Resource Equivalency Analysis for Scoters & Ducks
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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The New Carissa oil spill killed approximately 413 Scoters and ducks 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	**1,664.13**
1st Generation	4,240.55
+ 2nd Generation	6,597.15
= Total Indirect Injury	**10,837.70**
Total Direct & Indirect Injury:	**12,501.83**

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	52.864	34.279	71.499	59.345	49.256	40.882	33.932	28.164	23.376	19.402	413.000	--
2000	1.13	0.000	43.613	32.651	68.103	56.526	46.916	38.941	32.321	26.826	22.266	368.162	414.369
2001	1.09	0.000	0.000	39.470	29.549	61.633	51.156	42.459	35.241	29.250	24.278	313.036	342.063
2002	1.06	0.000	0.000	0.000	35.720	26.742	55.778	46.296	38.426	31.893	26.471	261.326	277.241
2003	1.03	0.000	0.000	0.000	0.000	32.327	24.201	50.479	41.898	34.775	28.863	212.544	218.920
2004	1.00	0.000	0.000	0.000	0.000	0.000	29.256	21.902	45.684	37.918	31.472	166.231	166.231
2005	0.97	0.000	0.000	0.000	0.000	0.000	0.000	26.476	19.821	41.344	34.315	121.957	118.405
2006	0.94	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23.961	17.938	37.416	79.316	74.763
2007	0.92	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21.685	16.234	37.919	34.701
2008	0.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	19.625	19.625	17.436
Total												**1,580.11**	**1,664.13**

*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	325.857	122.196	391.028	2.061	805.754	0.000	0.000	0.000	0.000	0.000
2000	1.13	324.549	121.706	389.459	1.999	778.445	0.000	0.000	0.000	0.000	0.000
2001	1.09	313.036	117.388	375.643	1.939	728.305	101.667	38.125	122.001	1.939	236.538
2002	1.06	261.326	97.997	313.592	1.881	589.758	193.268	72.476	231.922	1.881	436.166
2003	1.03	212.544	79.704	255.052	1.824	465.276	272.575	102.216	327.090	1.824	596.690
2004	1.00	166.231	62.336	199.477	1.770	352.976	328.214	123.080	393.857	1.770	696.934
2005	0.97	121.957	45.734	146.348	1.716	251.196	363.347	136.255	436.017	1.716	748.390
2006	0.94	79.316	29.743	95.179	1.665	158.466	380.693	142.760	456.832	1.665	760.594
2007	0.92	37.919	14.220	45.503	1.615	73.486	382.578	143.467	459.094	1.615	741.429
2008	0.89	19.625	7.359	23.550	1.567	36.891	370.980	139.117	445.176	1.567	697.383
2009	0.86	0.000	0.000	0.000	1.520	0.000	301.820	113.182	362.183	1.520	550.352
2010	0.84	0.000	0.000	0.000	1.474	0.000	233.705	87.640	280.446	1.474	413.365
2011	0.81	0.000	0.000	0.000	1.430	0.000	167.556	62.833	201.067	1.430	287.472
2012	0.79	0.000	0.000	0.000	1.387	0.000	114.950	43.106	137.939	1.387	191.300
2013	0.77	0.000	0.000	0.000	1.345	0.000	74.190	27.821	89.028	1.345	119.764
2014	0.74	0.000	0.000	0.000	1.305	0.000	43.804	16.427	52.565	1.305	68.591
2015	0.72	0.000	0.000	0.000	1.266	0.000	22.521	8.445	27.025	1.266	34.207
2016	0.70	0.000	0.000	0.000	1.228	0.000	9.246	3.467	11.096	1.228	13.623
2017	0.68	0.000	0.000	0.000	1.191	0.000	3.044	1.142	3.653	1.191	4.351
2018	0.66	0.000	0.000	0.000	1.155	0.000	0.000	0.000	0.000	1.155	0.000
2019	0.64	0.000	0.000	0.000	1.121	0.000	0.000	0.000	0.000	1.121	0.000
2020	0.62	0.000	0.000	0.000	1.087	0.000	0.000	0.000	0.000	1.087	0.000
Total		1,862.359	698.385	2,234.831		**4,240.554**	3,364.159	1,261.560			**6,597.148**

*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	Black Scoter Surf Scoter White-Winged Scoter Other waterfowl	Morgue database
# scoters & ducks killed (carcasses in hand)	202	Morgue database
# injured (rehabilitated birds)	45	Rehabilitation records
Estimated direct mortality (includes injured birds)	413	Morgue database; rehabilitation records; Ford *et al.* 2001
Confidence in mortality estimate	High	Ford *et al.* 2001
Age distribution	12.8% year 0-1 8.3% year 1-2 78.9% years 2+	OSPR Generic Bird REA
Average life span	10 years	Bordage & Savard 1995
Age of first breeding	2 years	Savard *et al.* 1998; Brown & Fredrickson 1997
Expected years of breeding	8 years	Average lifespan – Age of first breeding
Percentage of adult females that breed	75%	Sperduto *et al.* 1999
# eggs/nest	8 eggs/nest	Savard *et al.* 1998
Nesting success	40% 3.2 fledglings/pair	Bordage & Savard 1995; Savard *et al.* 1998
Fecundity	1.6 fledglings/individual	Sperduto *et al.* 1999
year 0-1 survival	0.40	Brown & Fredrickson 1997; North Cape Generic Scoter
year 1-2 survival	0.65	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	–	–

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

Table 5
Scoter & Ducks Population Information

% of Total Population	Age	Age Distribution of 413 Birds*	Annual Survival Rate
12.8%	0–1	52.864	0.40
8.3%	1–2	34.279	0.65
78.9%	2–3	71.499	0.905
	3–4	59.345	
	4–5	49.256	
	5–6	40.882	
	6–7	33.932	
	7-8	28.164	
	8-9	23.376	
	9-10	19.402	
	Total:	413	

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