

AGE SPECIFIC STELLER SEA LION SURVIVAL RATES ALONG the ASIAN COAST

Alexey Altukhov^{1,2} – aaltukhov@gmail.com;
 Russel Andrews^{1,3}; Donald Calkins⁴; Thomas Gelatt⁵; Eliezer Gurarie⁶; Thomas Loughlin⁷; Evgeny Mamaev⁸;
 Victor Nikulin⁹; Permyakov Peter¹⁰; Sergey Ryazanov¹⁰; Vladimir Vertyankin¹¹; Vladimir Burkanov^{2,4}

¹ School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 905 N. Koyukuk Drive, 245 O'Neill Building, Fairbanks, AK 99775, USA
² Kamchatka Branch of the Pacific Geographical Institute, 6 Partizanskaya St., Petropavlovsk-Kamchatsky, 683000, Russia
³ Alaska SeaLife Center, 301 Railway Ave, Seward, AK 99664, USA
⁴ North Pacific Wildlife Consulting, LLC, 12600 Elmwood Rd, Anchorage AK, 99516, USA
⁵ National Marine Mammal Laboratory, AFSC, NMFS, NOAA, 7600 Sand Point Way NE, Building 4, Seattle, WA, 98115, USA

⁶ Unaffiliated (Independent researcher)
⁷ TRL Wildlife Consulting (NMML retired)
⁸ State Nature Reserve «Komandorsky», Nikolskoe, Russia, 684500
⁹ Kamchatka Research Institute of Fisheries and Oceanography, 18 Naberezhnaya St., Petropavlovsk-Kamchatsky, 683000, Russia.
¹⁰ V.I.II'ichev Pacific Oceanological Institute, FEB RAS, 43 Baltiiskaya st., Vladivostok, 690041, Russia
¹¹ Kronotsky Reserve, 48, Ryabikova Street, Yelizovo, Kamchatka region, Russia, 684000

Introduction

The global population of Steller sea lions has declined dramatically over the last 30 to 40 years. The Western stock (from the eastern Gulf of Alaska to the Kamchatka Coast) declined throughout most of Alaska and Russia through the 1990s, but early in the 21st century the decline had slowed and in some areas seemed to be recovering. However, Steller sea lions in the western and central Aleutian Islands have not recovered, and continue on a slow decline. Rookeries along the Asian Coast showed similar patterns of decline and recovery. Populations in the Kuril Islands, the Sea of Okhotsk and on Sakhalin Island are currently increasing, but in Eastern Kamchatka the population has remained stable in the last 15 years. On the Commander Islands, as in the western and central Aleutians, the population has continued to decline through the past decade. Steller sea lions are a long-lived species with overlapping generations and this life-history strategy can buffer effects of short-term, environmental fluctuations. Longer term population trends are likely caused by persistent changes in vital rates that continue for two or three decades. Our goal was to determine whether differences in current population trajectories are due to differences in survival rates at rookeries throughout far eastern Russia.

Material and Methods

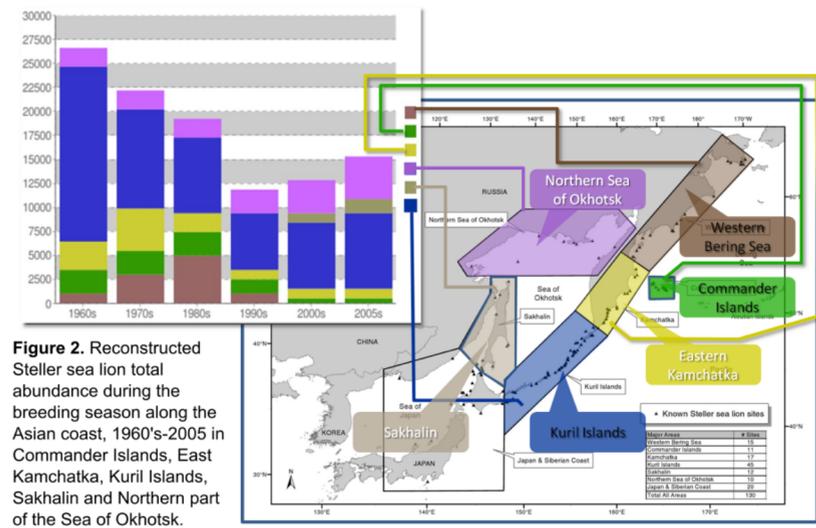


Figure 2. Reconstructed Steller sea lion total abundance during the breeding season along the Asian coast, 1960's-2005 in Commander Islands, East Kamchatka, Kuril Islands, Sakhalin and Northern part of the Sea of Okhotsk.

We used mark-recapture data from 6 of the 10 major rookeries along the Asian Coast. Steller sea lions were marked when approximately one month old by using hot iron branding (see Fig. 3).

For the period from 1989 to 2001 observations were only sporadic on most rookeries. Since 2002, we conducted observations at all major SSL rookeries for at least 2 months during the summer breeding season.

We used 7341 recapture records from 4765 marked sea lions.

A Cormack-Jolly-Seber model for open populations was used to estimate survival and sighting probabilities.



Figure 3. Branding history on 6 major rookeries along the Asian Coast for the period 1989-2012.

Results

Survival probabilities suggested higher survival rates in females than males.

There were no significant differences in first year survival between sexes across all sites.

Steller sea lions on Medny Island (MY) and Kozlova Cape (KC) displayed a dip in survival in year 2 relative to first and third year survival. (see Fig. 4 and Fig. 5)

In contrast to MY and KC, first year survival was significantly lower for both sexes and on all the Kuril Islands (KUR) than second year survival. (see Fig. 4 and Fig. 5)

There were no statistical differences in survival for the same ages and sexes between all sites within Kuril Islands.

Pup survival for both sexes was significantly higher in MY and KC than in all Kuril Islands (KUR). (see Fig. 5)

Survivorship of females in MY became lower than in other regions after age 4. (see Fig. 5)

We excluded animals branded in 1989 on three Kuril Islands in the comparative analysis. Analyzing them separately, we were able to estimate survivorship for males and females up to age 22. (see Fig. 6)

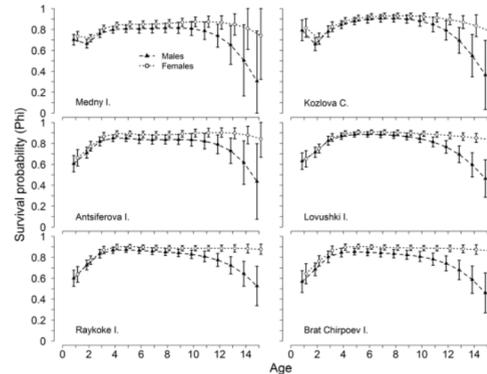


Figure 4. Age specific annual survival of females and males with 2*SE. Medny Island (MY), Kozlova Cape (KC), Antisferova Island (AI), Lovushki Island (LI), Raykoke Island (RI), Brat-Chirpoev Island (BI).

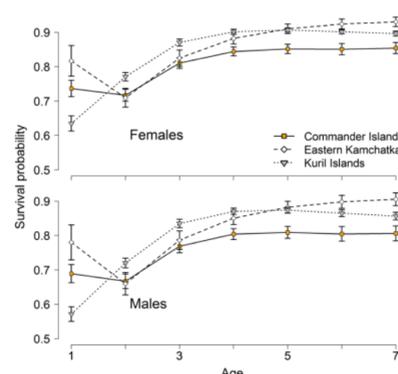


Figure 5. Age specific annual survival with errors for females and males until age 7 in the Commander Islands (Medny Islands), Eastern Kamchatka (Kozlova Cape) and Kuril Islands (4 pooled islands).

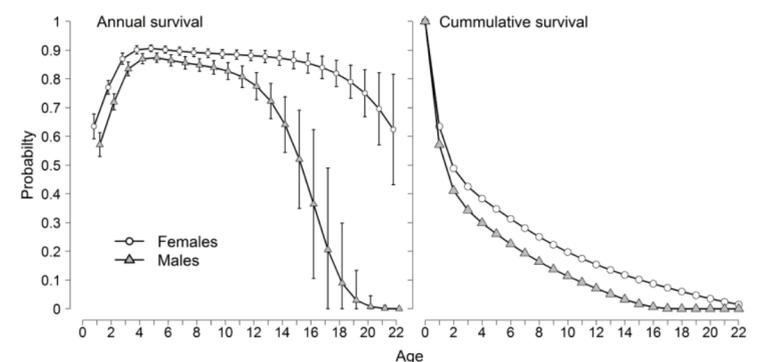


Figure 6. Age and sex specific annual survival with 2*SE for the Kuril Islands, and cumulative survivorship until the age of 22. Female survival was higher for all ages, as is typical for mammals with high levels of sexual dimorphism. Differentiation in survival between sexes greatly changed at ages 10-12 years.

Conclusions

Survival rates differed between the Kuril, Kamchatka and Commander Island regions, though not necessarily as predicted by population trends.

High survival of pups on the Commanders and Kamchatka is likely a consequence of less frequent (e.g. biennial) reproduction, allowing mothers to devote more to each pup.

Juvenile survival is lower in the Commanders and Kamchatka than on the Kuril Islands, which agrees with the existing data showing that – at least in early years – Commander and Kamchatka juveniles share feeding regions and experience similar environmental conditions.

All survival rates were lower in the Commanders than in all other regions.

The Kuril Islands population is increasing, but it did not have the highest pup or adult survival suggesting that birth rates are more important for explaining the overall population trends.

In order to tease apart the proximal causes for variation in population trends, our next step is to estimate both birth and migration rates, and to incorporate those into a comprehensive demographic model.

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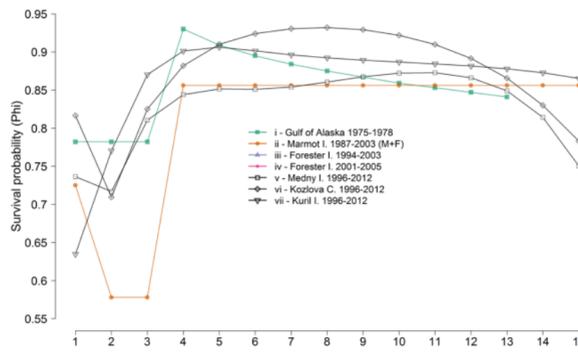


Figure 8. Annual survival in the Asian Stock (v,vi,vii - this study), pre decline survival in central Gulf of Alaska (i - York, 1994); pooled male and female survivorship during decline in Marmot I. (Western Stock) by Pendleton 2007 and female survival in Eastern Stock (iii - Pendleton et al., 2006, iv - Hastings et al., 2011).



Killer whales were only observed to take northern fur seals in the Commander Islands but not Steller sea lions - perhaps very large population of northern fur seals protect Steller sea lions.

Killer whales have been observed approaching rookeries in the Kuril Islands. Most of these rookeries only contain Steller sea lions. One observed rookery also has northern fur seals, but there are no differences in survival between these islands - so killer whale predation is probably not a factor.