Photo by Ken Balcomb

Southern Resident orca primary habitat.

Salish Sea Map
by Stefan Freelan, Western Washington University, 2009

…and across the waters Salish tribes traveled by canoe daily...

The tribes revered the killer whale as the most powerful inhabitant of the undersea world, where they lived in houses and ruled over other creatures.

J pod

ID	M/F	DOB
J16	F	1972*
J19	F	1979
J22	F	1985
J26	M	1991
J27	M	1991
J31	F	1995
J35	F	1998
J36	F	1999
J37	F	2001
J38	M	2003
J39	M	2003
J40	F	2004
J41	F	2005
J42	F	2007
J44	M	2009
J45	M	2009
J46	F	2009
J47	M	2010
J49	M	2012
J51	M	2015
J53	F	2015
J56	F	2019
J57	M	2020
J58	F	2020
J59	U	2022

K pod

ID	M/F	DOB
K12	F	1972*
K14	F	1977
K16	F	1985
K20	F	1986
K22	F	1987
K26	M	1993
K27	F	1994
K33	M	2001
K34	M	2001
K35	M	2002
K36	F	2003
K37	M	2004
K38	M	2004
K42	M	2008
K43	F	2010
K44	M	2011

L pod - 1

ID	M/F	DOB
L22	F	1971*
L25	F	1928*
L54	F	1977
L55	F	1977
L72	F	1986
L77	F	1987
L82	F	1990
L83	F	1990
L85	M	1991
L86	F	1991
L87	M	1992
L88	M	1993
L89	M	1993
L90	F	1993
L91	F	1995
L94	F	1995

L pod - 2

IID	M/F	DOB
L103	F	2003
L105	M	2004
L106	M	2005
L108	M	2006
L109	M	2007
L110	M	2007
L113	F	2009
L115	M	2010
L116	M	2010
L117	M	2010
L118	F	2011
L119	F	2012
L121	M	2015
L122	M	2015
L123	M	2015
L124	U	2019
L125	F	2021

Orca Survey

Southern Resident Killer Whales

ID GUIDE

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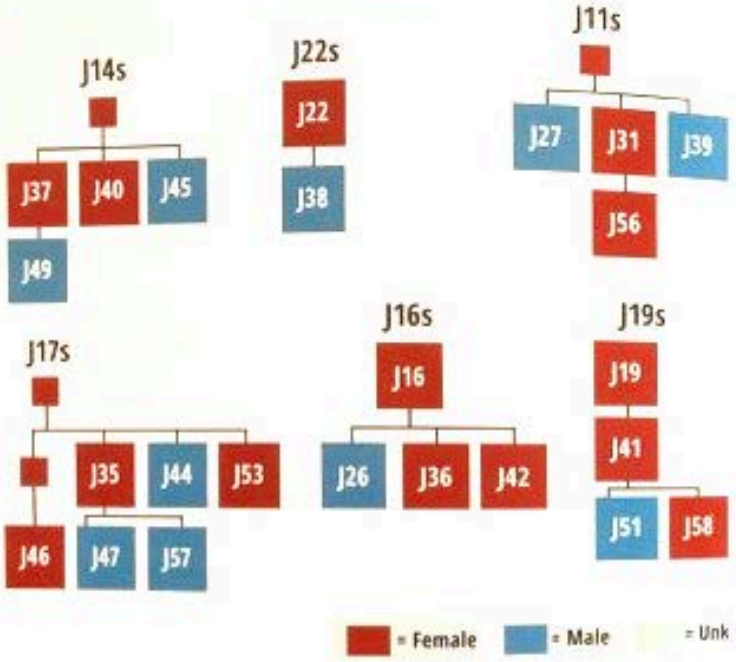
J POD



Center for Whale Research

J14 Matriline - J37, J40, J45, J49

J37 • Female • Born 2001
Mother is J14 (deceased);
siblings J40, J45. Mother of J49.

J40 • Female • Born 2004
Mother is J14 (deceased);
siblings J37, J45.

J45 • Male • Born 2009
Mother is J14 (deceased);
siblings J37, J40.

J49 • Male • Born 2012
Mother is J37.

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Culture in whales and dolphins

Luke Rendell[a] and Hal Whitehead[a,b]
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Rendell and Whitehead (2001): "The complex and stable vocal and behavioural **cultures** of sympatric groups of killer whales (*Orcinus orca*) appear to **have no parallel outside humans**, and represent an independent evolution of cultural faculties."

Keywords: Animal culture; cetaceans; coevolution; cognition; cultural transmission; dolphins; evolution of culture; imitation; teaching; whales

1. Introduction

The presence of cultural processes in nonhuman animals is an area of some controversy (de Waal 1999; Galef 1992). In this target article we attempt to fuel the debate by reviewing the evidence for cultural transmission in whales and dolphins (order Cetacea), a group that has so far received almost no attention from students of animal culture. Studies of cetaceans have uncovered a number of patterns of behaviour and vocalizations, which some cetologists have ascribed to cultural processes. Here we review these results from the perspectives used in research on cultural transmission in other animals.

Theoretical investigations suggest that cultural transmission of information should be adaptive in a broad range of environments (Boyd & Richerson 1985), but it is quite rarely documented outside humans (but see Slater 1986; Whiten et al. 1999). This discrepancy has yet to be explained (Laland et al. 1996). When stable over generations, culture can strongly affect biological evolution, in both theory (e.g., Findlay 1991) and practice – much of human behaviour is determined by a broad range of cultural processes, and there is good evidence for gene-culture coevolution in our species (Feldman & Laland 1996). In contrast, among nonhuman animals culture is much simpler, rarer, and, except possibly in the case of bird song (Grant & Grant 1996), thought not to have the stability necessary to make a substantial impact on genetic evolution (Feldman & Laland 1996; Laland 1992).

The logistical difficulties of studying wild cetaceans make the study of culture difficult, and often give rise to information that is incomplete and poor in detail. Nonetheless, we feel it is timely to introduce cetaceans into the wider debate surrounding animal culture for a number of reasons. First, there is growing evidence of cultural transmission and cultural evolution in the cetaceans, some of which is strong, some of which is weaker, but which when taken as a whole make a compelling case for the detailed study of cultural phenomena in this group. Although culture and cultural transmission have been briefly discussed in the context of cetaceans by a number of authors (Felleman et al. 1991; Ford 1991; Norris & Dohl 1980; Norris & Schilt 1988; Norris et al. 1994; Osborne 1986; Shane et al. 1986; Silber & Fertl 1995), no synthesis has been attempted. Second, the evidence now available describes some interesting and rare (in some cases unique outside humans) patterns of behavioural variation in the wild, likely maintained by cultural transmission processes. Third, there is growing evidence that in the complexity of their social systems – the only nonhuman example of second-order alliances (Connor et al.

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HAL WHITEHEAD, Killam Professor of Biology at Dalhousie University, is the author of over 100 papers mostly on the behaviour, ecology, population biology, and conservation of whales. He is co-editor of *Cetacean societies: Field studies of dolphins and whales*, published in 2000 by the University of Chicago Press.

 0140-525X/01 $12.50

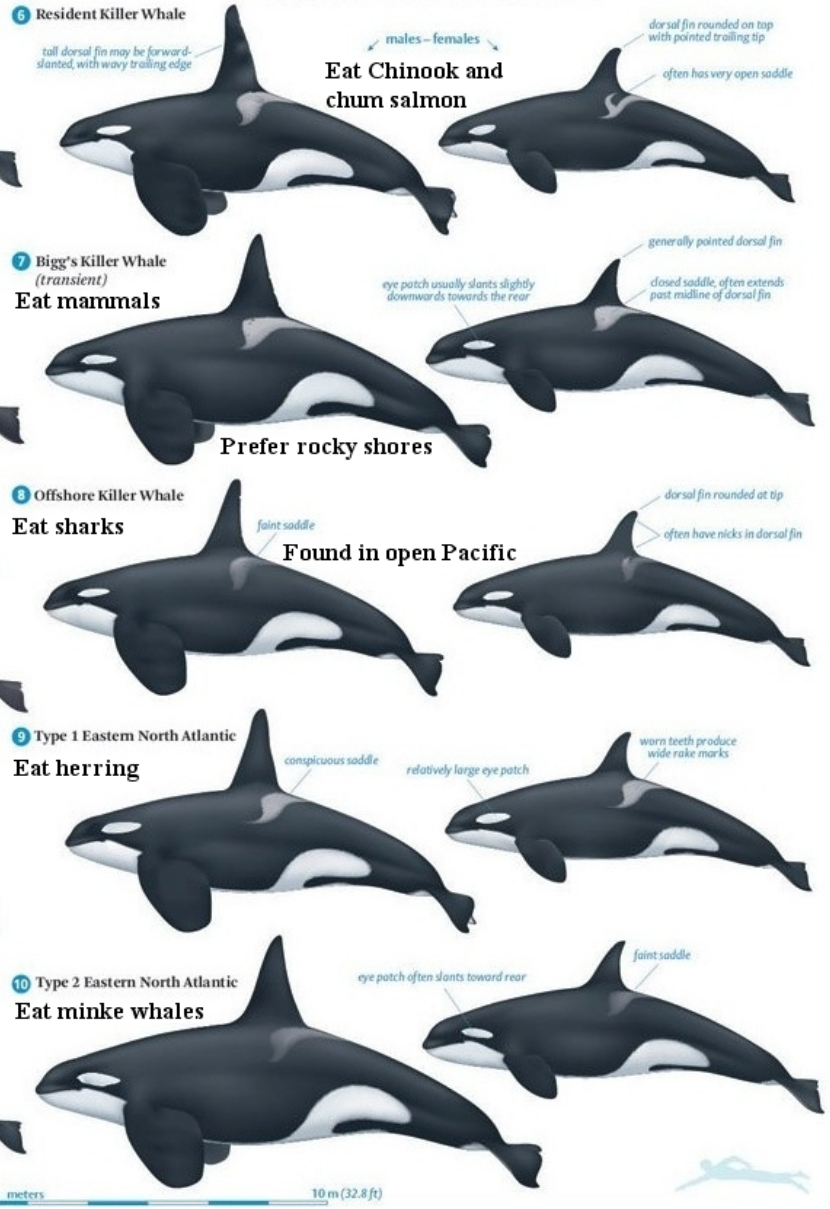
Illustrations by Uko Gorter

Orcinus orca KILLER WHALES *Ecotypes & Forms*

A diversified portfolio

SOUTHERN HEMISPHERE

NORTHERN HEMISPHERE



September, 2012

Adaptive Prolonged Postreproductive Life Span in Killer Whales

Emma A. Foster,[1,2] Daniel W. Franks,[3] Sonia Mazzi,[4] Safi K. Darden,[1] Ken C. Balcomb,[2] John K. B. Ford,[5] Darren P. Croft[1]*

The evolution of a prolonged postreproductive life span has attracted considerable interdisciplinary attention, primarily because of the long postmenopausal life span seen in humans (*1*). Two mechanisms have been proposed to underpin prolonged postreproductive life span: (i) an epiphenomenon of increased longevity, in which evolutionary benefits accrue only during the reproductive phase with no ad-

tive female cetaceans (*4*) suggests an adaptive benefit, there has been no evidence that a similar phenomenon occurs in nonhuman animals.

With multigenerational demographic records based on photographic censuses (1974 to 2010) of the Southern and Northern resident killer whale (*Orcinus orca*) populations in coastal waters off Washington state, USA, and British Columbia, Canada [see (*5*) for details], we used a Cox proportional hazards model (*6*) to examine the consequences of a mother's death on offspring survival. This unique data set consisted of 589 individually identifiable animals, of which 297 died during the study period (*6*).

Resident killer whales have the longest postreproductive life span of all nonhuman animals: Females stop reproducing in their 30s to 40s but can survive into their 90s (*5*). Because neither sex disperses from the maternal group (*7*), theory based on kinship dynamics (*4*) predicts that fe-

ter's offspring are raised within the group, increasing within-group competition (*4*). Old mothers can therefore maximize inclusive fitness benefits by directing care toward sons (*4*).

Postreproductive mothers are known to have little effect on their daughter's reproductive success in resident killer whales (*8*). However, we show that both postreproductive and reproductive females increase their own offspring's survival, particularly older male offspring (Fig. 1 and table S1). For male offspring ≤30 years old, there is a 3.1-fold increase in mortality risk in the year after their mother's death (Fig. 1). For males >30, this risk increases to 8.3-fold (Fig. 1). In contrast, female offspring ≤30 show no increase in mortality risk, whereas those >30 show some increase in risk (2.7-fold) in the year after their mother's death (Fig. 1). Importantly, the magnitude of this effect does not differ between reproductive and postreproductive females (*6*). Indeed, for offspring >30, the death of a postreproductive mother increases mortality risk 13.9-fold in sons and 5.4-fold in daughters in the year after their mother's death.

Our results demonstrate an adaptive benefit to a prolonged postreproductive life span in killer whales. Because reproductive success increases with age in male killer whales (*9*), increasing the survival of older male offspring will maximize inclusive fitness (*4*). Resident killer whales are unusual in that mothers maintain strong social relations

"…female killer whales have the longest menopause of any non-human species."

reproductive life span of any nonhuman animal.

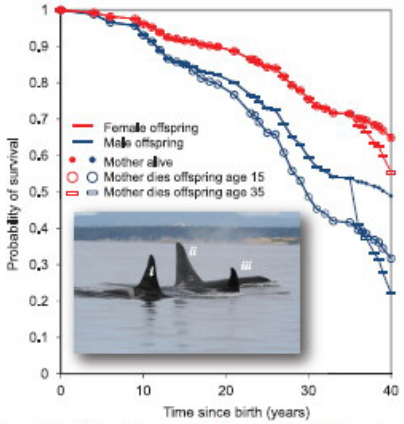


Fig. 1. Survival curves derived from a Cox proportional hazards model (*6*) for male and female offspring experiencing their mother's death at different ages. (**Inset**) Adult sons (i and ii) traveling with their postreproductive mother (iii).

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Supplementary Materials
www.sciencemag.org/cgi/content/full/337/6100/1313/DC1
Materials and Methods

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*To whom correspondence should be addressed. E-mail: d.p.croft@exeter.ac.uk

September 5, 2020
Newborn J57 is born in Legendary Superpod

K and L pods came running from out west

September 5, south of Victoria BC
Photo by Mark Malleson, © Center for Whale Research

Photo by Mark Malleson ©Center for Whale Research 2020

K37_K26_K42

Photo by Mark Malleson ©Center for Whale Research 2020


Photo by Mark Malleson ©Center for Whale Research 2020

Photo by Ken Balcomb ©Center for Whale Research 2020

L25, L72, and L105

Meanwhile, 30+ miles to the east, near San Juan Island…

Baby J57 is born

Photo by Katie Jones, north of Dungeness Spit

The New York Times

Orca That Carried Dead Calf for 17 Days Gives Birth Again

Researchers spotted the killer whale they call J35 alongside her "robust and lively" new calf on Saturday — a ray of hope for the endangered Southern Resident population off the Pacific Northwest.

Researchers noticed a higher rate of excitement calls in the days immediately after the birth of a calf.

-Journal of the Acoustic Society of America. 2006

J47, J57 (1 day), J35 Tahlequah

Sept. 5, Strait of Juan de Fuca

Photo by David Ellifrit, © Center for Whale Research

Sept. 22 - Sara Hysong-Shimazu was lucky enough to get a photo of the newborn J57 breaching and was able to determine that "It's a boy!"

Southern Resident orcas are social.

Photo: Howard Garrett, Orca Network

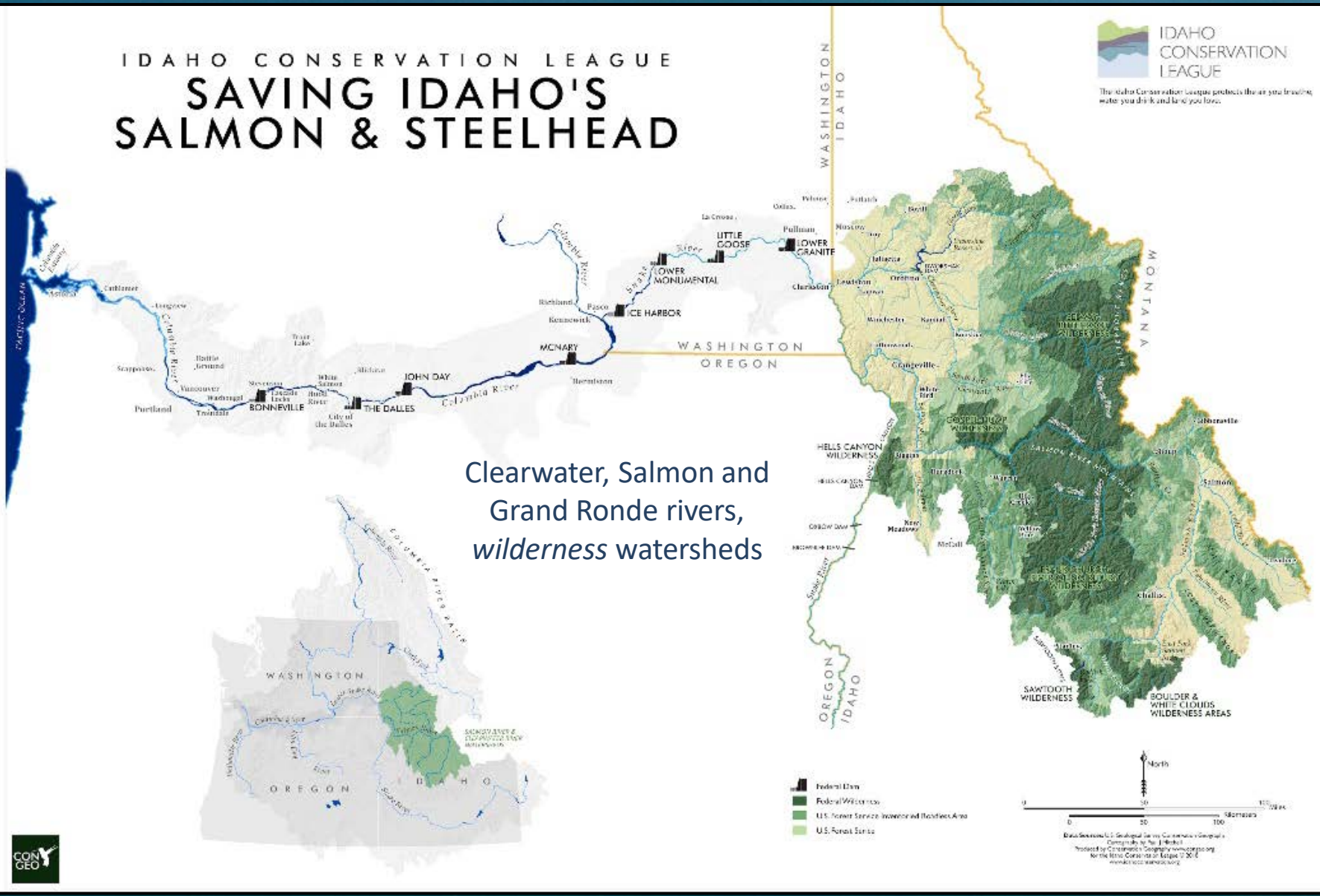
Photo by Katie Jones

"…*these animals are creatures of tradition*. They learn as a calf what constitutes food and how to catch it."

- Dr. John Ford, Fisheries and Oceans Canada

Chinook salmon are the *traditional* choice for Southern Resident orcas – about 80% of diet.

Photo: David Ellifrit, Center for Whale Research


IDAHO CONSERVATION LEAGUE
SAVING IDAHO'S SALMON & STEELHEAD
IDAHO CONSERVATION LEAGUE
WASHINGTON
IDAHO
OREGON
MONTANA
LITTLE GOOSE
LOWER GRANITE
LOWER MONUMENTAL
ICE HARBOR
MCNARY
JOHN DAY
THE DALLES
BONNEVILLE
Columbia River
Snake River
Portland
Vancouver
Pasco
Richland
Kennewick
Lewiston
Clarkston
Pullman
Moscow
Grangeville
Salmon
McCall
HELLS CANYON WILDERNESS
SAWTOOTH WILDERNESS
BOULDER & WHITE CLOUDS WILDERNESS AREAS
Clearwater, Salmon and Grand Ronde rivers, *wilderness* watersheds
Federal Dam
Federal Wilderness
U.S. Forest Service Inventoried Roadless Area
U.S. Forest Service
North

Southern Resident orca need salmon.
Breach the four Snake River dams

What would the breach look like?

All 4 dams have earthen berms that can removed, freeing the river.

The berms only need to be notched. The river will do the rest.