

Analysis of Pacific Harbor Seal Survival at Wolf Hollow Wildlife
Rehabilitation Center, Friday Harbor, WA

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November 2011

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ABSTRACT

The Wolf Hollow Wildlife Rehabilitation Center cares for and releases dozens of Pacific Harbor Seals each year. Analysis of 161 seal records from mid-2004 to 2010 showed that the sex, weight, and age of the incoming seals are not statistically significant predictors of survival to release. On the other hand, the absence of wounds and injuries correlates with increased survival rates of about two times greater than that of wounded seals.

INTRODUCTION

The Wolf Hollow Wildlife Rehabilitation Center is a non-profit organization in the San Juan Islands, WA that rescues, rehabilitates, and releases injured and orphaned wildlife. The center was founded in 1983 and typically cares for about 600 animals a year [1]. Among the 220 different species treated at Wolf Hollow, the Pacific Harbor Seal (*Phoca vitulina*) is a species seen each year at the center.

Pacific Harbor Seals are common in many different wildlife and marine mammal rehabilitation centers. Pupping begins in May, and lactation usually lasts from 24 to 30 days. The pups are often born around 8-10kg and expected to gain weight rapidly through nursing to about 20kg [2]. During nursing, the mother leaves the pup on land while she forages for food. It is during this time that the mother may die or human involvement with the pup may scare the mother away, resulting in abandoned and malnourished pups. This is when a rescue center comes in and cares for the seal.

Rehabilitation of one seal pup at Wolf Hollow is estimated to cost about \$3000 with about 23% of the seal pups not surviving rehab [3]. Different studies have been carried out testing for predictors of survival, which would enable the center to screen incoming animals and distinguish the animals that will not survive the rehab process. A study by Williams (2011) found that most years showed no correlation between low intake weight and survival to release in Pacific Harbor Seals at Wolf Hollow [3]. The Marine Mammal Center and the Sea Mammal Research Unit carried out a study on hematology and serum chemistry looking at correlations between survival and blood variables. However, the only correlation showed that all pups less than ten kilograms died during treatment [4]. With further testing, reliable predictors can be found, allowing a rehab center to better assist animals more likely to survive.

During the summer of 2011, I participated in Wolf Hollow's nine week internship focusing on animal care, rescues, and releases. I searched for correlations indicating predictors of survival using the center's Harbor Seal records from the past seven years.

MATERIALS AND METHODS

During my internship at Wolf Hollow, I gathered data from the written records on Harbor Seals admitted over the course of seven years. Many of the records contained incomplete or missing data, and some of the written records were missing altogether. Information was gathered from 2010 back to mid-2004, due to my limited time at the center. Data from the seals admitted in 2011 was not included as none of the seals had been released prior to the end of my internship.

The data gathered included many different parameters. The sex, weight, and length/girth ratio were all recorded with the date and reason for admission. The body condition score and the dehydration level were both given depending on the apparent body fat and skin turgor, while the age was estimated in regards to the presence or absence of the umbilical cord. The body condition score was based on a scale from 1 to 5, one being the most underweight and malnourished. The dehydration level was recorded as a percent dehydration. The attitude of the animal on arrival was also recorded. The animal was either bright, alert and responsive (BAR), quiet, alert and responsive (QAR), stressed, depressed and lethargic, or unconscious. The presence of injuries and infections were noted, and blood samples were tested for white blood cell counts (WBC), hematocrit or pack cell volume (PCV), glucose levels, and total protein levels (TP). Finally, the final disposition of the animal was recorded. The rescued Harbor Seals were either marked as 'lived' or 'died.'

Due to missing data and limitations of logistic regression analysis, only the final disposition, weight, age, and presence of wounds/injuries were used. Of the 168 individuals, seven were omitted due to missing values [5].

This data was compiled in the program Excel and analyzed with Minitab. A binary logistic regression analysis resulted in a logistic regression table containing p-values, odds ratios, and 95% confidence intervals for the four parameters (Table 1). This analysis was used to form probabilities of survival regarding the four parameters using Minitab's binary logistic regression probability analysis. These probabilities represent the probability of survival when each of the four parameters are indicated. These probabilities were then graphed in relation to each parameter individually for better visualization.

RESULTS

Upon logistic regression analysis of the sampled seals, only one of the four parameters tested statistically significant. The sex, weight, age, and presence of wounds had p-values of 0.786, 0.563, 0.473, and 0.058 respectively (Table 1). With a p-value of 0.058, the presence of wounds was barely significant compared to the usual cutoff of a 0.05 p-value. These values indicate that the sex, weight, and age of the seal are not good predictors for survival, and the presence of wounds is only slightly significant.

Creating a logistic function including all four parameters provided the probability of survival of seals with a specific sex, weight, age, and wounds. The presence of wounds is the only parameter that showed statistical significance. Wounded seals tend to have lower probabilities of survival

(Figure 1). The sex of the seal was not a statistically significant predictor of survival, and there appeared to be no correlation between sex and survival (Figure 2). While the incoming weight of the seal was not a statistically significant predictor, within the logistic function for all four parameters, there is a slight correlation between larger weights and higher probabilities of survival (Figure 3). Similarly, older seal age shows a slight correlation with lower probabilities of survival (Figure 4).

The odds ratio for the presence of wounds (odds of survival if the seal is wounded) is 0.49 with a 95% confidence interval from 0.23 to 1.03. Likewise, the odds of survival if the seal is not wounded are 2.04 with a 95% confidence interval from 0.97 to 4.35. For the sampled seals only, not wounded seals are two times more likely to survive than wounded seals.

DISCUSSION

The statistical analysis done in this study shows that sex, weight, and age are not good predictors of survival in Pacific Harbor Seals treated at Wolf Hollow from 2004 to 2010. However, heavier animals tend to have a higher probability of survival, and older animals tend to have a lower probability of survival. These two correlations are understandable. Heavier seals are usually in better health and tend to not be as dehydrated. These seals may have had human interference or a mother killed, but has not been badly starved. The older animals may have been hit by boats or are severely unhealthy. This may account for the lower survival in older animals, as they tend to come to the center with more drastic problems.

The presence of wounds, with a p-value closest to the cutoff for significance, can be labeled as significant for the sampled seals. Incoming seals with no wounds were two times more likely to survive than wounded seals. However, with such a high p-value, this is not a foolproof method for predicting survival. Further studies may look deeper into the types and severity of wounds and injuries.

While this research did provide an insight to the possible importance of wounds on survival in Harbor Seals, there are many more parameters that may have a larger effect. The dehydration level, pack cell volume, glucose levels, and total protein are some other variables that may be more closely tied to survival. However, Wolf Hollow's incomplete records made it difficult to gather significant data.

The staff and interns at Wolf Hollow dedicate themselves to each and every animal that comes to the center, and the Pacific Harbor Seal pups are possibly the most cared for and expensive species each year, costing up to about \$3000 to rehabilitate a single seal [3]. While many initial decisions as to whether a seal can be saved are made by the Stranding Network on San Juan Island, Wolf Hollow could benefit from reliable predictors of survival relevant on their own facilities. With these predictors, the staff can focus most of its efforts and supplies on those seals likely to survive. The seals less likely to survive can be identified, and minimum care can be provided unless the seal appears to be doing significantly better. The goal of rehabilitation is to release as many animals back to the wild as possible. By saving resources for animals more likely to survive, Wolf Hollow can help release even more animals back to nature.

ACKNOWLEDGEMENTS

I would like to thank all the staff and interns at Wolf Hollow for the amazing experience and knowledge that they have provided. Also, I would like to thank my senior project advisor, Dr. William Plummer, for helping me determine and reach my goals.

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TABLES AND FIGURES

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI	
						Lower	Upper
Constant	1.14499	0.971392	1.18	0.239			
Sex							
m	0.104015	0.382489	0.27	0.786	1.11	0.52	2.35
Wt (kg)	0.0685114	0.118438	0.58	0.563	1.07	0.85	1.35
Age (d)	-0.0329649	0.0459296	-0.72	0.473	0.97	0.88	1.06
Wounds/Injuries							
yes	-0.715024	0.377417	-1.89	0.058	0.49	0.23	1.03

Table 1: Logistic Regression Table as analyzed by Minitab

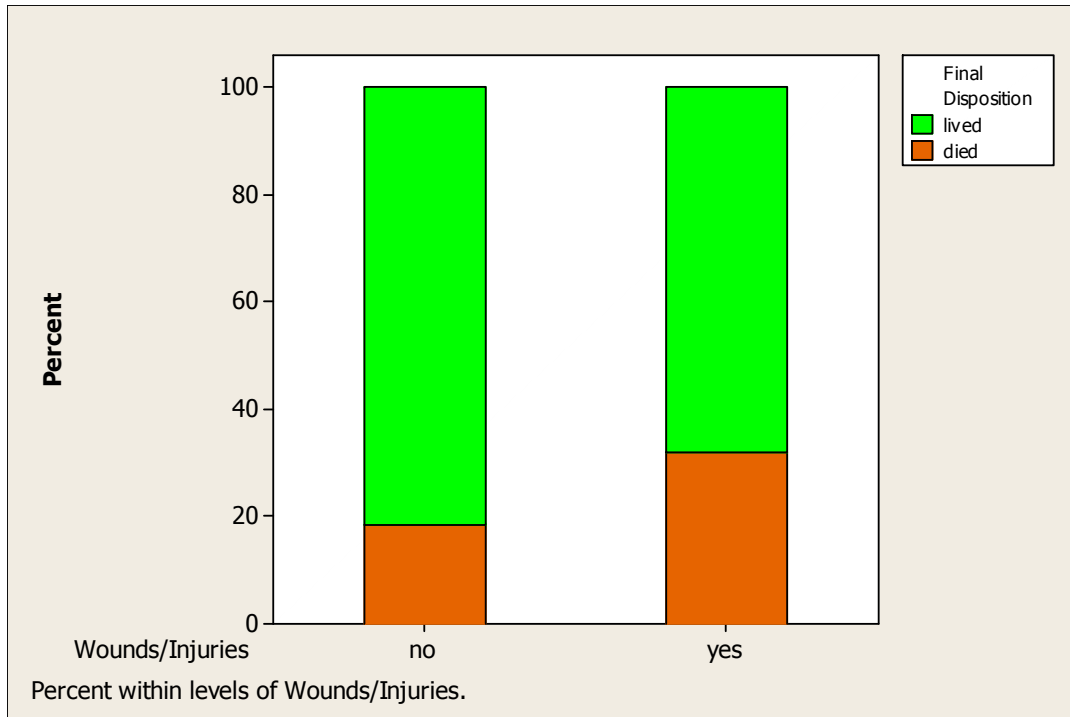


Figure 1: Chart of the Pacific Harbor Seal final disposition (percentage of animals that lived and those that died) versus the presence of wounds/injuries upon arrival.

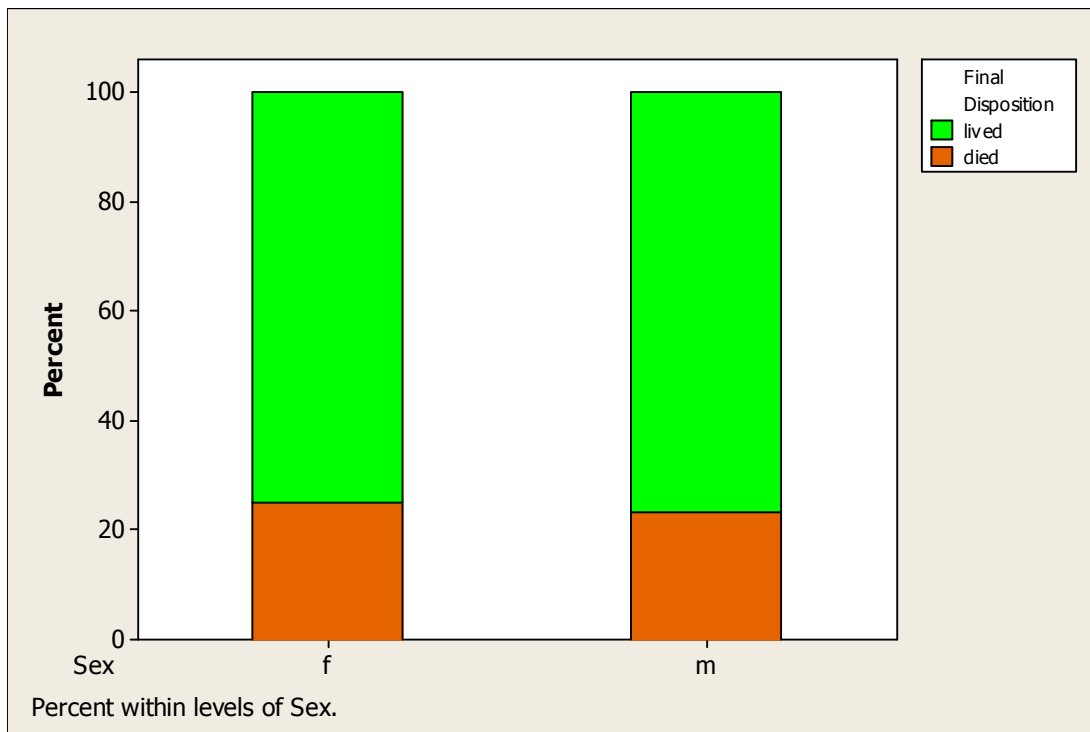


Figure 2: Chart of the Pacific Harbor Seal final disposition (percentage of animals that lived and those that died) versus the seal sex.

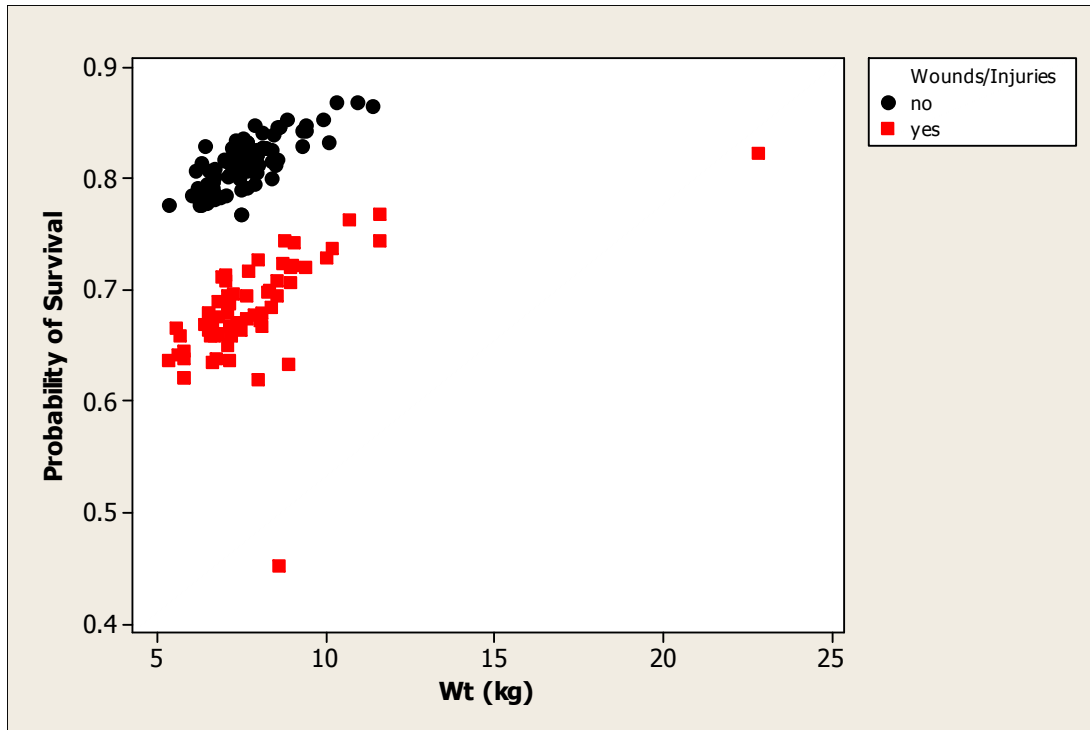


Figure 2: Graph of the probability of survival for Pacific Harbor Seals verses incoming seal weight (kg) with regard to animals with and without injuries.

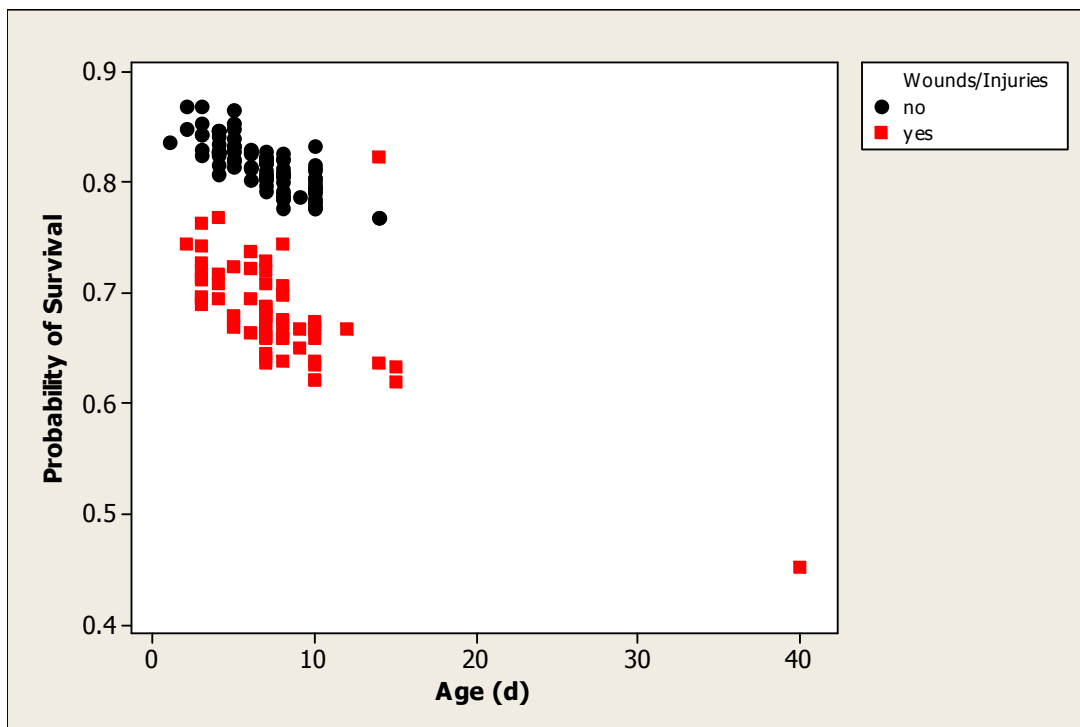


Figure 3: Graph of the probability of survival for Pacific Harbor Seals verses incoming seal age (days) with regard to animals with and animals without injuries.