

**Resource Equivalency Analysis for Gulls & Kittiwakes
New Carissa Spill, February 1999**

May 24, 2005

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**Resource Equivalency Analysis for Gulls & Kittiwakes
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The New Carissa oil spill killed approximately 340 Gulls and Kittiwakes 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	1,595.79
1st Generation	3,292.06
+ 2nd Generation	3,209.19
= Total Indirect Injury	6,501.25
Total Direct & Indirect Injury:	8,097.04

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Table 2
Direct Injury by Age Class*

Discount Bird-Years by Age Class														Total Lost	Total Lost	
Year	Factor	(0-1)	(1-2)	(2-3)	(3-4)	(4-5)	(5-6)	(6-7)	(7-8)	(8-9)	(9-10)	(10-11)	(11-12)	(12-13)	Bird-Years	Bird-Years in PV
1999	1.16	98.600	34.000	27.200	23.800	23.800	20.400	20.400	17.000	17.000	17.000	13.600	13.600	13.600	340.000	--
2000	1.13	0.000	89.726	31.280	25.024	21.896	21.896	18.768	18.666	15.555	15.470	15.470	12.308	12.240	298.299	335.738
2001	1.09	0.000	0.000	75.370	28.778	23.022	20.144	20.144	17.173	17.079	14.155	14.078	14.000	11.077	255.021	278.668
2002	1.06	0.000	0.000	0.000	63.311	26.475	21.180	18.533	18.432	15.713	15.542	12.881	12.740	12.600	217.408	230.648
2003	1.03	0.000	0.000	0.000	0.000	53.181	24.357	19.486	16.957	16.865	14.299	14.143	11.657	11.466	182.413	187.885
2004	1.00	0.000	0.000	0.000	0.000	0.000	44.672	22.409	17.830	15.516	15.347	13.012	12.800	10.492	152.077	152.077
2005	0.97	0.000	0.000	0.000	0.000	0.000	0.000	37.524	20.504	16.314	14.120	13.966	11.776	11.520	125.724	122.062
2006	0.94	0.000	0.000	0.000	0.000	0.000	0.000	0.000	31.145	18.761	14.846	12.849	12.639	10.598	100.839	95.050
2007	0.92	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	25.851	17.073	13.510	11.628	11.375	79.437	72.696
2008	0.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21.198	15.536	12.226	10.465	59.425	52.799
2009	0.86	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.382	14.060	11.004	42.446	36.614
2010	0.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.079	12.654	26.734	22.389
2011	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.264	11.264	9.158
Total															1551.086	1595.785

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

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Table 3
Indirect Injury*

Year	Discount Factor	Total # Birds-- Reproduction Age	1st Gen Lost				Total # Birds--				2nd Gen Lost
			# Reproducing Females	# 1st Gen Fledglings	Bird-Years/ Fledge in PV	Bird-Years Total in PV	1st Gen-- Reproduction Age	# Reproducing Females	# 2nd Gen Fledglings	Bird-Years/ Fledge in PV	Bird-Years Total in PV
1999	1.16	132.600	59.670	96.665	4.133	399.490	0.000	0.000	0.000	0.000	0.000
2000	1.13	130.373	58.668	95.042	4.009	380.997	0.000	0.000	0.000	0.000	0.000
2001	1.09	127.851	57.533	93.203	3.888	362.418	0.000	0.000	0.000	0.000	0.000
2002	1.06	127.622	57.430	93.037	3.772	350.916	0.000	0.000	0.000	0.000	0.000
2003	1.03	129.232	58.154	94.210	3.659	344.683	0.000	0.000	0.000	0.000	0.000
2004	1.00	152.077	68.435	110.864	3.549	393.446	35.236	15.856	25.687	3.549	91.160
2005	0.97	125.724	56.576	91.653	3.442	315.509	64.242	28.909	46.832	3.442	161.218
2006	0.94	100.839	45.377	73.512	3.339	245.467	87.937	39.572	64.106	3.339	214.061
2007	0.92	79.437	35.747	57.909	3.239	187.567	107.532	48.389	78.391	3.239	253.906
2008	0.89	59.425	26.741	43.321	3.142	136.107	124.217	55.897	90.554	3.142	284.504
2009	0.86	42.446	19.101	30.943	3.048	94.301	143.968	64.786	104.953	3.048	319.850
2010	0.84	26.734	12.030	19.489	2.956	57.611	153.286	68.979	111.746	2.956	330.335
2011	0.81	11.264	5.069	8.211	2.867	23.545	154.163	69.373	112.385	2.867	322.258
2012	0.79	0.000	0.000	0.000	0.000	0.000	141.343	63.605	103.039	2.781	286.596
2013	0.77	0.000	0.000	0.000	0.000	0.000	125.406	56.432	91.421	2.698	246.651
2014	0.74	0.000	0.000	0.000	0.000	0.000	107.681	48.456	78.499	2.617	205.436
2015	0.72	0.000	0.000	0.000	0.000	0.000	88.724	39.926	64.680	2.539	164.192
2016	0.70	0.000	0.000	0.000	0.000	0.000	68.726	30.927	50.102	2.462	123.369
2017	0.68	0.000	0.000	0.000	0.000	0.000	47.825	21.521	34.864	2.389	83.273
2018	0.66	0.000	0.000	0.000	0.000	0.000	32.042	14.419	23.359	2.317	54.119
2019	0.64	0.000	0.000	0.000	0.000	0.000	20.451	9.203	14.909	2.247	33.506
2020	0.62	0.000	0.000	0.000	0.000	0.000	12.154	5.469	8.860	2.180	19.314
2021	0.61	0.00	0.000	0.000	0.000	0.000	6.501	2.925	4.739	2.115	10.021
2022	0.59	0.00	0.000	0.000	0.000	0.000	2.859	1.287	2.084	2.051	4.275
2023	0.57	0.00	0.000	0.000	0.000	0.000	0.792	0.357	0.578	1.990	1.149
Total		1,245.623	560.531	908.059		3,292.057	1,525.086	686.289			3,209.193

*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	Western Gull; Glaucous-winged; GW-WG hybrid; Bonaparte's Gull; Herring Gull; Mew Gull; Black-legged Kittiwake; Red-legged Kittiwake	Field Surveys
# birds killed (carcasses in hand)	150	Morgue database
# injured (rehabbed+observed birds)	85	Rehab records, Ford <i>et al.</i> 2001
Estimated direct mortality(includes injured birds)	340	Field Surveys, Ford <i>et al.</i> 2001
Confidence in mortality estimate	High	Ford et al. 2001
Age Distribution of Birds Killed (estimate)	age 0-1 = 29% age 1-2 = 10% age 2-3 = 8% age 3-4 = 7% age 4-5 = 7% age 5-6 = 6% age 6-7 = 6% age 7-8 = 5% age 8-9 = 5% age 9-10 = 5% age 10-11 = 4% age 11-12 = 4% age 12-13 = 4%	OSPR General Bird REA 2002
Average life span	13 years	Russell 1999; Pierotti & Annett 1995; Verbeek 1993. Calculated based on adult survival rate of 0.926
Age of first breeding	5 years	Russell 1999; Pierotti & Annett 1995; Verbeek 1993
Expected years of breeding	8 years	Average lifespan–Age of first breeding
% of adult females that breed	90%	Russell 1999
# eggs/nest	3 eggs	Penniman <i>et al.</i> 1990; Pierotti & Annett 1995; Verbeek 1993
Nesting success (% of nests that successfully fledge a chick)	54% 1.62 fledglings/pair	Penniman <i>et al.</i> 1990; Verbeek 1993

Parameter	REA Value	Reference
Year 0-1 survival	60%	Verbeek 1993; Baird 1994
Annual adult survival	age 1-2 = 75% age 2-3 = 82% age 3-7 = 84% age 7-9 = 83% age 9-11 = 82% age 11-12 = 81% age 12+ = 80%	Zafonte 2002
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, December 9, 2004, and finalized on May 7, 2005.

**Table 5
Population Information**

% of Total Population	Age	Age Distribution of 340 Birds*	Annual Survival Rate
29%	0-1	98.60	0.60
10%	1-2	34.00	0.75
8%	2-3	27.20	0.82
7%	3-4	23.80	0.84
7%	4-5	23.80	
6%	5-6	20.40	
6%	6-7	20.40	
5%	7-8	17.00	0.83
5%	8-9	17.00	
5%	9-10	17.00	0.82
4%	10-11	13.60	
4%	11-12	13.60	0.81
4%	12-13	13.60	0.80
Total:		340	

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