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Northwest Fisheries Science Center

Southern Resident killer whale demographics and trends

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1. Reconstructing historical population size

2. Demographic summary

3. Projections for decline

4. Data gaps

How big was SRKW population pre-1976?

- What is the historical population size?
 140?
- 200?

other?

Where did 140 come from?
 N(1971) + total removals + shootings
 Source: SRKW Recovery Plan, p 54-56



Population dynamics in reverse

- Harvests 1962-1979 treated as known
- Assume max growth rate 4%
- Estimate N(1962) given N(1976, 1977, ...)





SRKW have likely been small for some time



Reconstruction from Bain & Balcomb



Genetic data also suggest population size has been small (Ford et al. 2018)

• Effective Nb = 10-53 (mean = 22)



Figure 3 Trends in the estimated effective number of breeders

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What's going on now?

 Lots of demography highlighted in 2011-2012 DFO NOAA workshops, Nov 2017 workshop at UBC

 SRKW have reduced fecundity and survival compared to NRKW and SEAK populations of killer whales

Ward et al. (2009), Ford et al. (2010), Ward et al. (2013), Ward et al. (2016)



Other fish-eating killer whales doing very well

- NRKW
- - 265 to 281 (2011 to 2017)
- - no strong signs of density dependence

- SRKW
 - 87 to 76 animals (2011 to 2017)



Recent declines appear similar to 1990s





Changing age structure



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Increasing trend toward male births





But recovery may be limited by females

animal	pod	age	last	animal	pod	age	last
J42	J	10	NA	L103	L103 L		2
J41	J	12	2	L91 L		22	2
J40	J	13	NA	L94 L		22	2
J37	J	16	2	L90	.90 L		NA
J36	J	18	2	L86	L	26	3
J35	J	19	7	L82	L	27	7
J31	J	22	1	L83	L	27	10
J22	J	32	14	L77	L	30	5
J19	J	38	12	L72	L	31	12
J17	J	40	2	L54	L	40	7
K27	K	23	6	L55	L	40	6
K22	K	30	11		_	-	-
K20	K	31	13				
K16	K	32	15				
K14	K	40	9				



Some females might not ever produce a calf again

(arow)			-				-	-
(grey)	animal	pod	age	last	animal	pod	age	last
	J42	J	10	NA	L103	L	14	2
	J41	J	12	2	L91	L	22	2
	J40	J	13	NA	L94	L	22	2
	J37	J	16	2	L90	L	24	NA
	J36	J	18	2	L86	L	26	3
	J35	J	19	7	L82	L	27	7
	J31	J	22	1	L83	L	27	10
	J22	J	32	14	L77	L	30	5
	J19	J	38	12	L72	L	31	12
	J17	J	40	2	L54	L	40	7
	K27	K	23	6	L55	L	40	6
	K22	K	30	11				
	K20	К	31	13				
	K16	К	32	15				
	K14	K	40	9				



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Looking forward: is this a crisis?

- Status quo projections suggested slight increase
- But high uncertainty (95% CIs for 2017 = 76 108)
- 2011-2012 workshops: 87 whales, 2017 = 76



Ward, E.J., M.J. Ford, R.G. Kope, J.K.B. Ford, L.A. Velez-Espino, C.K. Parken, L.W. LaVoy, M.B. Hanson, and K.C. Balcomb. 2013. Estimating the impacts of Chinook salmon abundance and prey removal by ocean fishing on Southern Resident killer whale population dynamics. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-123.



Influence of new data on demography



No surviving calves produced in 2013, 2016, 2017



Population projected to decline, won't meet recovery goals

• Rate depends on assumptions



Source: Dec 2016 status review



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Data gaps: SRKW versus other spp of concern SRKW represent a declining population of a species / ecotype that is doing really well

More fish-eating killer whales in NE Pacific now than since < 1972

For many species, threat(s) are clear, can be prioritized. Less so for SRKW.





Data gaps: unanswerable questions?

- Are the fluctuations we're seeing just chance?
- What are the reasons for individual deaths?
- Why are animals becoming pregnant but not producing live calves?
- If food limited, what prey is most limiting? Which stocks?
- Which season are the animals most nutritionally stressed?
- Which contaminants (if any) affect health, fecundity or survival?
- How does disease impact SRKW?
- Are any social behaviors, infanticide or other, affecting demographics?
- How is inbreeding impacting demographic rates?
- What (if anything) is causing the trend toward more male births?



Conclusions

- Historical population size of SRKW has likely been small, at least to the early 20th century
- SRKW projected to continue decline because
 - Fecundity appears to be slightly lower in the last 5-6 years
 - Small effective population size (~ 20-25), small number of successful breeding females
 - Trend toward more male births
- Relative importance of risks unclear

