

A photograph of three dolphins leaping from the ocean. They are captured mid-air, with their bodies arched and tails still in the water, creating a splash. The dolphins are dark grey with lighter underbellies. The background is a clear, vibrant blue sky. The ocean surface is visible at the bottom of the frame.

Survival Analysis: Captive Bottlenose Dolphins in the U.S.

LAINE B.

DA 6213

Data Source

Original data set

- Compiled by The Pudding from NOAA Marine Mammal Inventory and crowd-sourced Ceta-Base
- 1946 through May 7, 2017
- 2194 observations from 36 species

Bottlenose dolphins

- 1668 observations
- 1282 observations with birth and event dates

Data Preprocessing

- **Age-specific analysis**
 - Time to event calculated from birth rather than entry into captivity
 - Estimated birth year for captured or rescued animals

Data Preprocessing

- **Categorization of current or last location**
 - Lower accuracy for closed locations
 - 1221 remaining observations
 - 4 Types
 - Travel Destination (e.g., amusement parks, resorts)
 - Aquarium/Zoo
 - Research/Preserve
 - U.S. Navy

Kaplan-Meier Log Rank Test

SAS: proc lifetest

Summary of the Number of Censored and Uncensored Values					
Stratum	Location	Total	Failed	Censored	Percent Censored
1	Aquarium/Zoo	319	264	55	17.24
2	Navy	189	109	80	42.33
3	Research/Preserve	115	73	42	36.52
4	Travel Destination	598	359	239	39.97
Total		1221	805	416	34.07

Stratum	Mean Days to Event
1: Aquarium/Zoo	4801.5
2: U.S. Navy	* 9532.8
3: Research/Preserve	* 7689.6
4: Travel Destination	8161.0

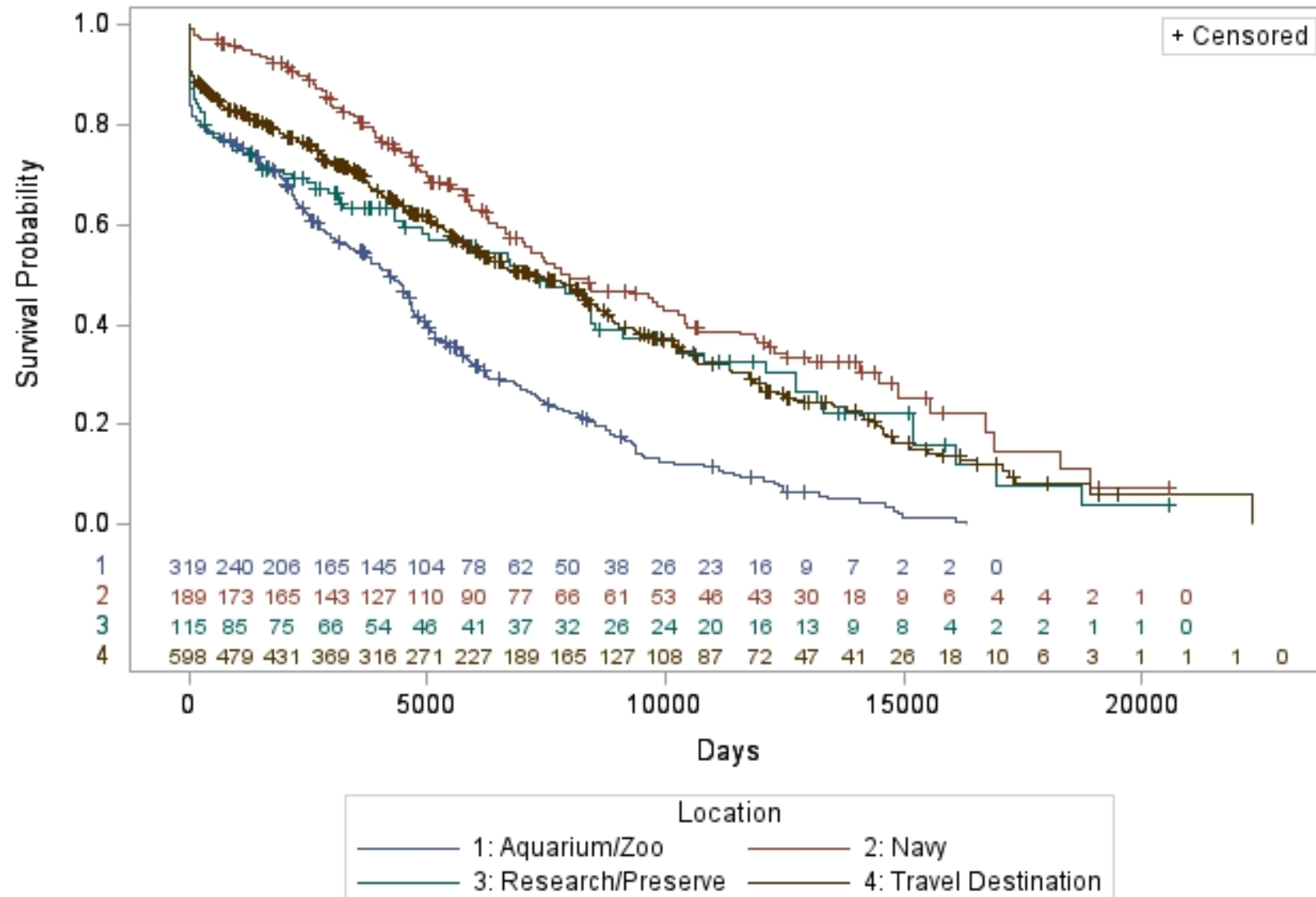
Log Rank Results

Significant differences

- Aquariums/Zoos
- Navy vs. Research/Preserve

Test of Equality over Strata			
Test	Chi-Square	DF	Pr > Chi-Square
Log-Rank	92.7731	3	<.0001

Adjustment for Multiple Comparisons for the Logrank Test				
Strata Comparison		Chi-Square	p-Values	
Location	Location		Raw	Sidak
Aquarium/Zoo	Navy	78.5176	<.0001	<.0001
Aquarium/Zoo	Research/Preserve	52.0643	<.0001	<.0001
Aquarium/Zoo	Travel Destination	46.5238	<.0001	<.0001
Navy	Research/Preserve	10.6332	0.0011	0.0066
Navy	Travel Destination	0.1066	0.7441	0.9997
Research/Preserve	Travel Destination	5.1179	0.0237	0.1339



Survival Plot

- Lowest expected survival:
 - Aquarium/Zoo
- Highest expected survival:
 - U.S. Navy

Cox Regression

SAS: proc phreg

- **Origin**

- 1246 observations
- 3 Categories
 - Birth/Pregnancy
 - Capture
 - Rescue (Group 0)

Summary of the Number of Event and Censored Values			
Total	Event	Censored	Percent Censored
1246	828	418	33.55

Cox Regression Results

- Highest Hazard Ratio
 - Birth/Pregnancy
- Lowest Hazard Ratio
 - Capture

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	26.3618	2	<.0001
Score	27.0810	2	<.0001
Wald	26.8111	2	<.0001

Analysis of Maximum Likelihood Estimates						
	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
Birth/Pregnancy	1	0.33766	0.24843	1.8473	0.1741	1.402
Capture	1	-0.04475	0.24760	0.0327	0.8566	0.956

Potential Future Research

Details of location
(e.g., available
space, feeding
procedures)

Initial condition
of animals

Number of
transfers



Reasonability Checks

Sources

Thomas, A. (2017). Free Willy and Flipper by the Numbers. *The Pudding*.
<https://pudding.cool/2017/07/cetaceans/> Data accessed via:
<https://data.world/the-pudding/cetaceans/workspace/file?filename=allCetaceanData.csv>
on April 27, 2022.

Kohler, I. V., Preston, S. H. and Bingaman Lackey, L. (17 November 2006). Comparative mortality levels among selected species of captive animals. *Demographic Research*. Volume 15, Article 14, pp. 413-434, 17 November 2006. <https://www.demographic-research.org/volumes/vol15/14/15-14.pdf>