**Supplemental Material 1**- Surrogacy Methods

Thirty-seven stranded pups were rescued and admitted to the study year-round and from throughout the sea otter range in central California (Pt. Año Nuevo to Oceano Dunes). We estimated age at stranding (in days or weeks) based on tooth eruption pattern (compared with data from known-age sea otter pups, Monterey Bay Aquarium, unpublished data), total length and weight, molting of the natal pelage, and behavior (Payne & Jameson, 1984; Riedman & Estes, 1990) Although pups admitted to the study ranged in age from 0-7 weeks, most (22 of 37, 59%) were ≤2 weeks at stranding. Surrogacy methods were designed so that pup development during the rehabilitation process best approximated that of wild-reared sea otters, habituation to human caregivers was minimized, and surrogate-reared otters could be intensively monitored after release to ensure the greatest probability of a successful transition from captivity to the wild.

Surrogacy methods (Mayer et al., in preparation) broadly encompassed five stages: 1) stabilization, which involved medical treatment and intensive care for orphaned pups prior to introduction to the surrogate mother (≤8 weeks of age); 2) dependency, after the surrogate mother successfully adopted a stable pup and the two were treated as a unit (9-28 weeks of age); 3) weaning, in which juveniles were permanently separated from their surrogate mother and housed with cohorts in preparation for release (22-28 weeks of age); 4) release, which included an intensive two-week monitoring period following return of an independent juvenile to the wild with the possibility of provisional recapture depending on behavior and foraging success (28 weeks – 1.5yrs); and 5) post-release monitoring, where surrogate-reared juveniles were considered to be free-ranging in the wild population, and re-sighted as frequently as practicable.

Between 2002 and 2015, a total of 9 non-pregnant, non-lactating, captive adult female sea otters were utilized as surrogate mothers for one or more orphaned pups. One additional female that displayed a tendency towards aggression on two occasions was eliminated from participating in the study. At the time of introduction to a pup, surrogate mothers ranged in age from 3.1 – 14.6 years of age ( = 8.4, SD = 3.4), and only 1 of the 9 females had prior experience with having pups of her own (though it is unknown whether this female had ever been successful at rearing pups in the wild). The process of an individual female accepting a pup varied, as did the strength of the maternal bond between mother and pup. Introductions were ultimately successful in 37 of 43 (86%) cases, and in the 6 instances in which a maternal bond failed to establish, each pup was eventually accepted by another female. Length of dependency with the surrogate mother was relatively consistent among pups ( = 127 days, SD = 24.2, n = 37). Following the weaning of a pup, surrogate mothers recovered for an average of 199 days (51-520 days) before being introduced to another pup. The length of this recovery period was comparable to mean length of the inter-birth interval (onset of estrous, conception, gestation) among wild females (Riedman et al., 1994). Therefore, mean duration of the “surrogacy cycle” (days between introductions to consecutive pups, = 327) approximated the duration of the reproductive cycle among wild females that pupped annually (Riedman et al., 1994, Tinker et al., 2019).

*Transmitter Implant and Flipper Tagging*

In preparation for release, juvenile otters were implanted with a VHF radio transmitter equipped with a temperature-sensitive mortality switch (Advanced Telemetry Systems Inc., Isanti, MN). Each otter was also tagged with unique color/number-coded plastic “Temple Tags” (livestock ear tags, Temple, TX) in the inter-digital space of the hind flippers (Ames et al., 1983) to allow for visual identification by field observers. The surgical procedures occurred when pups were 18-40 weeks of age ( = 26 weeks; SD = 5.7) and weighed at least 10 kg ( = 14.1; SD = 2.0), either while still dependent with the surrogate mother (70%, n=26) or after weaning (30%, n=11). Anesthetic and surgical procedures were performed by a qualified veterinarian and followed standardized methods described for previous telemetry-based studies of sea otters (Williams & Siniff, 1983; Ralls et al., 1989; Tinker et al., 2019). Following the procedure, pups were returned to a clean holding tank with their surrogate mother (if still dependent) or by themselves (if weaned) to make sure they had fully recovered before being reintroduced to cohorts.

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**Supplemental Material 2** – Individual-Based Model parameter estimate methods

*Survival Rates*

Sea otter survival rates were estimated using longitudinal monitoring data from radio-tagging studies conducted in Elkhorn Slough (including both surrogate-reared and wild sea otters), Monterey and Big Sur. We employed a Bayesian proportional hazards model (Walsh et al., 2015), similar to previously reported methods for estimating age- and sex-specific survival from radio-tagged sea otters (Tinker et al., 2019; Tinker et al., 2017). Our model accounted for the effects of age and sex as well as study group (*g* = 1, 2…*G*), and for the purposes of this analysis we classified animals into 3 groups: Outer coast (*g* = 1), made up of wild-captured sea otters from Monterey and Big Sur study groups; ES wild (*g* = 2); and ES surrogacy (*g* = 3) made up of wild-captured and surrogate-reared sea otters in Elkhorn Slough respectively. The cumulative effects of all hazards for an individual of age *i*, sex *j*, and group *g*, were estimated by the “logunit cumulative hazard” (γ), which represented the additive effects of various log hazards within that time interval:

 = + + + \**i* + \**j* (1)

where represented the baseline *log* hazard rate, represented age-varying hazards for each sex that were common to all study groups, and was a matrix of parameters specifying group-specific differences in survival, including a main effect (), and interaction terms associated with age () and sex (). Age-varying hazards for each sex () were assumed to be continuous variables and estimated using non-parametric conditional auto-regressive (CAR) methods (Sinha & Dey, 1997). Group effects were categorical variables and corresponded to additional hazards relative to a reference group (*g* = 1, Outer coast). Age-group interactions were continuous variables, while the age-sex interactions were categorical (i.e. additional hazards for males relative to females for group *g*).

The conditional survival probability for a given otter over a specified time period (i.e. given that an individual is alive at time *r*, what is probability that it will survive until time *s*?) was calculated from instantaneous hazards as:

Each of the terms on the right side of equation (2) represented the “unit cumulative hazard” over a short time interval, and could be approximated by a point estimate of the instantaneous hazard rate:

Thus, conditional survival ( was calculated from a summation of log unit cumulative hazard values () over the time period of interest:

Bayesian Markov Chain Monte Carlo (MCMC) fitting algorithms (implemented using MATLAB and JAGS programming environments) were used to fit equations (1) and (4) to interval-censored survival data from radio-tagged sea otters (Tinker et al., 2017; Tinker et al., 2019). Individual survival histories consisted of identifying the left-censored (i.e. release date for surrogate-reared otters or tagging date for wild-captured otters) and right-censored (date last observed) entry points for each monitoring record, as well as the fate at the end of the monitoring period (died, still alive, or disappeared and thus unknown fate). Our model was evaluated at time-step intervals of 1 month. Survival outcomes for each otter, over each observed time interval, were represented as random Bernoulli trials with probabilities determined by equation (1), and these comprised the binomial likelihoods maximized by the MCMC algorithm (Heisey & Patterson, 2006). Model convergence was evaluated and confirmed by examination of MCMC trace plots and R-hat statistic (Gelman et al., 2014). Age and sex-specific survival rates and 95% credible intervals were computed and examined graphically to determine whether there were differences in survivorship schedules between study groups.

*Reproductive Rates*

Longitudinal records of observational data from radio-tagged females were used to estimate per-capita annual birth rates (number of pups born per year per female) and weaning success rates (the probability a pup survives to weaning age at 6 months). As with survival analyses described above, we computed and compared statistics among 3 study groups.

 To estimate birth rate for each of the groups, we selected *72* females for which 3 or more consecutive pup births had been recorded (with at least one pup successfully reared to weaning age), and computed *Dk* as the mean number of days between consecutive births for the *kth* female. Birth rate (*BR*) for each group was then calculated as:

Based on previously published data (Jameson and Johnson, 1993; Riedman et al, 1994; Tinker et al., 2006) we assumed birth rates among females were essentially constant after 3 years of age, while for 2-year-olds, we arbitrarily set a value of 0.25 to reflect the fact that a small proportion of 2-year-old females do reproduce.

 To estimate weaning success rate, we fit a suite of generalized linear mixed models (GLMMs) that related putative predictor variables to the binomial response variable of known weaning outcomes for individual females (following Tinker et al., 2006). For these models we treated individual tagged females as a random effect, to account for any intra-subject correlations in weaning success. Based on previous studies, the primary factor affecting weaning success was age of the mother (Tinker et al., 2017; Tinker et al., 2019); however, we also wanted to test for differences among the 3 study groups. We therefore evaluated 8 different functional models for calculating mother’s age- and group-specific weaning success (*Wi,g*) including various combinations of age effects (linear and higher order polynomials) and group differences, as well as simpler models excluding these main effects. We then compared AIC values to select the best-supported model (Burnham and Anderson, 2002).

The only free parameters in the IBM model that were not available as empirical data or estimated independently from tagging studies (as described in the above sections), were the parameters and , representing the mean net annual rates of immigration to the Slough of wild females and males respectively. We generated maximum likelihood estimates (MLEs) for these parameters by comparing expected population growth using the IBM to observed population dynamics, while varying and . Specifically, the likelihood of obtaining the observed Elkhorn Slough sea otter survey counts of independents (*Nobs*) and pups (*Pobs*) given a particular set of values for and was calculated as:

Equations (6) and (7) were log-transformed and multiplied by -1 to obtain negative log-likelihoods, which were summed for independents and pups and then summed across years to produce a cumulative negative log-likelihood value (Σ-*LL*). We used a global optimization algorithm to find values of and that minimized Σ-*LL*., and used these to parameterize remaining IBM simulations.

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**Supplemental Material 3**- Pseudo code of Individual-Based model

1. Initiate model at time *t* = 1 (corresponding to 2002) by creating a matrix with individuals as rows and attributes of individuals as columns: the matrix represents the “population pool” at time *t*. The attributes of individuals include age, sex, class (released juvenile or wild) and reproductive status. Annual population surveys (Tinker & Hatfield, 2016) and supplementary information indicated a resident population in the Slough of approximately 20 males in 2002. Accordingly, the population pool is initiated with 20 males with ages drawn randomly from the multinomial distribution corresponding to the Stable Stage distribution associated with the best-fit survival schedule.
2. Step sequentially through all remaining time steps (t = 2 to 15), and for each one complete the instructions in steps 3 to 8.
3. Add released individuals to the population pool, according to the numbers, ages and sexes of released animals actually introduced to the Slough.
4. Add immigrants to the population pool, with numbers of males and females drawn randomly from Poisson distributions with parameters λF and λM (these parameters are estimated using Maximum Likelihood methods as described in Supplemental material 2). The ages of immigrants are drawn randomly from a multinomial distribution corresponding to the appropriate Stable Stage distribution.
5. Step sequentially through all individuals in the population pool alive at time *t* (including any new immigrants and released juveniles added in steps 3 and 4) and for each one complete the instructions in steps 6 and 7.
6. Determine the survival of the individual. If the individual is a released juvenile, this determination may be deterministic (if monitoring data are available for the individual in question at time *t*), otherwise the determination is stochastic and drawn from a Bernoulli distribution with probability *Si,j,g* (age, sex and group-specific survival, estimated as described in Supplemental material 2). If the individual is determined not to survive, it is removed from the population pool for the remaining time steps; otherwise, its age is incremented by one year, and it is included in the population pool for the subsequent time step.
7. Determine the reproductive success of the individual in the case of surviving females aged 2 or more (males and females less than 2 are assumed not to produce pups). If the individual is a released juvenile, this determination may be deterministic (if monitoring data are available for the individual in question at time *t*), otherwise the determination is the product of two stochastic variables, pup birth and weaning success. The former variable is drawn from a Bernoulli distribution with probability *BR*, while the latter variable is drawn from a Bernoulli distribution with probability *Wi,g*. If the individual is determined to have successfully weaned a pup, then a new individual of age 0 is added to the population pool that is carried forward to the next year. Note that the sex of all pups produced is treated as a stochastic Bernoulli trial assuming a 50:50 sex ratio.
8. Tally the number of individuals in the population pool still alive at the end of the time step (including new pups produced in step 7) to calculate the expected abundances of independents and pups at time *t*, *Nexp* and *Pexp*, and then advance to the next time step.

|  |
| --- |
| **Table S1**. Survival data for tagged sea otters used in survival analysis across 3 study groups (Outer coast, Elkhorn Slough Wild, and Elkhorn Slough released).  |
| **Study Group** | **Otter ID** | **Sex 1** | **Entry Month** | **Exit Month** | **Fate2** |
| Monterey, Outer Coast | 1 | 0 | 1 | 35 | 1 |
| Monterey, Outer Coast | 2 | 0 | 1 | 21 | 1 |
| Monterey, Outer Coast | 3 | 0 | 1 | 15 | 1 |
| Monterey, Outer Coast | 4 | 1 | 4 | 5 | 1 |
| Monterey, Outer Coast | 5 | 0 | 1 | 105 | 0 |
| Monterey, Outer Coast | 6 | 1 | 1 | 89 | 1 |
| Monterey, Outer Coast | 7 | 0 | 1 | 36 | 1 |
| Monterey, Outer Coast | 8 | 1 | 1 | 109 | 1 |
| Monterey, Outer Coast | 9 | 1 | 1 | 25 | 1 |
| Monterey, Outer Coast | 10 | 1 | 1 | 39 | 1 |
| Monterey, Outer Coast | 11 | 0 | 1 | 80 | 1 |
| Monterey, Outer Coast | 12 | 0 | 1 | 84 | 0 |
| Monterey, Outer Coast | 13 | 0 | 1 | 27 | 1 |
| Monterey, Outer Coast | 14 | 1 | 1 | 64 | 0 |
| Monterey, Outer Coast | 15 | 0 | 13 | 66 | 0 |
| Monterey, Outer Coast | 16 | 0 | 13 | 52 | 1 |
| Monterey, Outer Coast | 17 | 1 | 13 | 95 | 0 |
| Monterey, Outer Coast | 18 | 0 | 13 | 105 | 0 |
| Monterey, Outer Coast | 19 | 0 | 13 | 81 | 0 |
| Monterey, Outer Coast | 20 | 0 | 13 | 42 | 0 |
| Monterey, Outer Coast | 21 | 0 | 13 | 56 | 0 |
| Monterey, Outer Coast | 22 | 1 | 13 | 50 | 1 |
| Monterey, Outer Coast | 23 | 0 | 13 | 14 | 1 |
| Monterey, Outer Coast | 24 | 0 | 13 | 92 | 0 |
| Monterey, Outer Coast | 25 | 0 | 13 | 142 | 0 |
| Monterey, Outer Coast | 26 | 0 | 24 | 136 | 0 |
| Monterey, Outer Coast | 27 | 0 | 25 | 45 | 1 |
| Monterey, Outer Coast | 28 | 0 | 24 | 64 | 0 |
| Monterey, Outer Coast | 29 | 0 | 13 | 40 | 0 |
| Monterey, Outer Coast | 30 | 0 | 13 | 142 | 0 |
| Monterey, Outer Coast | 31 | 1 | 24 | 34 | 1 |
| Monterey, Outer Coast | 32 | 1 | 24 | 116 | 0 |
| Monterey, Outer Coast | 33 | 1 | 25 | 27 | 1 |
| Monterey, Outer Coast | 34 | 1 | 25 | 45 | 1 |
| Monterey, Outer Coast | 35 | 0 | 28 | 114 | 1 |
| Monterey, Outer Coast | 36 | 1 | 37 | 73 | 1 |
| Monterey, Outer Coast | 37 | 0 | 36 | 65 | 0 |
| Monterey, Outer Coast | 38 | 0 | 36 | 73 | 0 |
| Monterey, Outer Coast | 39 | 0 | 1 | 94 | 1 |
| Monterey, Outer Coast | 40 | 0 | 37 | 117 | 0 |
| Monterey, Outer Coast | 41 | 0 | 37 | 71 | 0 |
| Monterey, Outer Coast | 42 | 0 | 37 | 55 | 1 |
| Monterey, Outer Coast | 43 | 1 | 37 | 114 | 1 |
| Monterey, Outer Coast | 44 | 0 | 22 | 39 | 1 |
| Monterey, Outer Coast | 45 | 0 | 75 | 105 | 1 |
| Monterey, Outer Coast | 46 | 0 | 84 | 140 | 0 |
| Monterey, Outer Coast | 47 | 0 | 75 | 99 | 1 |
| Monterey, Outer Coast | 48 | 1 | 48 | 140 | 0 |
| Monterey, Outer Coast | 49 | 1 | 55 | 140 | 0 |
| Monterey, Outer Coast | 50 | 0 | 60 | 140 | 0 |
| Monterey, Outer Coast | 51 | 0 | 75 | 140 | 0 |
| Monterey, Outer Coast | 52 | 0 | 74 | 120 | 0 |
| Monterey, Outer Coast | 53 | 0 | 75 | 103 | 1 |
| Monterey, Outer Coast | 54 | 0 | 74 | 140 | 0 |
| Monterey, Outer Coast | 55 | 0 | 75 | 132 | 1 |
| Monterey, Outer Coast | 56 | 0 | 75 | 140 | 0 |
| Monterey, Outer Coast | 57 | 0 | 75 | 114 | 0 |
| Monterey, Outer Coast | 58 | 0 | 75 | 132 | 1 |
| Monterey, Outer Coast | 59 | 0 | 75 | 95 | 1 |
| Monterey, Outer Coast | 60 | 1 | 75 | 113 | 1 |
| Monterey, Outer Coast | 61 | 0 | 75 | 95 | 1 |
| Monterey, Outer Coast | 62 | 0 | 75 | 124 | 0 |
| Monterey, Outer Coast | 63 | 0 | 75 | 135 | 1 |
| Monterey, Outer Coast | 64 | 0 | 75 | 140 | 0 |
| Monterey, Outer Coast | 65 | 1 | 75 | 140 | 0 |
| Monterey, Outer Coast | 66 | 0 | 84 | 128 | 0 |
| Monterey, Outer Coast | 67 | 0 | 84 | 105 | 1 |
| Monterey, Outer Coast | 68 | 0 | 84 | 85 | 1 |
| Monterey, Outer Coast | 69 | 0 | 84 | 128 | 1 |
| Monterey, Outer Coast | 70 | 0 | 84 | 140 | 0 |
| Monterey, Outer Coast | 71 | 0 | 84 | 127 | 1 |
| Monterey, Outer Coast | 72 | 0 | 84 | 95 | 0 |
| Monterey, Outer Coast | 73 | 0 | 84 | 93 | 1 |
| Monterey, Outer Coast | 74 | 0 | 84 | 97 | 0 |
| Monterey, Outer Coast | 75 | 0 | 84 | 106 | 1 |
| Monterey, Outer Coast | 76 | 0 | 84 | 111 | 1 |
| Monterey, Outer Coast | 77 | 0 | 84 | 138 | 0 |
| Monterey, Outer Coast | 78 | 0 | 84 | 113 | 1 |
| Monterey, Outer Coast | 79 | 0 | 84 | 121 | 0 |
| Monterey, Outer Coast | 80 | 0 | 84 | 140 | 0 |
| Monterey, Outer Coast | 81 | 0 | 84 | 95 | 1 |
| Monterey, Outer Coast | 82 | 0 | 97 | 108 | 1 |
| Monterey, Outer Coast | 83 | 1 | 97 | 114 | 1 |
| Monterey, Outer Coast | 84 | 1 | 103 | 140 | 0 |
| Monterey, Outer Coast | 85 | 0 | 103 | 140 | 0 |
| Monterey, Outer Coast | 86 | 1 | 103 | 140 | 0 |
| Monterey, Outer Coast | 87 | 0 | 104 | 140 | 0 |
| Monterey, Outer Coast | 88 | 1 | 104 | 134 | 0 |
| Monterey, Outer Coast | 89 | 0 | 104 | 140 | 0 |
| Monterey, Outer Coast | 90 | 1 | 104 | 109 | 1 |
| Monterey, Outer Coast | 91 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 92 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 93 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 94 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 95 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 96 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 97 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 98 | 0 | 105 | 140 | 0 |
| Monterey, Outer Coast | 99 | 0 | 103 | 137 | 1 |
| Monterey, Outer Coast | 100 | 0 | 103 | 140 | 0 |
| Monterey, Outer Coast | 101 | 0 | 113 | 140 | 0 |
| Monterey, Outer Coast | 102 | 0 | 113 | 140 | 0 |
| Monterey, Outer Coast | 103 | 0 | 113 | 116 | 1 |
| Monterey, Outer Coast | 104 | 1 | 113 | 140 | 0 |
| Monterey, Outer Coast | 105 | 0 | 117 | 140 | 0 |
| Monterey, Outer Coast | 106 | 0 | 118 | 140 | 0 |
| Monterey, Outer Coast | 107 | 1 | 123 | 136 | 0 |
| Monterey, Outer Coast | 108 | 1 | 125 | 140 | 0 |
| Monterey, Outer Coast | 109 | 0 | 74 | 85 | 1 |
| Big Sur, Outer Coast | 110 | 1 | 98 | 107 | 0 |
| Big Sur, Outer Coast | 111 | 0 | 120 | 133 | 1 |
| Big Sur, Outer Coast | 112 | 0 | 98 | 107 | 1 |
| Big Sur, Outer Coast | 113 | 0 | 98 | 102 | 1 |
| Big Sur, Outer Coast | 114 | 0 | 98 | 126 | 0 |
| Big Sur, Outer Coast | 115 | 0 | 120 | 127 | 1 |
| Big Sur, Outer Coast | 116 | 0 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 117 | 0 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 118 | 0 | 98 | 110 | 1 |
| Big Sur, Outer Coast | 119 | 0 | 98 | 105 | 1 |
| Big Sur, Outer Coast | 120 | 0 | 98 | 107 | 1 |
| Big Sur, Outer Coast | 121 | 0 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 122 | 0 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 123 | 0 | 98 | 133 | 1 |
| Big Sur, Outer Coast | 124 | 0 | 98 | 99 | 1 |
| Big Sur, Outer Coast | 125 | 1 | 98 | 107 | 0 |
| Big Sur, Outer Coast | 126 | 1 | 110 | 111 | 1 |
| Big Sur, Outer Coast | 127 | 1 | 98 | 117 | 1 |
| Big Sur, Outer Coast | 128 | 1 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 129 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 130 | 0 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 131 | 1 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 132 | 0 | 98 | 138 | 0 |
| Big Sur, Outer Coast | 133 | 0 | 98 | 122 | 0 |
| Big Sur, Outer Coast | 134 | 0 | 98 | 106 | 1 |
| Big Sur, Outer Coast | 135 | 0 | 110 | 138 | 0 |
| Big Sur, Outer Coast | 136 | 0 | 110 | 138 | 0 |
| Big Sur, Outer Coast | 137 | 1 | 110 | 126 | 1 |
| Big Sur, Outer Coast | 138 | 0 | 110 | 131 | 1 |
| Big Sur, Outer Coast | 139 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 140 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 141 | 1 | 110 | 118 | 1 |
| Big Sur, Outer Coast | 142 | 0 | 110 | 138 | 0 |
| Big Sur, Outer Coast | 143 | 1 | 110 | 120 | 0 |
| Big Sur, Outer Coast | 144 | 0 | 110 | 138 | 0 |
| Big Sur, Outer Coast | 145 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 146 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 147 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 148 | 1 | 120 | 130 | 0 |
| Big Sur, Outer Coast | 149 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 150 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 151 | 0 | 120 | 138 | 0 |
| Big Sur, Outer Coast | 152 | 0 | 120 | 138 | 0 |
| Elkhorn Slough Wild | 153 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 154 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 155 | 1 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 156 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 157 | 0 | 156 | 162 | 1 |
| Elkhorn Slough Wild | 158 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 159 | 1 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 160 | 0 | 156 | 163 | 1 |
| Elkhorn Slough Wild | 161 | 1 | 156 | 164 | 1 |
| Elkhorn Slough Wild | 162 | 1 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 163 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 164 | 1 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 165 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 166 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 167 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 168 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 169 | 0 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 170 | 1 | 156 | 185 | 0 |
| Elkhorn Slough Wild | 171 | 0 | 174 | 185 | 0 |
| Elkhorn Slough Wild | 172 | 0 | 174 | 185 | 0 |
| Elkhorn Slough Wild | 173 | 0 | 174 | 185 | 0 |
| Elkhorn Slough Wild | 174 | 1 | 174 | 185 | 0 |
| Elkhorn Slough Wild | 175 | 0 | 174 | 185 | 0 |
| Elkhorn Slough Wild | 176 | 1 | 77 | 174 | 1 |
| Elkhorn Slough Wild | 177 | 0 | 121 | 185 | 0 |
| Elkhorn Slough Wild | 178 | 1 | 156 | 185 | 0 |
| Elkhorn Slough Release | 179 | 1 | 17 | 170 | 1 |
| Elkhorn Slough Release | 180 | 1 | 21 | 144 | 1 |
| Elkhorn Slough Release | 181 | 1 | 25 | 26 | 1 |
| Elkhorn Slough Release | 182 | 1 | 26 | 27 | 1 |
| Elkhorn Slough Release | 183 | 1 | 33 | 47 | 1 |
| Elkhorn Slough Release | 184 | 1 | 36 | 158 | 1 |
| Elkhorn Slough Release | 185 | 1 | 37 | 122 | 1 |
| Elkhorn Slough Release | 186 | 1 | 42 | 111 | 1 |
| Elkhorn Slough Release | 187 | 0 | 49 | 67 | 0 |
| Elkhorn Slough Release | 188 | 1 | 58 | 93 | 1 |
| Elkhorn Slough Release | 189 | 0 | 63 | 163 | 0 |
| Elkhorn Slough Release | 190 | 1 | 70 | 101 | 1 |
| Elkhorn Slough Release | 191 | 0 | 70 | 156 | 0 |
| Elkhorn Slough Release | 192 | 0 | 73 | 80 | 1 |
| Elkhorn Slough Release | 193 | 0 | 85 | 154 | 0 |
| Elkhorn Slough Release | 194 | 1 | 86 | 174 | 1 |
| Elkhorn Slough Release | 195 | 0 | 98 | 184 | 0 |
| Elkhorn Slough Release | 196 | 1 | 108 | 172 | 1 |
| Elkhorn Slough Release | 197 | 1 | 115 | 175 | 0 |
| Elkhorn Slough Release | 198 | 0 | 116 | 137 | 0 |
| Elkhorn Slough Release | 199 | 0 | 118 | 119 | 1 |
| Elkhorn Slough Release | 200 | 0 | 122 | 123 | 1 |
| Elkhorn Slough Release. | 201 | 0 | 130 | 185 | 0 |
| Elkhorn Slough Release | 202 | 1 | 133 | 157 | 1 |
| Elkhorn Slough Release | 203 | 1 | 134 | 140 | 1 |
| Elkhorn Slough Release | 204 | 0 | 136 | 184 | 0 |
| Elkhorn Slough Release | 205 | 1 | 144 | 169 | 0 |
| Elkhorn Slough Release | 206 | 0 | 146 | 185 | 0 |
| Elkhorn Slough Release | 207 | 0 | 153 | 154 | 1 |
| Elkhorn Slough Release | 208 | 1 | 158 | 162 | 1 |
| Elkhorn Slough Release | 209 | 1 | 163 | 185 | 0 |
| Elkhorn Slough Release | 210 | 1 | 164 | 184 | 1 |
| Elkhorn Slough Release | 211 | 0 | 169 | 185 | 0 |
| Elkhorn Slough Release | 212 | 0 | 171 | 185 | 0 |
| Elkhorn Slough Release | 213 | 0 | 176 | 185 | 0 |
| Elkhorn Slough Release | 214 | 1 | 180 | 182 | 0 |
| Elkhorn Slough Release | 215 | 0 | 180 | 185 | 0 |

1 1= Male, 0= Female

2 Survival Outcome. 1= Known mortality, 0= Survived to end of study, or unknown fate

**Table S2**. Summary of IBM simulation results, showing the relative contribution to population increase of different segments of the population (released surrogate-reared otters, immigrating wild females and wild males).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Contribution to Population Growth (%)** | Adults | Pups | Total | CI 95 L | CI 95 H |
| Released Juveniles | 53.07 | 63.71 | 54.37 | 37.24 | 76.72 |
| Total Wild Immigration | 46.93 | 36.29 | 45.63 | 21.67 | 79.88 |
|  Female Immigration | 33.67 | 36.29 | 33.98 |  |  |
|  Male Immigration | 13.26 | 0.00 | 11.65 |  |  |



**Figure S1**. Posterior distribution plots from the Bayesian survival analysis, showing probability densities and credible intervals for log hazard ratios associated with study group differences. Refer to Supplemental Material 2 for parameter definitions.



**Figure S2**. Plots of weaning success rates versus age for female sea otters in central California, including data from three study groups: outer coast, Elkhorn Slough wild otters, and Elkhorn Slough surrogate-reared otters. Heavy line indicates mean weaning success rates under the best supported model and semi-transparent polygon indicates 90% prediction intervals.



**Figure S3**. Surface heat map plot showing variation in negative log likelihood values (as indicated by color bar on right) associated with different combinations of two parameters, λF and λM, representing (respectively) the mean annual rates of female immigration and male immigration to Elkhorn Slough. The optimal value is indicated by the lowest negative log likelihood (dark blue color).