Streaked horned lark abundance and trends for the Puget lowlands

And the lower Columbia River/Washington Coast, 2010-2018

Research Progress Report

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INTRODUCTION

The streaked horned lark (*Eremophila alpestris strigata*) is a partially migratory subspecies associated with sparsely vegetated grassland habitats (Beason 1995, Stinson 2005, Altman 2011) and is listed as threatened under the Endangered Species Act. It is also listed as endangered by the state of Washington and in Canada (Canadian Species at Risk Act 2002). The breeding range of streaked horned lark has contracted over time, with local extirpation from the northern (Puget trough, southern British Columbia, and the Washington Coast north of Grays Harbor) and southern (Rogue River Valley of Oregon) extremes of their range (Beauchesne and Cooper 2003, Stinson 2005, Altman 2011). The current breeding range includes agricultural habitats and grasslands of the Willamette Valley of Oregon, dredge deposition islands along the lower Columbia River, southern Washington coastal dune habitats, and grasslands in the Puget lowlands near Olympia and Tacoma, Washington.

Estimates of survival and fecundity from the mid-2000s indicated streaked horned lark populations in Washington were declining rapidly (Camfield et al. 2011). To provide more up to date population assessments, we developed a monitoring strategy (Pearson et al. 2015) detailing protocols for transect based monitoring that we have been implementing since 2010 on permanently occupied sites. Here we assess abundance and trends using this protocol in two geographic strata (1) Puget Sound region (sites in Pierce, Thurston, and Mason counties), and (2) Lower Columbia River and Washington coast using an analytic method that addresses issues of detectability. The goal of this monitoring effort is to assess changes in abundance and trend of this rare and declining subspecies and to provide critical information for making informed management decisions.

METHODS AND ANALYTICAL APPROACH

Lark surveys of occupied sites along the lower Columbia River, Washington coast, and southern Puget Lowlands, were conducted from 2010-2018 (Table 1) generally following the protocol of Pearson et al. (2015). All sites were visited 1-8 times per season (April 20 – July 9) and all larks detected were categorized as male, female, unknown, or young-of-the-year. In addition, observers recorded how they first detected the bird, did they see or hear it. We broadened the recommend survey window in Pearson (2015) of 1 May – 30 June to 20 April – 9 July to be more inclusive of surveys at some sites. In the future, we hope that all surveys will follow the recommended survey window. Nine sites are included “Puget" Sound region and 22 sites were included in the “River/Coast". The majority of sites were visited three times a year, but some sites might have been visited only once (or not at all) in a any given year. Any site with only one year of data or where no birds were ever detected were not included in our analysis or figures.

A separate hierarchical binomial mixture (N-mixture) model was fit to each of the two geographic regions (Puget Lowlands and Columbia River/Coast) with four visit-level detection parameter terms for adult males, females and linear effects of wind speed for each sex (using a logit link). Detection terms are common across sites, years and first detection (audio or visual). The implication of fitting the model to the River/Coast and Puget Lowland regions separately is that sites within a region do not share information between the two regions. We feel this separation is likely given the geographic distance

between these regions and based on our information on within and between breeding season dispersal among sites and regions (Pearson et al. 2008, Wolf et al. 2019). Furthermore, inspection of the raw data suggests differences in abundance trends and detectability between the two regions, which also indicates that modelling the two regions independently is warranted (see Results).

Unclassified (sex and/or age) birds contributed to site and year specific estimates (*n*) with probabilities calculated from the conditional distributions from known male and female detections that were either visually detected or detected calling. Any singing bird was classified as a male with probability 1 because only males have been observed singing. Uniform priors were placed on all common terms across sites and years in a region.

The population observed at each site x year combination was assumed to have a Poisson distribution with regional mean growth rates for males and females and an autoregressive first order multiple of annual growth rate. We assess growth rate of density not abundance because it was necessary to offset density by transect length because of differences in transect length between years for a given site.

Analytical approach - In other words, for visit $l \in \{1, 2, \ldots L_{ij}\}$ to site $i \in \{1,2, \ldots I\}$ in year $j \in \{1, 2, \ldots, 9\}$ and sex $k \in \{\text{males, females}\}$, observed counts Y:

$$Y_{IJKL} \sim Binom(\theta_k, n_{ijk} - u_{ijkl}) \quad \text{where } u_{ijkl} \text{ are unclassified birds} \quad (1)$$

$$logit(\theta_k) = \bar{p}_k + \beta_k^p W \quad \text{where } W \text{ is wind speed} \quad (2)$$

$$n_{ijk} \sim Poisson(e^{u_{jk}} t_{ij}) \quad \text{where } t \text{ is a transect length offset term} \quad (3)$$

$$u_{jk} = u_{j-1k} + \ln(\lambda_k) \quad \text{for } j \geq 2 \text{ and a diffused prior on } u_{jk} \quad (4)$$

To estimate the number of unclassified birds u_{ijkl} we first considered the likelihood of a classified bird (both adult and unknown age) being visually detected (as opposed to an aural detection), where V is the number detected visually with proportion Φ out of D detected either visually or aurally (calling only).

$$V_K \sim Binom(\Phi_k, D_k) \quad (5)$$

The standardized probabilities of an unknown-sex bird being a male given method of detection are then:

$$\Pr(male|visual) = \frac{1}{1 + \frac{\Phi f}{\Phi m}} \quad (6)$$

$$\Pr(male|aural) = \frac{1}{1 + \frac{1 - \Phi f}{1 - \Phi m}} \quad (7)$$

The probability of an unknown-sex bird being a female is the compliment:

$$\Pr(female|visual) = 1 - \Pr(male|visual) \quad (8)$$

$$\Pr(female|visual) = 1 - \Pr(male|aural) \quad (9)$$

The above gives you the same result as when Bayes rule is applied as follows:

$$\Pr(sex|detection) \propto \Pr(detection|sex)\pi(sex) \quad (10)$$

The unclassified larks were multiplied by the probabilities in equations 6-9. We then multiplied the unclassified age by a uniform probability of being an adult, which produces the required quantity u_{ijkl}.

Our model was fit in JAGS 34.1 (Plummer, 2003; Appendix 1) called from R 3.5.2 (R Development Core Team 2014). Three independent chains were initialized with over-dispersed starting values were run for 7,500 iterations with the first 2,500 discarded (burn in period) and one of every ten were retained after the burn-in period for a sample of 1,500 independent draws from the posterior. Convergence of MCMC chains was checked by visual inspection of trace plots and a Gelman and Rubin's $\hat{R}$ diagnostic.

RESULTS

For the Puget Sound region, our estimate of lambda was 0.92(0.89-0.96) for females and 1.02 (0.99-1.04) for males indicating a declining female population and a stable to increasing male population. For the Columbia River/Washington Coast, our estimate of lambda was 0.99 (0.95-1.04) for females and 0.93 (0.91-0.96) for males indicating a stable female population and a declining male population.

Table 1. Male and female detection probabilities (low/high bounds of a 95% highest posterior density interval). Note the much higher detection probability for males than females in both regions. This is not surprising given that males sing, perch on high ground and objects/rocks, and conduct flight displays.

Probability of Detection			
	Mean	Lwr95HPD	Uppr95HPD
Puget males	0.503	0.451	0.546
Puget females	0.278	0.213	0.340
River/Coast males	0.545	0.501	0.595
River/Coast females	0.360	0.291	0.421

Table 2. Influence of wind on probability of detection by sex and region. Note that there is no effect of wind on detection when the low/high bounds of the highest posterior density intervals overlap 1.0. Because the high/low bounds do not overlap zero for Puget males, this indicates a 3.2% decrease in detection probability for every 1 mph increase in wind speed.

Probability of Detection			
	Mean	Lwr95HPD	Uppr95HPD
Puget males	0.968	0.937	0.997
Puget females	0.987	0.952	1.023
River/Coast males	1.011	0.984	1.041
River/Coast females	1.033	1.002	1.069

Table 3. Mean percent of males detected audibly and females detected visually by region (low/high bounds of a 95% highest posterior density interval).

Percent of Detections			
	Mean	Lwr95HPD	Uppr95HPD
Puget males audio	80	73	85
Puget females visual	54	53	55
River/Coast males audio	78	73	83
River/Coast females visual	55	54	56

DISCUSSION

The Puget Sound region female lark population is continuing to decline while the male lark population is stable to slightly increasing. On the Washington coast/Columbia River, the female population appears stable while the male population is declining.

A declining female population in the Puget Sound region is particularly worrisome given the importance of females to population recruitment and ultimately population growth. This decline was most evident on Olympia and Shelton airports (Figure 1) where little to no lark management occurred in recent years. A declining population trend on these sites may suggest the need to reevaluate our current management strategies for these sites, our overall conservation strategy for this region, and the potential need for more frequent surveys. In contrast, the Joint Base Lewis McChord (JBLM) sites appear to have relatively stable female populations and growing male populations, which may reflect a population response to ongoing management of lark habitat and human activities in nesting locations.

The declining male population on the Coast/Columbia River sites is less worrisome, unless some females are not able to find mates due to a decreasing male population. However, there is currently no evidence that females are going unmated. The only site in this region demonstrating a strong male decline was Leadbetter Point. Male and female trends on other sites in this region are relatively stable. In fact, female trends on Rice, Browns, and Miller islands appear to be increasing. Note that there are many sites on the Columbia River that are surveyed annually that currently don't have any breeding birds and therefore don't contribute information to the overall model for this region and are not included in the figures that follow.

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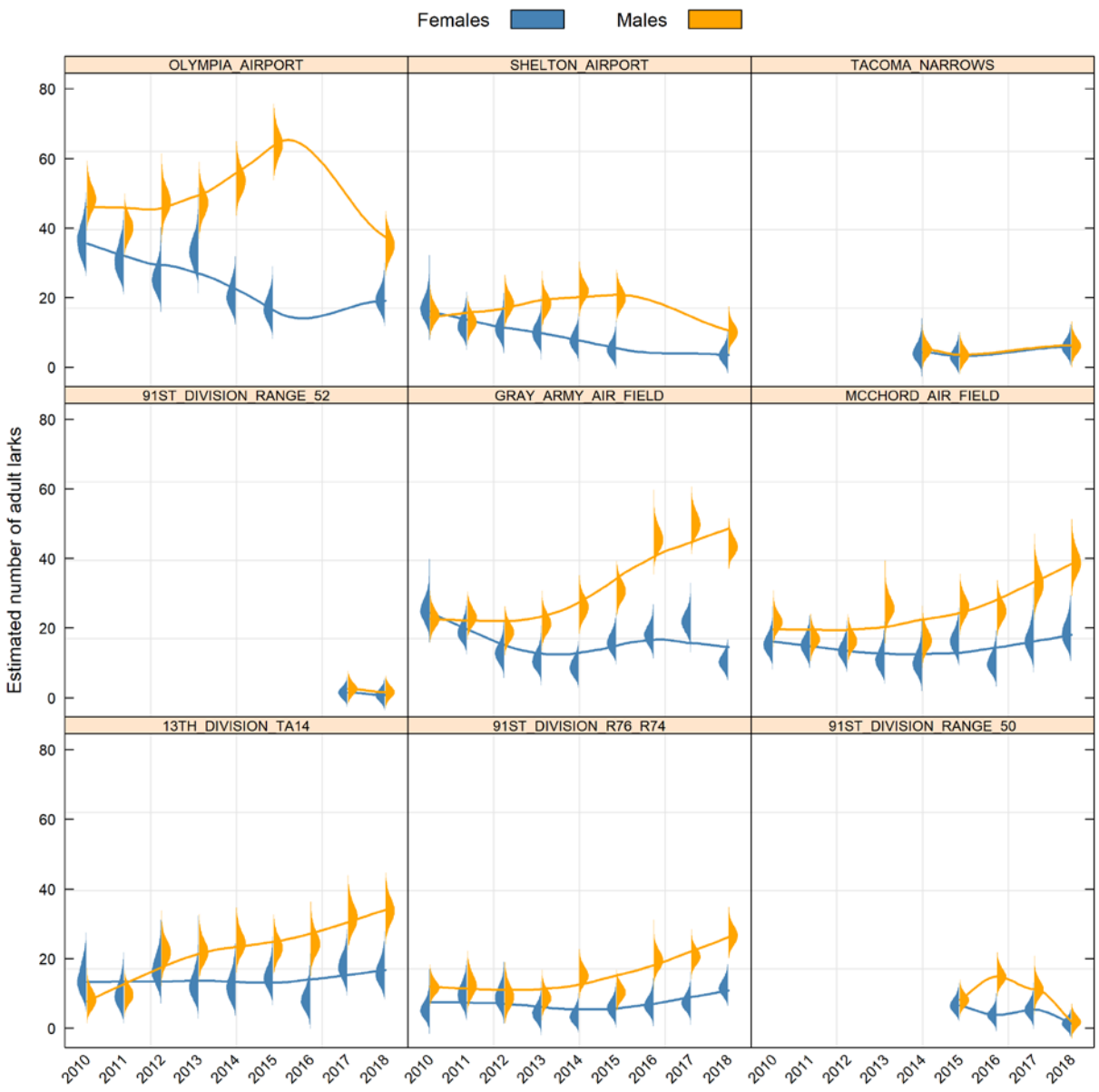

Figure 1: Site-specific trends in abundance of males and females for Puget region

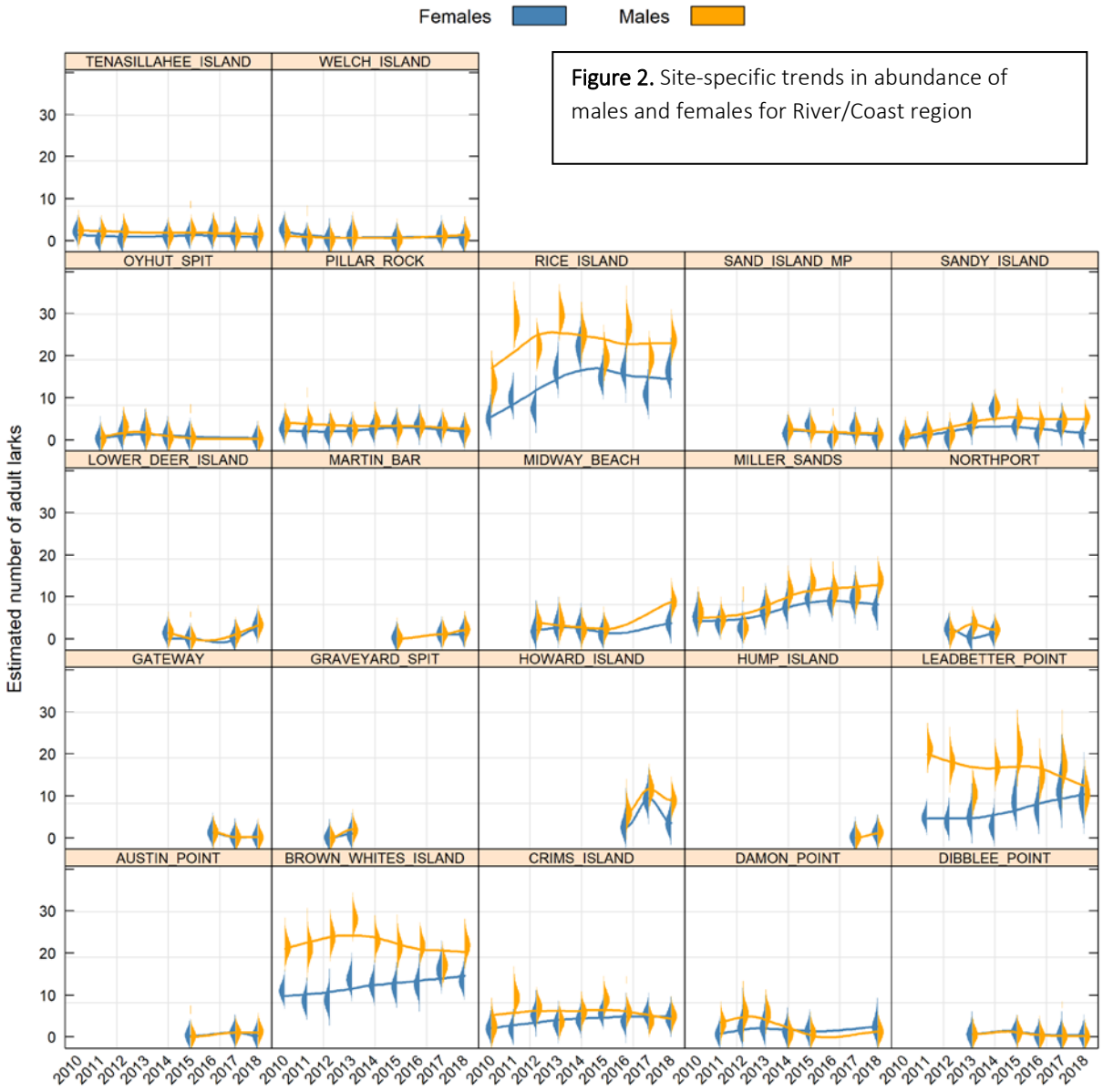

Figure 2. Site-specific trends in abundance of males and females for River/Coast region

Appendix 1. Estimated number of Male and Female larks (95% credible interval) by site and year.

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Females	2010	13TH_DIVISION_TA14	8	15	25
Males	2010	13TH_DIVISION_TA14	5	8	13
Females	2011	13TH_DIVISION_TA14	5	10	19
Males	2011	13TH_DIVISION_TA14	6	10	14
Females	2012	13TH_DIVISION_TA14	11	18	28
Males	2012	13TH_DIVISION_TA14	17	22	28
Females	2013	13TH_DIVISION_TA14	7	13	22
Males	2013	13TH_DIVISION_TA14	17	22	29
Females	2014	13TH_DIVISION_TA14	7	12	21
Males	2014	13TH_DIVISION_TA14	19	24	31
Females	2015	13TH_DIVISION_TA14	10	15	23
Males	2015	13TH_DIVISION_TA14	18	23	30
Females	2016	13TH_DIVISION_TA14	4	9	16
Males	2016	13TH_DIVISION_TA14	19	24	31
Females	2017	13TH_DIVISION_TA14	13	18	27
Males	2017	13TH_DIVISION_TA14	26	32	39
Females	2018	13TH_DIVISION_TA14	11	17	25
Males	2018	13TH_DIVISION_TA14	27	33	41
Females	2010	91ST_DIVISION_R76_R74	2	5	11
Males	2010	91ST_DIVISION_R76_R74	10	12	15
Females	2011	91ST_DIVISION_R76_R74	5	10	18
Males	2011	91ST_DIVISION_R76_R74	8	12	19
Females	2012	91ST_DIVISION_R76_R74	4	9	16
Males	2012	91ST_DIVISION_R76_R74	5	9	15
Females	2013	91ST_DIVISION_R76_R74	1	4	10
Males	2013	91ST_DIVISION_R76_R74	6	9	13
Females	2014	91ST_DIVISION_R76_R74	2	4	8
Males	2014	91ST_DIVISION_R76_R74	12	15	19
Females	2015	91ST_DIVISION_R76_R74	3	6	10
Males	2015	91ST_DIVISION_R76_R74	8	10	14
Females	2016	91ST_DIVISION_R76_R74	4	7	12
Males	2016	91ST_DIVISION_R76_R74	16	20	24
Females	2017	91ST_DIVISION_R76_R74	5	8	12
Males	2017	91ST_DIVISION_R76_R74	18	21	25
Females	2018	91ST_DIVISION_R76_R74	9	12	16
Males	2018	91ST_DIVISION_R76_R74	23	27	31
Females	2015	91ST_DIVISION_RANGE_50	5	7	11
Males	2015	91ST_DIVISION_RANGE_50	7	8	11
Females	2016	91ST_DIVISION_RANGE_50	3	4	8

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2016	91ST_DIVISION_RANGE_50	12	15	19
Females	2017	91ST_DIVISION_RANGE_50	3	6	10
Males	2017	91ST_DIVISION_RANGE_50	8	11	15
Females	2018	91ST_DIVISION_RANGE_50	1	1	3
Males	2018	91ST_DIVISION_RANGE_50	1	2	4
Females	2017	91ST_DIVISION_RANGE_52	1	1	4
Males	2017	91ST_DIVISION_RANGE_52	2	2	5
Females	2018	91ST_DIVISION_RANGE_52	0	1	3
Males	2018	91ST_DIVISION_RANGE_52	1	1	4
Females	2010	GRAY_ARMY_AIR_FIELD	20	26	33
Males	2010	GRAY_ARMY_AIR_FIELD	19	23	27
Females	2011	GRAY_ARMY_AIR_FIELD	15	19	26
Males	2011	GRAY_ARMY_AIR_FIELD	19	23	27
Females	2012	GRAY_ARMY_AIR_FIELD	9	13	19
Males	2012	GRAY_ARMY_AIR_FIELD	15	19	23
Females	2013	GRAY_ARMY_AIR_FIELD	7	11	17
Males	2013	GRAY_ARMY_AIR_FIELD	17	21	26
Females	2014	GRAY_ARMY_AIR_FIELD	5	9	14
Males	2014	GRAY_ARMY_AIR_FIELD	22	26	31
Females	2015	GRAY_ARMY_AIR_FIELD	12	16	22
Males	2015	GRAY_ARMY_AIR_FIELD	26	31	36
Females	2016	GRAY_ARMY_AIR_FIELD	14	18	24
Males	2016	GRAY_ARMY_AIR_FIELD	40	45	52
Females	2017	GRAY_ARMY_AIR_FIELD	18	22	28
Males	2017	GRAY_ARMY_AIR_FIELD	44	50	56
Females	2018	GRAY_ARMY_AIR_FIELD	8	10	15
Males	2018	GRAY_ARMY_AIR_FIELD	40	43	48
Females	2010	MCCHORD_AIR_FIELD	12	16	22
Males	2010	MCCHORD_AIR_FIELD	18	22	26
Females	2011	MCCHORD_AIR_FIELD	11	16	22
Males	2011	MCCHORD_AIR_FIELD	14	17	21
Females	2012	MCCHORD_AIR_FIELD	10	14	20
Males	2012	MCCHORD_AIR_FIELD	13	16	21
Females	2013	MCCHORD_AIR_FIELD	7	11	18
Males	2013	MCCHORD_AIR_FIELD	21	26	32
Females	2014	MCCHORD_AIR_FIELD	6	10	17
Males	2014	MCCHORD_AIR_FIELD	12	17	22
Females	2015	MCCHORD_AIR_FIELD	12	17	24
Males	2015	MCCHORD_AIR_FIELD	21	26	32
Females	2016	MCCHORD_AIR_FIELD	6	10	17

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2016	MCCHORD_AIR_FIELD	21	25	30
Females	2017	MCCHORD_AIR_FIELD	12	17	26
Males	2017	MCCHORD_AIR_FIELD	27	33	41
Females	2018	MCCHORD_AIR_FIELD	14	19	28
Males	2018	MCCHORD_AIR_FIELD	33	39	47
Females	2010	OLYMPIA_AIRPORT	29	38	49
Males	2010	OLYMPIA_AIRPORT	42	48	55
Females	2011	OLYMPIA_AIRPORT	24	32	42
Males	2011	OLYMPIA_AIRPORT	35	40	47
Females	2012	OLYMPIA_AIRPORT	20	26	35
Males	2012	OLYMPIA_AIRPORT	41	48	55
Females	2013	OLYMPIA_AIRPORT	27	34	44
Males	2013	OLYMPIA_AIRPORT	41	47	54
Females	2014	OLYMPIA_AIRPORT	15	21	29
Males	2014	OLYMPIA_AIRPORT	47	53	62
Females	2015	OLYMPIA_AIRPORT	12	17	25
Males	2015	OLYMPIA_AIRPORT	57	64	72
Females	2018	OLYMPIA_AIRPORT	15	20	27
Males	2018	OLYMPIA_AIRPORT	29	35	41
Females	2010	SHELTON_AIRPORT	12	18	26
Males	2010	SHELTON_AIRPORT	12	15	20
Females	2011	SHELTON_AIRPORT	8	13	19
Males	2011	SHELTON_AIRPORT	10	13	18
Females	2012	SHELTON_AIRPORT	7	12	18
Males	2012	SHELTON_AIRPORT	14	18	24
Females	2013	SHELTON_AIRPORT	6	10	16
Males	2013	SHELTON_AIRPORT	14	18	23
Females	2014	SHELTON_AIRPORT	4	8	14
Males	2014	SHELTON_AIRPORT	18	22	27
Females	2015	SHELTON_AIRPORT	2	5	10
Males	2015	SHELTON_AIRPORT	16	20	25
Females	2018	SHELTON_AIRPORT	1	4	8
Males	2018	SHELTON_AIRPORT	7	10	14
Females	2014	TACOMA_NARROWS	1	4	9
Males	2014	TACOMA_NARROWS	3	5	9
Females	2015	TACOMA_NARROWS	1	3	8
Males	2015	TACOMA_NARROWS	1	3	7
Females	2018	TACOMA_NARROWS	3	6	10
Males	2018	TACOMA_NARROWS	3	6	10
Females	2015	AUSTIN_POINT	0	0	2

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2015	AUSTIN_POINT	0	0	2
Females	2017	AUSTIN_POINT	1	1	2
Males	2017	AUSTIN_POINT	1	1	2
Females	2018	AUSTIN_POINT	0	0	2
Males	2018	AUSTIN_POINT	1	1	3
Females	2010	BROWN_WHITES_ISLAND	9	11	14
Males	2010	BROWN_WHITES_ISLAND	19	22	25
Females	2011	BROWN_WHITES_ISLAND	6	9	13
Males	2011	BROWN_WHITES_ISLAND	18	22	26
Females	2012	BROWN_WHITES_ISLAND	6	9	13
Males	2012	BROWN_WHITES_ISLAND	20	24	29
Females	2013	BROWN_WHITES_ISLAND	11	14	18
Males	2013	BROWN_WHITES_ISLAND	25	28	32
Females	2014	BROWN_WHITES_ISLAND	10	13	16
Males	2014	BROWN_WHITES_ISLAND	21	23	27
Females	2015	BROWN_WHITES_ISLAND	9	12	17
Males	2015	BROWN_WHITES_ISLAND	19	22	26
Females	2016	BROWN_WHITES_ISLAND	10	13	17
Males	2016	BROWN_WHITES_ISLAND	19	22	26
Females	2017	BROWN_WHITES_ISLAND	13	16	21
Males	2017	BROWN_WHITES_ISLAND	15	17	21
Females	2018	BROWN_WHITES_ISLAND	12	14	17
Males	2018	BROWN_WHITES_ISLAND	19	22	26
Females	2010	CRIMS_ISLAND	1	2	5
Males	2010	CRIMS_ISLAND	0	3	7
Females	2011	CRIMS_ISLAND	1	2	5
Males	2011	CRIMS_ISLAND	7	10	13
Females	2012	CRIMS_ISLAND	4	5	8
Males	2012	CRIMS_ISLAND	5	7	10
Females	2013	CRIMS_ISLAND	2	3	6
Males	2013	CRIMS_ISLAND	2	4	6
Females	2014	CRIMS_ISLAND	3	4	7
Males	2014	CRIMS_ISLAND	5	6	8
Females	2015	CRIMS_ISLAND	5	6	8
Males	2015	CRIMS_ISLAND	7	9	11
Females	2016	CRIMS_ISLAND	3	4	6
Males	2016	CRIMS_ISLAND	5	6	8
Females	2017	CRIMS_ISLAND	5	5	8
Males	2017	CRIMS_ISLAND	3	4	6
Females	2018	CRIMS_ISLAND	3	5	7

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2018	CRIMS_ISLAND	4	5	7
Females	2011	DAMON_POINT	0	1	3
Males	2011	DAMON_POINT	2	3	6
Females	2012	DAMON_POINT	0	2	7
Males	2012	DAMON_POINT	3	6	9
Females	2013	DAMON_POINT	0	3	7
Males	2013	DAMON_POINT	4	6	9
Females	2014	DAMON_POINT	0	1	5
Males	2014	DAMON_POINT	0	1	3
Females	2015	DAMON_POINT	0	2	5
Males	2015	DAMON_POINT	0	1	4
Females	2018	DAMON_POINT	0	3	7
Males	2018	DAMON_POINT	0	1	4
Females	2013	DIBBLEE_POINT	0	1	3
Males	2013	DIBBLEE_POINT	0	1	3
Females	2015	DIBBLEE_POINT	1	1	3
Males	2015	DIBBLEE_POINT	1	1	2
Females	2016	DIBBLEE_POINT	0	0	2
Males	2016	DIBBLEE_POINT	0	0	1
Females	2017	DIBBLEE_POINT	0	0	3
Males	2017	DIBBLEE_POINT	0	0	2
Females	2018	DIBBLEE_POINT	0	0	2
Males	2018	DIBBLEE_POINT	0	0	2
Females	2016	GATEWAY	1	1	3
Males	2016	GATEWAY	1	1	3
Females	2017	GATEWAY	0	0	2
Males	2017	GATEWAY	0	0	1
Females	2018	GATEWAY	0	0	2
Males	2018	GATEWAY	0	0	1
Females	2012	GRAVEYARD_SPIT	0	0	1
Males	2012	GRAVEYARD_SPIT	0	0	0
Females	2013	GRAVEYARD_SPIT	0	1	4
Males	2013	GRAVEYARD_SPIT	1	2	5
Females	2016	HOWARD_ISLAND	0	3	8
Males	2016	HOWARD_ISLAND	4	6	10
Females	2017	HOWARD_ISLAND	7	10	14
Males	2017	HOWARD_ISLAND	9	12	16
Females	2018	HOWARD_ISLAND	1	4	8
Males	2018	HOWARD_ISLAND	7	9	13
Females	2017	HUMP_ISLAND	0	0	2

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2017	HUMP_ISLAND	0	0	1
Females	2018	HUMP_ISLAND	1	1	3
Males	2018	HUMP_ISLAND	1	1	3
Females	2011	LEADBETTER_POINT	4	5	7
Males	2011	LEADBETTER_POINT	19	21	25
Females	2012	LEADBETTER_POINT	2	4	8
Males	2012	LEADBETTER_POINT	15	18	23
Females	2013	LEADBETTER_POINT	2	5	10
Males	2013	LEADBETTER_POINT	7	11	16
Females	2014	LEADBETTER_POINT	1	3	7
Males	2014	LEADBETTER_POINT	14	17	21
Females	2015	LEADBETTER_POINT	4	9	16
Males	2015	LEADBETTER_POINT	16	21	28
Females	2016	LEADBETTER_POINT	3	7	14
Males	2016	LEADBETTER_POINT	12	15	21
Females	2017	LEADBETTER_POINT	6	12	19
Males	2017	LEADBETTER_POINT	13	18	23
Females	2018	LEADBETTER_POINT	5	10	17
Males	2018	LEADBETTER_POINT	7	11	17
Females	2014	LOWER_DEER_ISLAND	1	1	3
Males	2014	LOWER_DEER_ISLAND	1	1	3
Females	2015	LOWER_DEER_ISLAND	0	0	1
Males	2015	LOWER_DEER_ISLAND	0	0	1
Females	2017	LOWER_DEER_ISLAND	0	0	2
Males	2017	LOWER_DEER_ISLAND	1	1	2
Females	2018	LOWER_DEER_ISLAND	2	3	5
Males	2018	LOWER_DEER_ISLAND	3	3	5
Females	2015	MARTIN_BAR	0	0	2
Males	2015	MARTIN_BAR	0	0	1
Females	2017	MARTIN_BAR	1	1	3
Males	2017	MARTIN_BAR	1	1	2
Females	2018	MARTIN_BAR	1	1	3
Males	2018	MARTIN_BAR	2	2	4
Females	2012	MIDWAY_BEACH	0	2	6
Males	2012	MIDWAY_BEACH	2	4	7
Females	2013	MIDWAY_BEACH	1	3	7
Males	2013	MIDWAY_BEACH	1	4	8
Females	2014	MIDWAY_BEACH	1	3	7
Males	2014	MIDWAY_BEACH	1	2	5
Females	2015	MIDWAY_BEACH	0	1	4

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2015	MIDWAY_BEACH	2	2	5
Females	2018	MIDWAY_BEACH	2	4	8
Males	2018	MIDWAY_BEACH	7	9	12
Females	2010	MILLER_SANDS	3	5	9
Males	2010	MILLER_SANDS	4	6	10
Females	2011	MILLER_SANDS	3	4	6
Males	2011	MILLER_SANDS	4	5	7
Females	2012	MILLER_SANDS	2	2	5
Males	2012	MILLER_SANDS	2	2	5
Females	2013	MILLER_SANDS	4	7	10
Males	2013	MILLER_SANDS	5	8	11
Females	2014	MILLER_SANDS	5	8	12
Males	2014	MILLER_SANDS	9	11	15
Females	2015	MILLER_SANDS	8	10	13
Males	2015	MILLER_SANDS	12	13	16
Females	2016	MILLER_SANDS	7	9	13
Males	2016	MILLER_SANDS	9	11	15
Females	2017	MILLER_SANDS	7	10	14
Males	2017	MILLER_SANDS	9	11	14
Females	2018	MILLER_SANDS	5	7	11
Males	2018	MILLER_SANDS	12	14	17
Females	2012	NORTHPORT	2	2	4
Males	2012	NORTHPORT	1	1	3
Females	2013	NORTHPORT	0	0	2
Males	2013	NORTHPORT	3	3	5
Females	2014	NORTHPORT	1	1	3
Males	2014	NORTHPORT	2	2	3
Females	2011	OYHUT_SPIT	0	0	2
Males	2011	OYHUT_SPIT	0	0	2
Females	2012	OYHUT_SPIT	0	1	4
Males	2012	OYHUT_SPIT	2	3	6
Females	2013	OYHUT_SPIT	0	2	5
Males	2013	OYHUT_SPIT	0	2	5
Females	2014	OYHUT_SPIT	0	1	4
Males	2014	OYHUT_SPIT	0	0	3
Females	2015	OYHUT_SPIT	0	1	3
Males	2015	OYHUT_SPIT	0	0	2
Females	2018	OYHUT_SPIT	0	0	2
Males	2018	OYHUT_SPIT	0	0	1
Females	2010	PILLAR_ROCK	2	3	5

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2010	PILLAR_ROCK	3	4	6
Females	2011	PILLAR_ROCK	1	2	4
Males	2011	PILLAR_ROCK	4	4	6
Females	2012	PILLAR_ROCK	1	1	3
Males	2012	PILLAR_ROCK	3	3	5
Females	2013	PILLAR_ROCK	2	2	4
Males	2013	PILLAR_ROCK	2	2	4
Females	2014	PILLAR_ROCK	2	2	4
Males	2014	PILLAR_ROCK	4	4	6
Females	2015	PILLAR_ROCK	3	3	5
Males	2015	PILLAR_ROCK	2	2	4
Females	2016	PILLAR_ROCK	3	3	5
Males	2016	PILLAR_ROCK	3	3	5
Females	2017	PILLAR_ROCK	2	2	4
Males	2017	PILLAR_ROCK	3	3	5
Females	2018	PILLAR_ROCK	1	2	4
Males	2018	PILLAR_ROCK	2	2	3
Females	2010	RICE_ISLAND	3	5	10
Males	2010	RICE_ISLAND	10	14	19
Females	2011	RICE_ISLAND	7	10	15
Males	2011	RICE_ISLAND	24	28	34
Females	2012	RICE_ISLAND	5	8	12
Males	2012	RICE_ISLAND	19	23	27
Females	2013	RICE_ISLAND	13	17	22
Males	2013	RICE_ISLAND	26	30	35
Females	2014	RICE_ISLAND	18	23	29
Males	2014	RICE_ISLAND	22	25	30
Females	2015	RICE_ISLAND	12	15	21
Males	2015	RICE_ISLAND	16	20	24
Females	2016	RICE_ISLAND	13	17	22
Males	2016	RICE_ISLAND	23	27	32
Females	2017	RICE_ISLAND	8	11	16
Males	2017	RICE_ISLAND	17	20	24
Females	2018	RICE_ISLAND	13	17	22
Males	2018	RICE_ISLAND	21	24	29
Females	2014	SAND_ISLAND_MP	1	1	3
Males	2014	SAND_ISLAND_MP	2	2	4
Females	2015	SAND_ISLAND_MP	3	3	5
Males	2015	SAND_ISLAND_MP	2	2	4
Females	2016	SAND_ISLAND_MP	0	0	1

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2016	SAND_ISLAND_MP	1	1	2
Females	2017	SAND_ISLAND_MP	2	3	5
Males	2017	SAND_ISLAND_MP	2	2	4
Females	2018	SAND_ISLAND_MP	0	0	2
Males	2018	SAND_ISLAND_MP	1	1	2
Females	2010	SANDY_ISLAND	0	0	2
Males	2010	SANDY_ISLAND	1	1	3
Females	2011	SANDY_ISLAND	1	1	4
Males	2011	SANDY_ISLAND	1	2	4
Females	2012	SANDY_ISLAND	0	0	2
Males	2012	SANDY_ISLAND	1	1	3
Females	2013	SANDY_ISLAND	3	3	5
Males	2013	SANDY_ISLAND	4	5	7
Females	2014	SANDY_ISLAND	7	7	9
Males	2014	SANDY_ISLAND	7	8	10
Females	2015	SANDY_ISLAND	3	3	4
Males	2015	SANDY_ISLAND	5	5	7
Females	2016	SANDY_ISLAND	1	1	2
Males	2016	SANDY_ISLAND	3	4	6
Females	2017	SANDY_ISLAND	3	3	5
Males	2017	SANDY_ISLAND	4	4	6
Females	2018	SANDY_ISLAND	1	1	2
Males	2018	SANDY_ISLAND	5	5	7
Females	2010	TENASILLAHEE_ISLAND	2	2	4
Males	2010	TENASILLAHEE_ISLAND	2	2	4
Females	2011	TENASILLAHEE_ISLAND	0	0	2
Males	2011	TENASILLAHEE_ISLAND	2	2	3
Females	2012	TENASILLAHEE_ISLAND	0	0	2
Males	2012	TENASILLAHEE_ISLAND	2	2	4
Females	2014	TENASILLAHEE_ISLAND	1	1	3
Males	2014	TENASILLAHEE_ISLAND	1	1	2
Females	2015	TENASILLAHEE_ISLAND	1	1	3
Males	2015	TENASILLAHEE_ISLAND	2	2	4
Females	2016	TENASILLAHEE_ISLAND	1	1	3
Males	2016	TENASILLAHEE_ISLAND	2	3	4
Females	2017	TENASILLAHEE_ISLAND	1	1	3
Males	2017	TENASILLAHEE_ISLAND	1	1	3
Females	2018	TENASILLAHEE_ISLAND	0	0	3
Males	2018	TENASILLAHEE_ISLAND	1	1	3
Females	2010	WELCH_ISLAND	2	3	5

Sex	Year	Site	Freq.2.5%	Freq.50%	Freq.97.5%
Males	2010	WELCH_ISLAND	1	2	4
Females	2011	WELCH_ISLAND	0	0	2
Males	2011	WELCH_ISLAND	0	0	2
Females	2012	WELCH_ISLAND	0	0	2
Males	2012	WELCH_ISLAND	0	0	2
Females	2013	WELCH_ISLAND	0	1	4
Males	2013	WELCH_ISLAND	0	1	4
Females	2015	WELCH_ISLAND	0	0	2
Males	2015	WELCH_ISLAND	0	0	2
Females	2017	WELCH_ISLAND	1	1	3
Males	2017	WELCH_ISLAND	1	1	2
Females	2018	WELCH_ISLAND	0	0	2
Males	2018	WELCH_ISLAND	1	1	3