	0	1	1	1	2
NBLM1	Seedlings	0	0	1	0	2	9
NBLM2	Mature	2	0	1	1	1	3
NBLM2	Immature	1	0	0	3	3	0
NBLM2	Seedlings	0	5	0	0	0	1
NBLM3	Mature	7	5	5	2	0	4
NBLM3	Immature	0	2	0	0	1	0
NBLM3	Seedlings	0	0	1	0	0	2
EXC1	Mature	23	8	23	17	7	11
EXC1	Immature	3	1	3	4	4	2
EXC1	Seedlings	1	39	3	8	4	9
EXC2	Mature	26	37	11	7	7	4
EXC2	Immature	12	3	9	6	2	0
EXC2	Seedlings	0	13	5	6	2	2
NEXC1	Mature	11	11	7	5	1	2
NEXC1	Immature	4	8	9	4	1	0
NEXC1	Seedlings	5	19	5	12	2	4
NEXC2	Mature	28	19	3	3	0	0
NEXC2	Immature	7	4	12	2	2	2
NEXC2	Seedlings	3	41	4	31	5	0

If you have any questions or need additional information, please contact Mr. Jeff Nordin, Watershed Resources Supervisor, at (760) 873-0431.

Sincerely,

Adam Perez
Manager of Aqueduct

SR:jb
c: Mr. Jeff Nordin

Appendix 2

Bureau of Land Management
Trend plot data 2014 to 2021

Fish Slough ASLEPI Data - BLM
All but plot BLMS12-2014 were establised and first read in in 2014
Plots are circular, radius is 3.62 meters

BLMS - Plots within BLM Spring exclosure

BLMS11-2014	Total	Mature	Immature	Seedling
2021	8	5	2	1
2020	11	4	6	1
2019	10	4	3	3
2018	12	1	11	0
2017	19	2	9	8
2015	22	21	1	0
2014	31	27	4	0

BLMS12-2014	Total	Mature	Immature	Seedling
2021	7	4	1	2
2020	4	1	3	0
2019	4	3	1	0
2018	2	0	2	0
2017	1	1	0	0
2015	7	5	1	1
2014	8	7	1	0
2013	9			
2011	9			
2006	6			
2005	6			
2005	6			
2004	6			
2003	6			
1999	6			
1998	8			

BLMS13-2014	Total	Mature	Immature	Seedling
2021	4	0	0	4
2020	0	0	0	0
2019	1	0	0	1
2018	2	0	2	0
2017	3	0	3	0
2015	3	3	0	0
2014	5	5	0	0

BLMS14-2014	Total	Mature	Immature	Seedling
2021	12	8	1	3
2020	7	1	4	2
2019	4	1	2	1
2018	2	0	2	0
2017	3	1	2	0
2015	5	5	0	0
2014	6	5	1	0

FSL - Fish Slough Lake plots

FSL11-2014	Total	Mature	Immature	Seedling
2021	0	0	0	0
2020	0	0	0	0
2019	10	1	9	0
2018	14	2	12	0
2017	12	2*+4	2*+4	0
2015	23	10	5	8
2014	35	0	12	23

FSL12-2014	Total	Mature	Immature	Seedling
2021	4	1	2	1
2020	3	0	2	1
2019	1	1	0	0
2018	1	0	1	0
2017	1	0	0	1
2015	10	7	3	0
2014	9	6	2	1

FSL13-2014	Total	Mature	Immature	Seedling
2021	31	0	3	28
2020	0	0	0	0
2019	0	0	0	0
2018	0	0	0	0
2017	7	6*	1	0
2015	7	6	1	0
2014	8	3	4	1

SZ23 - South Zone 2/3

2017	Total	Mature	Immature	Seedling
2021	1	0	1	0
2020	1	0	0	1
2019	1	1	0	0
2018	2	0	2	0
2017	6	4*	2	0

SZ23-1-2017
South Zone 2/3 - 1 2017

FSL11-2014	Total	Mature	Immature	Seedling
2021	1	0	1	0
2020	1	0	0	1
2019	1	1	0	0
2018	4	0	3	1
2017	6	4	2	0

Plot methods are the same as those used by DWP
Circular plot with 3.62 m radius

*Difficult to tell if the plants produced flowers or fruit this year. Plants did not have obvious flowers or attached fruits. Some palnts had what looked like flowers that bloomed but