Resource Equivalency Analysis for Grebes
New Carissa Spill, February 1999

May 24, 2005

Prepared by:

Kristin E. Skrabis, Ph.D.
Resource Economist
Office of Policy Analysis, ms-4426
US Department of the Interior
1849 C Street, NW
Washington, DC 20240
202-208-4979 (phone)
202-208-4867 (fax)
Kristin_Skrabis@ios.doi.gov

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Table of Contents

Injury Results 1
REA Inputs 3

Tables

Table 1. Total Lost Bird-Years (Debit) 1
Table 2. Direct Injury by Age Class 1
Table 3. Indirect Injury 2
Table 4. Injury, Life History & Demographic Parameters 3
Table 5. Grebe Population Information 4

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The New Carissa oil spill killed approximately 111 Grebes 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	**460.93**
1st Generation	907.05
+ 2nd Generation	1,147.90
= Total Indirect Injury	**2,054.95**
Total Direct & Indirect Injury:	**2,515.88**

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)	(8-9)	(9-10)	Total Lost Bird-Years	Total Lost Bird-Years in PV
1999	1.16	17.538	10.545	18.194	15.101	12.534	10.403	8.634	7.167	5.948	4.937	111.000	--
2000	1.13	0.000	15.346	10.044	17.329	14.383	11.938	9.909	8.224	6.826	5.666	99.666	112.175
2001	1.09	0.000	0.000	13.888	9.090	15.683	13.017	10.804	8.967	7.443	6.178	85.070	92.958
2002	1.06	0.000	0.000	0.000	12.569	8.226	14.193	11.780	9.778	8.116	6.736	71.398	75.746
2003	1.03	0.000	0.000	0.000	0.000	11.375	7.445	12.845	10.661	8.849	7.345	58.519	60.274
2004	1.00	0.000	0.000	0.000	0.000	0.000	10.294	6.738	11.625	9.648	8.008	46.313	46.313
2005	0.97	0.000	0.000	0.000	0.000	0.000	0.000	9.316	6.098	10.520	8.732	34.666	33.656
2006	0.94	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.431	5.518	9.521	23.470	22.123
2007	0.92	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.630	4.994	12.624	11.553
2008	0.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.905	6.905	6.135
Total												**438.63**	**460.93**

*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	82.917	33.167	46.765	3.463	161.926	0.000	0.000	0.000	0.000	0.000
2000	1.13	84.320	33.728	47.556	3.359	159.726	0.000	0.000	0.000	0.000	0.000
2001	1.09	85.070	34.028	47.980	3.258	156.312	21.044	8.418	11.869	3.258	38.668
2002	1.06	71.398	28.559	40.268	3.160	127.254	40.446	16.178	22.811	3.160	72.087
2003	1.03	58.519	23.408	33.005	3.065	101.171	58.194	23.278	32.821	3.065	100.609
2004	1.00	46.313	18.525	26.120	2.973	77.666	70.786	28.315	39.923	2.973	118.708
2005	0.97	34.666	13.866	19.551	2.884	56.390	78.914	31.565	44.507	2.884	128.368
2006	0.94	23.470	9.388	13.237	2.798	37.033	83.171	33.268	46.908	2.798	131.234
2007	0.92	12.624	5.050	7.120	2.714	19.322	84.068	33.627	47.414	2.714	128.670
2008	0.89	6.905	2.762	3.895	2.632	10.252	82.038	32.815	46.270	2.632	121.797
2009	0.86	0.000	0.000	0.000	0.000	0.000	67.979	27.192	38.340	2.553	97.896
2010	0.84	0.000	0.000	0.000	0.000	0.000	53.644	21.458	30.255	2.477	74.935
2011	0.81	0.000	0.000	0.000	0.000	0.000	38.833	15.533	21.902	2.402	52.617
2012	0.79	0.000	0.000	0.000	0.000	0.000	26.990	10.796	15.222	2.330	35.473
2013	0.77	0.000	0.000	0.000	0.000	0.000	17.742	7.097	10.007	2.260	22.620
2014	0.74	0.000	0.000	0.000	0.000	0.000	10.768	4.307	6.073	2.193	13.316
2015	0.72	0.000	0.000	0.000	0.000	0.000	5.786	2.314	3.263	2.127	6.941
2016	0.70	0.000	0.000	0.000	0.000	0.000	2.556	1.022	1.442	2.063	2.974
2017	0.68	0.000	0.000	0.000	0.000	0.000	0.871	0.349	0.491	2.001	0.983
2018	0.66	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2019	0.64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020	0.62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total		506.202	202.481	285.498		**907.053**	743.830	297.532			**1,147.899**

*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/Clark's Grebe Horned Grebe Red-Necked Grebe Eared Grebe	Morgue database
# scoters & ducks killed (carcasses in hand)	83	Morgue database
# injured (rehabilitated birds)	5	Rehabilitation records
Estimated direct mortality (includes injured birds)	111	Morgue database; rehabilitation records; Ford *et al.* 2001
Confidence in mortality estimate	High	Ford *et al.* 2001
Age distribution	15.8% year 0-1 9.5% year 1-2 74.7% years 2+	OSPR Generic Bird REA
Average life span	10 years	Ivey 2003
Age of first breeding	2 years	Ivey 2003
Expected years of breeding	8 years	Average lifespan – Age of first breeding
Percentage of adult females that breed	80%	Johnsgard 1987; Stedman 2000
# eggs/nest	3 eggs/nest	Johnsgard 1987
Nesting success	65% 1.41 fledglings/pair	Storer & Nuechterlein 1992
Fecundity	0.70 young/individual	Storer & Nuechterlein 1992; Fjeldsa 1973
year 0-1 survival	0.60	Sperduto *et al.* 1999
year 1-2 survival	0.75	Interpolation
year 2+ survival	0.905	Based on mean lifespan of 10 years and Stout & Nuechterlein 1999
Threatened or Endangered?	No	–
Locally overpopulated?	No	–
Additional factors affecting recovery	No	–

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 30, 2004, and finalized on May 5, 2005.

Table 5
Grebe Population Information

% of Total Population	Age	Age Distribution of 111 Birds*	Annual Survival Rate
15.8%	0–1	17.538	0.70
9.5%	1–2	10.545	0.75
74.7%	2–3	18.194	0.905
	3–4	15.101	
	4–5	12.534	
	5–6	10.403	
	6–7	8.634	
	7-8	7.167	
	8-9	5.948	
	9-10	4.937	
	Total:	111	

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