Resource Equivalency Analysis for Auklets & Ancient Murrelet
New Carissa Spill, February 1999

May 24, 2005

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The New Carissa oil spill killed approximately 588 Auklets and Ancient Murrelets in February 1999. Resource equivalency analysis (REA) is used to evaluate the direct loss (birds killed) and indirect loss (two generations of lost reproduction) over time. Details on the method used are provided in the report for Marbled Murrelets in the Seabirds section. The scaling and results of restoration projects are provided in the Restoration Results section. Complete citations are provided in a separate References section. All figures are converted to 2004 values (present value, or PV) using a 3% discount rate. The injury results and REA inputs are provided in the tables below.

Injury Results

Table 1
Total Lost Bird-Years (Debit)

Interim Losses	Lost Bird-Years in PV
Direct Injury	**1,414.53**
1st Generation	962.34
+ 2nd Generation	269.92
= Total Indirect Injury	**1,232.26**
Total Direct & Indirect Injury:	**2,646.79**

Table 2
Direct Injury by Age Class

Year	Discount Factor	Bird-Years by Age Class (0-1)	(1-2)	(2-3)	(3-4)	(4-5)	(5-6)	(6-7)	(7-8)	Total Lost Bird-Years	Total Lost Bird-Years in PV
1999	1.16	58.800	58.800	82.320	89.269	83.020	77.209	71.804	66.778	588.000	--
2000	1.13	0.000	50.568	53.508	74.911	81.235	75.548	70.260	65.342	471.372	530.533
2001	1.09	0.000	0.000	41.466	43.877	61.427	66.613	61.950	57.613	332.945	363.818
2002	1.06	0.000	0.000	0.000	34.002	35.979	50.370	54.622	50.799	225.772	239.522
2003	1.03	0.000	0.000	0.000	0.000	27.882	29.503	41.304	44.790	143.478	147.782
2004	1.00	0.000	0.000	0.000	0.000	0.000	22.863	24.192	33.869	80.924	80.924
2005	0.97	0.000	0.000	0.000	0.000	0.000	0.000	18.748	19.838	38.585	37.461
2006	0.94	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.373	15.373	14.491
Total										**1308.449**	**1414.531**

*Totals are rounded by the computer; hand calculations may not sum to those presented.

Table 3
Indirect Injury*

Year	Discount Factor	Total # Birds-- Reproduction Age	# Reproducing Females	# 1st Gen Fledglings	Bird-Years/ Fledge in PV	1st Gen Lost Bird-Years Total in PV	Total # Birds-- 1st Gen-- Reproduction Age	# Reproducing Females	# 2nd Gen Fledglings	Bird-Years/ Fledge in PV	2nd Gen Lost Bird-Years Total in PV
1999	1.16	388.080	155.232	97.796	2.605	254.796	0.000	0.000	0.000	0.000	0.000
2000	1.13	367.296	146.918	92.559	2.527	233.916	0.000	0.000	0.000	0.000	0.000
2001	1.09	291.479	116.592	73.453	2.451	180.062	0.000	0.000	0.000	0.000	0.000
2002	1.06	225.772	90.309	56.895	2.378	135.287	35.798	14.319	9.021	2.378	21.451
2003	1.03	143.478	57.391	36.156	2.307	83.396	63.235	25.294	15.935	2.307	36.755
2004	1.00	80.924	32.370	20.393	2.237	45.626	78.740	31.496	19.843	2.237	44.394
2005	0.97	38.585	15.434	9.723	2.170	21.102	85.393	34.157	21.519	2.170	46.701
2006	0.94	15.373	6.149	3.874	2.105	8.155	83.257	33.303	20.981	2.105	44.167
2007	0.92	0.000	0.000	0.000	0.000	0.000	62.464	24.986	15.741	2.042	32.142
2008	0.89	0.000	0.000	0.000	0.000	0.000	42.219	16.887	10.639	1.981	21.073
2009	0.86	0.000	0.000	0.000	0.000	0.000	26.069	10.428	6.569	1.921	12.622
2010	0.84	0.000	0.000	0.000	0.000	0.000	13.656	5.462	3.441	1.864	6.413
2011	0.81	0.000	0.000	0.000	0.000	0.000	6.291	2.516	1.585	1.808	2.866
2012	0.79	0.000	0.000	0.000	0.000	0.000	2.391	0.956	0.603	1.753	1.057
2013	0.77	0.000	0.000	0.000	0.000	0.000	0.641	0.256	0.162	1.701	0.275
Total		1550.987	620.395	390.849		**962.341**	500.155	200.062			**269.916**

*Totals are rounded by the computer; hand calculations may not sum to those presented.

REA Inputs

Table 4
Injury, Life History & Demographic Parameters

Parameter	REA Value	Reference
Species	Auklets & Ancient Murrelet	Morgue database
# killed (carcasses in hand)	214	Morgue database
# injured (rehabilitated birds)	1	Rehabilitation records
Estimated direct mortality (includes injured birds)	588	Morgue database; Ford *et al.* 2001
Confidence in mortality estimate	High	Ford *et al.* 2001
Age Distribution	10% 0-1 year old 10% 1-2 years old 14% 2-3 years old 66% 3+ years old	Calculated using age-specific survival rates and data from Lee & Sydeman 2004
Average life span	8 years	Lee & Sydeman 2004; Desanto & Nelson 1995
Age of first breeding	3 years	Lee & Sydeman 2004; Manuwal & Thoresen 1993; Desanto & Nelson 1995
Expected years of breeding	5 years	Average lifespan – age of first breeding
Percentage of adult females that breed	80%	Lee & Sydeman 2004; Manuwal & Thoresen 1993
# eggs/nest	1	Manuwal & Thoresen 1993; Desanto & Nelson 1995
Nesting success (% of nests that successfully fledge a chick)	63% 0.63 fledglings/pair	Lee & Sydeman 2004; Manuwal & Thoresen 1993; Desanto & Nelson 1995; Gaston & Dechesne 1996
Fecundity	0.72	Lee & Sydeman 2004
year 0-1 survival	0.62	Lee & Sydeman 2004
year 1-2 survival	0.72	Lee & Sydeman 2004
year 2-3 survival	0.82	Lee & Sydeman 2004; Desanto & Nelson 1995; Ainley *et al.* 1990a and 1990b; Bertram *et al.* 2000
years 3+ survival	0.82	Lee & Sydeman 2004; Desanto & Nelson 1995; Ainley *et al.* 1990a and 1990b; Bertram *et al.* 2000
Threatened or Endangered?	No	–
Locally overpopulated?	No	–
Additional factors affecting recovery	None	–

Source: Research and data were provided by Mike Szumski, Natural Resource Damage Assessment/Spill Response, US Fish & Wildlife Service, US Department of the Interior, 2600 SE 98th Ave., Suite 100, Portland, OR, 97266-1398, August 24, 2004, and finalized on May 5, 2005.

Table 5
Auklets & Ancient Murrelet Population Information

% of Total Population	Age	Age Distribution of 588 Birds*	Annual Survival Rate
10%	0–1	58.800	0.62
10%	1–2	58.800	0.72
14%	2–3	82.320	0.82
66%	3–4	89.269	
	4–5	83.020	
	5–6	77.209	
	6–7	71.804	
	7-8	66.778	
	Total:	588	

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