

these actions on smelt survival and the interactions of project operations with other stressors on delta smelt health, fecundity and survival is needed. This information may provide justification for refining these actions to better address the needs of delta smelt. Studies like those of the IEP's POD workteam have provided much useful information on the needs of delta smelt and the stressors affecting them that was integral in the development of these actions.

Avoidance of Jeopardy and Adverse Modification

The conservation needs of the delta smelt at this time are primarily associated with: (1) protective measures for pre-spawning adult delta smelt; (2) improvement of flow conditions in the Central and South Delta so that larval and juvenile delta smelt can successfully rear and move downstream with a minimum entrainment risk; and (3) restoration and enhancement of habitat availability and quality that improves growth and survival of delta smelt.

The RPA components described above and in Attachment B specifically address the above factors to the extent provided by the regulatory criteria that define a RPA. Implementation of this RPA will increase the likelihood that delta smelt habitat conditions and attributes for migration, spawning, recruitment, growth, and survival will be provided during the term of the proposed action. For these reasons, the Service finds that implementation of the RPA described above is likely to avoid jeopardy to the delta smelt and adverse modification of its critical habitat.

Incidental Take Statement

Introduction

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be a prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary and must be implemented by Reclamation, working with DWR under the COA and other interagency agreements, in order for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activities that are covered by this Incidental Take Statement for the life of the proposed action. If Reclamation fails to assume and implement the RPA and terms and conditions or is unable to ensure that DWR adheres to the RPA and terms and conditions of this Incidental Take Statement while jointly operating under the COA and other interagency agreements, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impacts of incidental take, Reclamation must report the progress of the action and its impacts on the delta smelt to the Service as specified in this Incidental Take Statement. [50 CFR §402.14(i)(3)]

The Service developed the following Incidental Take Statement based on the premise that the RPA will be implemented. A detailed description of the rationale for the development of the incidental take statement is in Attachment C. This Incidental Take Statement assumes full implementation of the RPA.

Form of Take Anticipated

The Service anticipates that take of the delta smelt is likely to occur in the form of kill, capture (via salvage), wound, harm, and harass as a result of CVP/SWP operations within the action area, inclusive of activities at the NBA and at CCWD facilities, and in conjunction with studies to determine screening criteria and to improve delta smelt handling and survival in the salvage process. The above forms of take will result in the injury or death of delta smelt. This Incidental Take Statement addresses all of the above.

Amount or Extent of Take

Take of Delta Smelt at the NBA and CCWD Facilities

The Service anticipates that incidental take of delta smelt at the NBA and at the CCWD diversions will be difficult to detect since no monitoring program samples for entrainment at these facilities on a regular basis. Incidental take is not expected to be high since the other diversions have fish screens and the unscreened Rock Slough diversion is at a dead end slough where delta smelt are not usually present. Due to the difficulty in quantifying the number of delta smelt that will be taken as a result of the proposed action, the Service is quantifying incidental take for the NBA and the CCWD diversion to be all delta smelt inhabiting the water diverted at these facilities under the conditions of 71 TAF per year at the NBA and 195 TAF at the CCWD diversions.

Take of Adult Delta Smelt

The Service anticipates that take of adult delta smelt via entrainment will be minimized when OMR flows are limited to -2,000 cfs during the first winter flush when adult smelt move within the zone of entrainment. OMR flows held between -1,250 and -5,000 cfs following the first flush until the onset of spawning will protect later delta smelt migrants and spawners. During frequent intervals within the timeframe for RPA Component 1, the SWG shall provide specific OMR flow recommendations to the Service; and the Service

shall then determine flow requirements using the adaptive process as described in the RPA.

To estimate take with implementation of the RPA, the Service scaled projected salvage to abundance using the estimates provided by the prior year's FMWT Index (further details on the methods used in developing the Incidental Take Statement can be found in Attachment C). The segregation of year types is based upon descriptive statistics comprising quartiles, as expressed in Figure C-1 of Attachment C, and quantified following the approach described below.

The Cumulative Salvage Index (CSI) is calculated as the total year's adult salvage (the aggregate number for expanded salvage at both the Banks and Jones export facilities for the period December through March) divided by the previous year's FMWT Index. Water years 2006 to 2008 were years in which salvage, negative OMR flows, and delta smelt abundance were all lower relative to the historic values. The Service therefore believes these years within the historic dataset best approximate expected salvage under RPA Component 1.

The average CSI value for WYs 2006 to 2008 was 7.25. Projecting this average rate of salvage to the years in which CVP/SWP operations will be conducted within the sideboards established by the RPA would yield estimates of salvage at 7.25 times the prior year's FMWT Index. The Service used this estimator to predict incidental take levels of adult delta smelt during each year that the RPA's will be in effect. This value, which can be calculated upon release of the final FMWT Index within the current water year, is regarded as the incidental take for adult delta smelt under the RPA.

Incidental Take: Cumulative Expanded Salvage = 7.25 * Prior Year's FMWT Index

Delta smelt abundance is critically low, and without habitat quality conditions to appreciably improve juvenile growth and rearing from recent historic levels, is expected to remain so for the foreseeable future. The current population cannot tolerate direct mortality through adult entrainment at levels approaching even "moderate" take as observed through the historic record of recent decades. The method utilized herein to calculate take contains uncertainty within the estimates, and this fact translates into population-level risk. Further, there is a recognized need to provide a quantitative framework so that the Service and CVP/SWP operators have a common analytical methodology for reference and to further guide the adaptive process.

Therefore, the Service is also providing a Concern Level estimate, meant to indicate salvage levels approaching the take threshold, and help guide implementation of the RPA. Reaching this expanded salvage figure within a given season may require that OMR flows be set to a more restrictive level, unless available data indicate some greater level of exports is possible without increasing entrainment (e.g., there is strong reason to presume the pre-spawning migration has passed). Throughout the water year, as the SWG convenes and reviews daily salvage data, reaching the Concern Level for adult salvage requires an immediate specific recommendation to the Service.

The Service believes this Concern Level value should trigger at 75 percent of the calculated adult incidental take, as an indicator that operations may need to be more constrained to avoid exceeding the incidental take.

Concern Level: Cumulative Expanded Salvage = 5.43 * Prior Year's FMWT Index

Table IT-1 lists threshold levels of concern and incidental take for a range of potential FMWT indices. This table is intended to be used as a reference to discern levels of salvage reflecting the range of expected adult delta smelt mortality with implementation of the RPA, and as an indicator of adult delta smelt salvage levels that constitutes an increasing adverse effect to the delta smelt population due to CVP/SWP operations.

Table IT-1: Incidental Take Expanded Salvage Numbers by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	11	15	66	359	479	220	1197	1596	550	2992	3989
4	22	29	72	392	522	240	1305	1741	560	3046	4061
6	33	44	78	424	566	260	1414	1886	570	3100	4134
8	44	58	84	457	609	280	1523	2031	580	3155	4206
10	54	73	90	490	653	300	1632	2176	590	3209	4279
12	65	87	96	522	696	320	1741	2321	600	3264	4351
14	76	102	100	544	725	340	1849	2466	620	3372	4496
16	87	116	102	555	740	360	1958	2611	640	3481	4642
18	98	131	104	566	754	380	2067	2756	660	3590	4787
20	109	145	106	577	769	400	2176	2901	680	3699	4932
22	120	160	108	587	783	420	2285	3046	700	3808	5077
24	131	174	110	598	798	460	2502	3336	720	3916	5222
26	141	189	120	653	870	480	2611	3481	740	4025	5367
28	152	203	130	707	943	500	2720	3626	760	4134	5512
30	163	218	140	762	1015	502	2731	3641	780	4243	5657
34	185	247	150	816	1088	504	2741	3655	800	4351	5802
38	207	276	160	870	1160	506	2752	3670	840	4569	6092
42	228	305	170	925	1233	510	2774	3699	880	4787	6382
48	261	348	180	979	1305	520	2828	3771	920	5004	6672
54	294	392	190	1033	1378	530	2883	3844	960	5222	6962
60	326	435	200	1088	1450	540	2937	3916	1000	5439	7252

Take of Larval and Juvenile Delta Smelt

The Service has largely followed the methodology for estimating incidental take of larval delta smelt similar to that utilized for adults. Specifically, an average of the last four years (2005-2008) cumulative larval/juvenile salvage by month (April through July) was calculated. This can be summarized as a Juvenile Salvage Index (JSI), calculated as:

**Monthly Juvenile Salvage Index = cumulative seasonal ≥ 20 mm salvage by month
and divided by current WY FMWT Index**

The mean values from 2005-2008 were used as an estimate of take under the RPA. The reason for selecting this span of years is that the apparent abundance of delta smelt since 2005 as indexed by the 20-mm Survey and the TNS is the lowest on record. It was necessary to separate out this abundance variable, but also to account for other poorly understood factors relating salvage to OMR, distribution, and the extant conditions. On a monthly basis (cumulative salvage across the spring), this estimate represents a concern level where entrainment has reached high enough numbers to indicate the need for more protective OMR restrictions. The cumulative salvage figures in the Incidental Take Statement reflect totals beginning with the first seasonal juvenile salvage through the end of the current month (i.e., prior month totals are added to the succeeding month's values). The tables provided cover the full month to the final day of the applicable calendar month.

Concern Level = Monthly JSI 2005-2008 mean * Current WY FMWT

The last four years average monthly cumulative salvage was used to calculate the concern level for larval/juvenile smelt, as opposed to the incidental take under the RPA. It is acknowledged that salvage across years will be variable, as distribution, spawning success, prior entrainment of adults, enhanced survival of <20 mm larval delta smelt under the RPA, and extant natural conditions determine. As mentioned above, this constrains predictability of take using this methodology, and is less reliable overall as the method used for adults. Also, it is believed that individuals of the larval/juvenile lifestage are less demographically significant than adults. Given these considerations, the incidental take estimate for ≥ 20 mm larval/juvenile delta smelt under the RPA will be above the four year average by 50 percent.

Larval/Juvenile Incidental Take = 1.5 * Concern Level

Lookup tables relating (current WY) FMWT to concern level and incidental take for cumulative salvage by month appears in Table IT-2 through IT-5, below.

Table IT-2: April Cumulative ≥ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	1	1	102	30	45	502	147	221
4	1	2	104	30	46	504	148	222
6	2	3	106	31	47	506	148	223
8	2	4	108	32	47	510	150	224
10	3	4	110	32	48	520	152	229
12	4	5	120	35	53	530	155	233
14	4	6	130	38	57	540	158	237
16	5	7	140	41	62	550	161	242
18	5	8	150	44	66	560	164	246
20	6	9	160	47	70	570	167	251
22	6	10	170	50	75	580	170	255
24	7	11	180	53	79	590	173	259
26	8	11	190	56	84	600	176	264
28	8	12	200	59	88	620	182	273
30	9	13	220	64	97	640	188	281
34	10	15	240	70	106	660	193	290
38	11	17	260	76	114	680	199	299
42	12	18	280	82	123	700	205	308
48	14	21	300	88	132	720	211	317
54	16	24	320	94	141	740	217	325
60	18	26	340	100	150	760	223	334
66	19	29	360	106	158	780	229	343
72	21	32	380	111	167	800	235	352
78	23	34	400	117	176	840	246	369
84	25	37	420	123	185	880	258	387
90	26	40	460	135	202	920	270	405
96	28	42	480	141	211	960	281	422
100	29	44	500	147	220	1000	293	440

Table IT-3: May Cumulative $\geq$ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	26	39	102	1329	1994	502	6543	9815
4	52	78	104	1356	2033	504	6569	9854
6	78	117	106	1382	2072	506	6595	9893
8	104	156	108	1408	2112	510	6647	9971
10	130	196	110	1434	2151	520	6778	10167
12	156	235	120	1564	2346	530	6908	10362
14	182	274	130	1694	2542	540	7038	10558
16	209	313	140	1825	2737	550	7169	10753
18	235	352	150	1955	2933	560	7299	10949
20	261	391	160	2085	3128	570	7429	11144
22	287	430	170	2216	3324	580	7560	11340
24	313	469	180	2346	3519	590	7690	11535
26	339	508	190	2476	3715	600	7821	11731
28	365	547	200	2607	3910	620	8081	12122
30	391	587	220	2868	4301	640	8342	12513
34	443	665	240	3128	4692	660	8603	12904
38	495	743	260	3389	5083	680	8863	13295
42	547	821	280	3650	5474	700	9124	13686
48	626	938	300	3910	5865	720	9385	14077
54	704	1056	320	4171	6256	740	9645	14468
60	782	1173	340	4432	6647	760	9906	14859
66	860	1290	360	4692	7038	780	10167	15250
72	938	1408	380	4953	7429	800	10427	15641
78	1017	1525	400	5214	7821	840	10949	16423
84	1095	1642	420	5474	8212	880	11470	17205
90	1173	1760	460	5996	8994	920	11991	17987
96	1251	1877	480	6256	9385	960	12513	18769
100	1303	1955	500	6517	9776	1000	13034	19551

Table IT-4: June Cumulative ≥ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	66	99	102	3369	5053	502	16578	24868
4	132	198	104	3435	5152	504	16644	24967
6	198	297	106	3501	5251	506	16711	25066
8	264	396	108	3567	5350	510	16843	25264
10	330	495	110	3633	5449	520	17173	25759
12	396	594	120	3963	5944	530	17503	26255
14	462	694	130	4293	6440	540	17833	26750
16	528	793	140	4623	6935	550	18164	27245
18	594	892	150	4954	7431	560	18494	27741
20	660	991	160	5284	7926	570	18824	28236
22	727	1090	170	5614	8421	580	19154	28732
24	793	1189	180	5944	8917	590	19485	29227
26	859	1288	190	6275	9412	600	19815	29722
28	925	1387	200	6605	9907	620	20475	30713
30	991	1486	220	7265	10898	640	21136	31704
34	1123	1684	240	7926	11889	660	21796	32695
38	1255	1882	260	8586	12880	680	22457	33685
42	1387	2081	280	9247	13870	700	23117	34676
48	1585	2378	300	9907	14861	720	23778	35667
54	1783	2675	320	10568	15852	740	24438	36657
60	1981	2972	340	11228	16843	760	25099	37648
66	2180	3269	360	11889	17833	780	25759	38639
72	2378	3567	380	12549	18824	800	26420	39630
78	2576	3864	400	13210	19815	840	27741	41611
84	2774	4161	420	13870	20806	880	29062	43593
90	2972	4458	460	15191	22787	920	30383	45574
96	3170	4756	480	15852	23778	960	31704	47556
100	3302	4954	500	16512	24769	1000	33025	49537

Table IT-5: July Cumulative $\geq$ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	75	112	102	3822	5732	502	18808	28213
4	150	225	104	3897	5845	504	18883	28325
6	225	337	106	3971	5957	506	18958	28437
8	300	450	108	4046	6070	510	19108	28662
10	375	562	110	4121	6182	520	19483	29224
12	450	674	120	4496	6744	530	19857	29786
14	525	787	130	4871	7306	540	20232	30348
16	599	899	140	5245	7868	550	20607	30910
18	674	1012	150	5620	8430	560	20981	31472
20	749	1124	160	5995	8992	570	21356	32034
22	824	1236	170	6369	9554	580	21731	32596
24	899	1349	180	6744	10116	590	22105	33158
26	974	1461	190	7119	10678	600	22480	33720
28	1049	1574	200	7493	11240	620	23229	34844
30	1124	1686	220	8243	12364	640	23979	35968
34	1274	1911	240	8992	13488	660	24728	37092
38	1424	2136	260	9741	14612	680	25477	38216
42	1574	2360	280	10491	15736	700	26227	39340
48	1798	2698	300	11240	16860	720	26976	40464
54	2023	3035	320	11989	17984	740	27725	41588
60	2248	3372	340	12739	19108	760	28475	42712
66	2473	3709	360	13488	20232	780	29224	43836
72	2698	4046	380	14237	21356	800	29973	44960
78	2922	4384	400	14987	22480	840	31472	47208
84	3147	4721	420	15736	23604	880	32971	49456
90	3372	5058	460	17235	25852	920	34469	51704
96	3597	5395	480	17984	26976	960	35968	53952
100	3747	5620	500	18733	28100	1000	37467	56200

Effect of the Take

The Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat when the RPA is implemented.

Attachment C: Methods Used in Developing the Incidental Take Statement

Methods Used in Developing the Incidental Take Statement

The objective adopted by the Service to minimize take of adult delta smelt through entrainment is two-fold. First, adult entrainment shall be minimized during all year types through the RPA. More critically, demographic losses from periodic episodes of high entrainment will be eliminated through implementation of the RPA. These outcomes shall be accomplished through the application of measures as defined in RPA Components 1 and 2.

Adoption of the RPA included in this biological opinion is expected to appreciably reduce the number of delta smelt salvaged during certain years. Implementation of the RPA should avoid significant mortality during those years of high entrainment. The Service believes these high salvage year events (such as in WY 2003 for adult delta smelt) resulted in mortality at levels that were demographically significant to the delta smelt population. Further, at low abundances observed in the last few years, high entrainment events (observed more frequently, for adult delta smelt in 2003, 2004, and 2005, successively) further reduces the resilience of the current delta smelt population.

The Service anticipates that take of adult delta smelt via entrainment will be minimized when OMR flows are limited to -2,000 cfs during the first winter flush when adult smelt move within the zone of entrainment. OMR flows held between -1,250 and -5,000 cfs following the first flush until the onset of spawning will protect later delta smelt migrants and spawners. During frequent intervals within the timeframe for RPA Component 1, the SWG shall provide specific OMR flow recommendations to the Service; and the Service will then determine flow requirements using the adaptive process as described in the RPA.

This approach was adopted because it reflects the most reasonable strategy to allow continued CVP/SWP operations while providing necessary protection to the delta smelt population under real-time conditions. It accounts for uncertainty of adult smelt entrainment risk resulting from variable environmental, demographic, and operational conditions; and adapts operations in response to real-time data.

The specific level of take of adult delta smelt at the CVP/SWP pumping facilities is difficult to definitively project, due to inherent uncertainties. First, the only data available from which to derive population estimates come from monitoring that is not specifically designed to assess the abundance of delta smelt. Distribution of adult smelt is highly variable between years, and is driven by factors that are both inherently difficult to predict and also not completely understood. These factors are, at best, imperfectly controlled. Additionally, salvage data (our most definitive measurement endpoint) reflects only a portion of the total mortality associated with entrainment. Losses to predation and inefficient screening are significant, but unknown. Finally, salvage itself is clearly at least partially a function of abundance. In other words, the more delta smelt there are out there, the higher the salvage numbers will be, given the same operational conditions and delta smelt distribution. In short, entrainment and the population-level

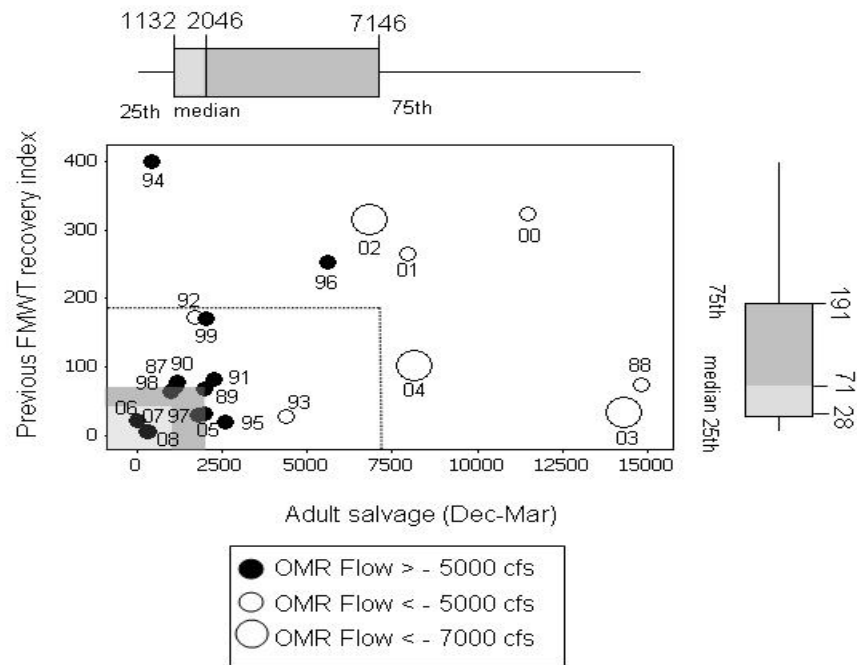
effect from direct mortality attributed to pumping is a multivariate and complex process, and this complexity defies ready predictive modeling.

The Service in past take statements has relied upon historic salvage as the most reasonable predictor of future salvage. Adult delta smelt salvage data (grouped by sorting entrainment years into quartiles by the total number salvaged between December and March) can be plotted by year and related to delta smelt population abundance and flows as shown in Figure C-1. The historic (1987-2007) median salvage levels with 25th and 75th percentiles are plotted versus the preceding FMWT Recovery Index (RI). The RI provides an indication of the status of the delta smelt population based on distributional and abundance criteria from a subset of September and October FWMT sampling data (Service 1995). A low RI indicates the delta smelt population is at a low level, whereas a high RI value (~400) indicates a larger population. Figure 1 uses 1987 to 2007 as the historic baseline dataset for this analysis because these years represent the period after which delta smelt experienced coincident declines in abundance and habitat quality (Feyrer et al. 2007), and because these are years for which salvage data are considered most reliable.

One benchmark for determining the severity of salvage is the 25th percentile (first quartile) of recent historic winter salvage of delta smelt at the CVP/SWP export facilities. For reference, the first quartile historic salvage count for 1987 through 2007 is 1,132 adult delta smelt, while the median value during this same interval is 2,046 individuals. Salvage above these levels is likely to lead to large losses of spawning delta smelt relative to the mean population size. For example, in 2003 and 2004, the projects salvaged 14,323 and 8,148 adult delta smelt respectively. These losses are disproportionately high (i.e., greater than the 75th percentile of historical salvage) for their given RI values, 33 (2003) and 101 (2004), respectively. According to Kimmerer (2008), 2003 and 2004 were years when entrainment accounted for 50 percent and 19 percent losses, respectively, of adults from the population. These are very high loss rates even by commercial fishery standards and for delta smelt, with such low population numbers, it is an even greater concern.

As presented in Figure C-1, using a rough estimate of expected future flows based on implementation of the RPA (i.e., >5,000 cfs OMR) and when abundance indices are low (based on RI), adult salvage levels during WY's 2006, 2007, and 2008 best approximates adult salvage numbers expected in the future.

Figure C-1. Adult delta smelt salvage levels in relation to OMR flows and the FMWT RI for the period 1987-2007.



To estimate take with implementation of the RPA, the Service scaled projected salvage to abundance using the estimates provided by the prior year's FMWT Index (note that this differs somewhat from Figure C-1, which used the RI, reflecting a subset of FMWT Index data). The segregation of year types is based upon descriptive statistics comprising quartiles, as expressed above in Figure C-1, and quantified following the approach described below.

A Cumulative Salvage Index

The Cumulative Salvage Index (CSI) is calculated as the total year's adult salvage (the aggregate number for expanded salvage at both the Banks and Jones export facilities for the period December through March) divided by the previous year's FMWT Index. Taking all water year types together (regardless of abundance or OMR flows in a given year), the median CSI value for the period 1993 to 2008 is 12.0. The first and third quartile CSI values for this period are 6 and 26, respectively. These data are summarized below in Table C-1.

Incidental Take for Adult Entrainment (Salvage)

Water years 2006 to 2008 were years in which salvage, negative OMR flows, and delta smelt abundance were all relatively lower relative to the historic values. These are the

only three years of lower negative OMR flows which coincided with salvage values below the first quartile within the historic range and low overall adult delta smelt abundances (below first quartile FMWT Index). The corresponding CSI values are: 8.3 (2006), 0.88 (2007), and 12.6 (2008). The Service therefore believes these years within the historic dataset best approximate expected salvage under the RPA Component 1.

The mean value for adult salvage during WYs 2006 to 2008 is 247 adult delta smelt. The average CSI value for WYs 2006 to 2008 was 7.25. Projecting this average rate of salvage to the years in which CVP/SWP operations will be conducted within the sideboards established by the RPA would yield estimates of salvage at 7.25 times the prior year's FMWT Index. The Service use this estimator to predict incidental take levels of adult delta smelt during each year that the RPA's will be in effect. This value, which can be calculated upon release of the final FMWT Index within the current water year, is regarded as the incidental take for adult delta smelt under the RPA.

Incidental Take: Cumulative Expanded Salvage = 7.25 * Prior Year's FMWT Index

As indicated in Table C-1, for the entire span of WY's since 1993, this numerical salvage threshold would have been exceeded in WY's 1993, 1995, and 2003-2005.

**Table C-1: Adult Salvage Summary Statistics
1993-2008**

Year	FMWT Index	Adult Salvage	Cumulative Salvage Index	Take Threshold
1993	156	4425	28.4	X
1994	1078	359	0.33	
1995	102	2608	25.6	X
1996	899	5628	6.3	
1997	127	1828	14.4	
1998	303	1027	3.4	
1999	420	2074	4.9	
2000	864	11505	13.3	
2001	756	8015	10.6	
2002	603	6865	11.4	
2003	139	14338	103	X
2004	210	8058	38.4	X
2005	74	2018	27.3	X
2006	26	216	8.3	
2007	41	36	0.88	
2008	28	352	12.6	
min	26	36	0.33	
max	1078	14338	103	
mean	364	4335	19.3	
25th	95.0	860.0	5.9	
median	183	2341	12.0	
75th	641.3	7152.5	26.0	

High Concern Level for Adult Entrainment (Salvage)

Delta smelt abundance is critically low, and without habitat quality conditions to appreciably improve juvenile growth and rearing from recent historic levels, is expected

to remain so for the foreseeable future. The current population cannot tolerate direct mortality through adult entrainment at levels approaching even “moderate” take as observed through the historic record of recent decades. The method utilized herein to calculate take contains uncertainty within the estimates, and this fact translates into population-level risk. Further, there is a recognized need to provide a quantitative framework so that the Service and CVP/SWP operators have a common analytical methodology for reference and to further guide the adaptive process.

Therefore, the Service is also providing a Concern Level estimate, meant to indicate salvage levels approaching the take threshold, and help guide implementation of the RPA. Reaching this expanded salvage figure within a given season may require that OMR flows be set to a more restrictive level, unless available data indicate some greater level of exports is possible without increasing entrainment (e.g., there is strong reason to presume the pre-spawning migration has passed). Throughout the water year, as the SWG convenes and reviews daily salvage data, reaching the Concern Level for adult salvage requires an immediate specific recommendation to the Service.

The Service believes this Concern Level value should trigger at 75 percent the adult incidental take, as an indicator that operations need to be more constrained to avoid exceeding the incidental take.

Concern Level: Cumulative Expanded Salvage = $5.43 * \text{Prior Year's FMWT Index}$

The rationale for a value approaching 75 percent (as opposed to 50 percent, for example), is that the window for adult entrainment, once begun, is generally short (~1 month), and it is not expected that aggressive pumping restrictions would continue for long durations once salvage is occurring and data are available. The SWG will take timing into account during interpretation of salvage within a given season, and recommend OMR restrictions to the Service accordingly.

For reference purposes, the population level losses reported in Kimmerer (2008) appear in Table 2 compared to our CSI metric. Caution is necessary when comparing field data to take estimates from population models due to; (1) their high inherent predictive uncertainty based on broad underlying assumptions and limited monitoring methodology, (2) the crude discriminative capacity of the inherent methodology utilized within the CSI-derived risk thresholds, and (3) the paucity of available data. However, regressing the Kimmerer (2008) estimates against the CSI approach in order to make this comparison ($y = 0.4539x + 1.8905$; $r^2 = 0.9105$) yields an expected take under implementation of the RPA defined herein approximating delta smelt population level losses during the adult lifestage to around 5 percent. The concern level would roughly approximate salvage of 4 percent of the adult pre-spawning population.

Table C-2. Cumulative Salvage Index in comparison to adult take estimates in Kimmerer (2008).

Year	Estimate	Lower 95% Confidence Boundary	Upper 95% Confidence Boundary	FMWT Recovery Index	Total Salvage	CSI
2002	15	5	24	603	6865	11.4
2003	50	19	69	139	14338	103
2004	19	6	31	210	8058	38.4
2005	7	2	12	74	2018	27.3
2006	4	1	6	26	216	8.3

Table C-3 lists threshold levels of high concern and incidental take for a range of potential FMWT indices. This table is intended to be used as a reference to discern levels of salvage reflecting the range of expected adult delta smelt mortality with implementation of the RPA, and an indicator of adult delta smelt salvage levels that constitutes an increasing and adverse effect to the delta smelt population due to CVP/SWP operations.

Table C-3: Incidental Take Expanded Salvage Numbers by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	11	15	66	359	479	220	1197	1596	550	2992	3989
4	22	29	72	392	522	240	1305	1741	560	3046	4061
6	33	44	78	424	566	260	1414	1886	570	3100	4134
8	44	58	84	457	609	280	1523	2031	580	3155	4206
10	54	73	90	490	653	300	1632	2176	590	3209	4279
12	65	87	96	522	696	320	1741	2321	600	3264	4351
14	76	102	100	544	725	340	1849	2466	620	3372	4496
16	87	116	102	555	740	360	1958	2611	640	3481	4642
18	98	131	104	566	754	380	2067	2756	660	3590	4787
20	109	145	106	577	769	400	2176	2901	680	3699	4932
22	120	160	108	587	783	420	2285	3046	700	3808	5077
24	131	174	110	598	798	460	2502	3336	720	3916	5222
26	141	189	120	653	870	480	2611	3481	740	4025	5367
28	152	203	130	707	943	500	2720	3626	760	4134	5512
30	163	218	140	762	1015	502	2731	3641	780	4243	5657
34	185	247	150	816	1088	504	2741	3655	800	4351	5802
38	207	276	160	870	1160	506	2752	3670	840	4569	6092
42	228	305	170	925	1233	510	2774	3699	880	4787	6382
48	261	348	180	979	1305	520	2828	3771	920	5004	6672
54	294	392	190	1033	1378	530	2883	3844	960	5222	6962
60	326	435	200	1088	1450	540	2937	3916	1000	5439	7252

Take of Larval and Juvenile Delta Smelt

In contrast to adult delta smelt, there is no well established index of larval and juvenile abundance to reliably scale the take of this lifestage to abundance. Indices of abundance are constructed from fishery surveys performed by DFG (Figure C-2). The DFG has monitored the distribution and relative abundance of larval and post-larval delta smelt throughout their spring range since 1995. This survey is named the 20-mm survey for the size at which delta smelt are retained and readily identified by the fish salvage facilities, and provides near-real time information on larval abundance and distribution for individuals that have reached this size class. There is no established way to measure and document take of larval smelt below this size. Protection of this age class is afforded through the RPA, when setting OMR restrictions, but there is no reliable means to assess performance until later in the season when >20mm larvae are present. This should be kept in mind in light of salvage numbers, pre-emptive OMR prescriptions based on salvage predictions, and the take statement for the earlier part of the spring season (i.e., April).

Historically, as with adults, larval and juvenile delta smelt salvage has varied widely, as a function of overall abundance, distribution and Delta hydrology (Figures C-3 and C-4). This variability makes prediction of salvage of larvae and juvenile delta smelt difficult. In order for a survey to have significant predictive value, it must precede the period of entrainment with as few confounding variables (intervening factors) between the estimate and the event as possible. Larval and juvenile take cannot be scaled to either the 20-mm Survey Index or the TNS Index because both surveys overlap the period during which the salvage occurs. Further, as migration, spawning distribution and success, adult delta smelt entrainment and mortality (due to quantifiable and unquantified variables) occur between the FMWT (the parental generation) and salvage of their progeny (the following April through July); it is difficult to infer actual larval abundance reliably through the next spring. This dilutes the statistical reliability of the calculation of a larval/juvenile salvage index, corresponding to the CSI for adult delta smelt. However, review of the salvage data relative to actual OMR values within a given year does reveal that a relationship of fall parental abundance to salvage of progeny exists—enough so such that predictability does increase through scaling to current water year FMWT.

The Service has therefore largely followed the methodology for estimating incidental take of larval delta smelt similar to that utilized for adults. Specifically, an average of the last four years (2005-2008) cumulative larval/juvenile salvage by month (April through July) was calculated. This can be summarized as a Juvenile Salvage Index (JSI), calculated as:

**Monthly Juvenile Salvage Index = cumulative seasonal salvage $\geq$ 20 mm by month
end divided by current WY FMWT Index**

The mean values from 2005-2008 were used as an initial estimate of take under the RPA. The reason for selecting this span of years is that the apparent abundance of delta smelt since 2005 as indexed by the 20-mm Survey and the TNS is the lowest on record (Table

Concern Level = Monthly JSI 2005-2008 mean * Current WY FMWT

Larval/Juvenile Incidental Take = 1.5 * Concern Level

Adult Entrainment			Juvenile Entrainment							Adult	
							Fall Mid-Water Trawl				
			Tow-Net Survey								
			20-mm Survey								
Spring Kodiak Trawl											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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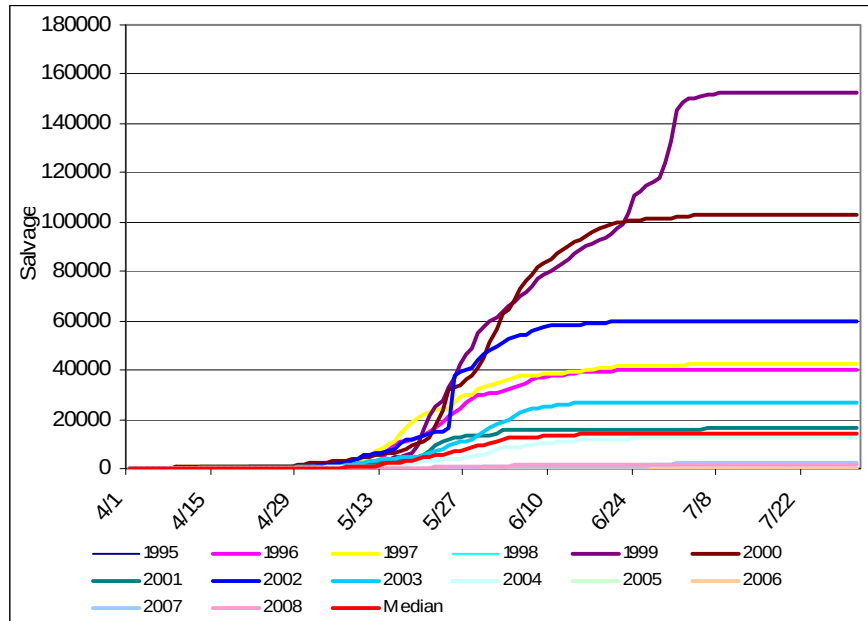


Figure C-3. Cumulative salvage of larval and juvenile delta smelt, 1995 through 2008.

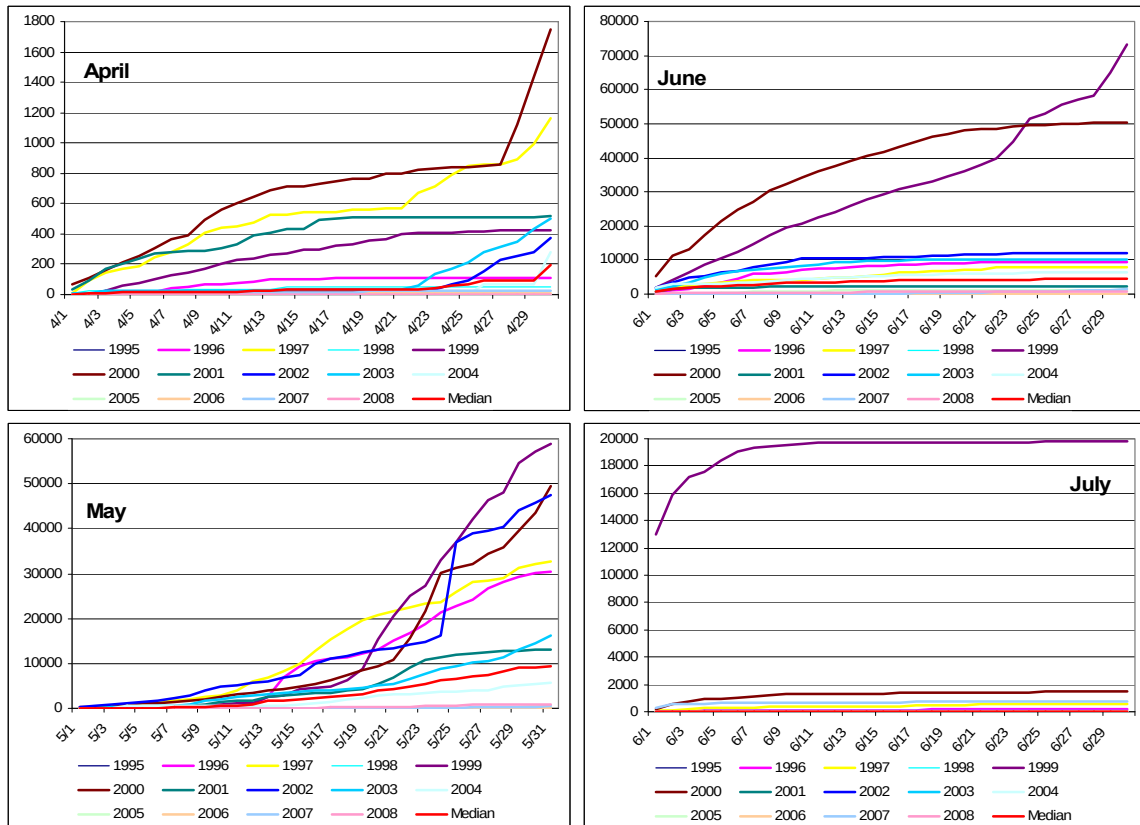


Figure C-4. Cumulative salvage of larval and juvenile delta smelt, 1995-2008, by month.

Table C-4. Larval/juvenile ≥ 20 mm delta smelt abundance and salvage statistics.

Water Year	Prior Year FMWT Index	20-mm Index	STNS	Salvage	Juvenile Salvage Index
1995	102	4.4	3.2	24	0.2
1996	899	33.9	11.1	40099	44.6
1997	127	19.3	4.0	42091	331.4
1998	303	7.7	3.3	242	0.8
1999	420	39.7	11.9	152526	363.2
2000	864	23.8	8.0	101783	117.8
2001	756	11.3	3.5	15984	21.1
2002	603	8	4.7	59652	98.9
2003	139	13.1	1.6	26220	188.6
2004	210	8.2	2.9	12441	59.2
2005	74	15.4	0.3	1734	23.4
2006	27	9.9	0.4	12	0.4
2007	41	1	0.4	2669	65.1
2008	28	2.9	0.6	1705	60.9
min	27	1	0.3	12	0.2
max	899	39.7	11.9	14213	363
mean	328	15.0	4.3	32656	98
25th	81	6.05	0.5	152526	22
median	175	10.6	3.25	1712	60
75th	557	17.3	4.3	41593	363
ITS	April	May	June	July	Total
Concern Level	0.29*FMWT	13.03*FMWT	33.02*FMWT	37.47*FMWT	37.47*FMWT
Incidental Take	0.44*FMWT	19.6*FMWT	49.5*FMWT	56.2*FMWT	56.2*FMWT

Table C-5: April Cumulative $\geq$ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	1	1	102	30	45	502	147	221
4	1	2	104	30	46	504	148	222
6	2	3	106	31	47	506	148	223
8	2	4	108	32	47	510	150	224
10	3	4	110	32	48	520	152	229
12	4	5	120	35	53	530	155	233
14	4	6	130	38	57	540	158	237
16	5	7	140	41	62	550	161	242
18	5	8	150	44	66	560	164	246
20	6	9	160	47	70	570	167	251
22	6	10	170	50	75	580	170	255
24	7	11	180	53	79	590	173	259
26	8	11	190	56	84	600	176	264
28	8	12	200	59	88	620	182	273
30	9	13	220	64	97	640	188	281
34	10	15	240	70	106	660	193	290
38	11	17	260	76	114	680	199	299
42	12	18	280	82	123	700	205	308
48	14	21	300	88	132	720	211	317
54	16	24	320	94	141	740	217	325
60	18	26	340	100	150	760	223	334
66	19	29	360	106	158	780	229	343
72	21	32	380	111	167	800	235	352
78	23	34	400	117	176	840	246	369
84	25	37	420	123	185	880	258	387
90	26	40	460	135	202	920	270	405
96	28	42	480	141	211	960	281	422
100	29	44	500	147	220	1000	293	440

Table C-6: May Cumulative $\geq$ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	26	39	102	1329	1994	502	6543	9815
4	52	78	104	1356	2033	504	6569	9854
6	78	117	106	1382	2072	506	6595	9893
8	104	156	108	1408	2112	510	6647	9971
10	130	196	110	1434	2151	520	6778	10167
12	156	235	120	1564	2346	530	6908	10362
14	182	274	130	1694	2542	540	7038	10558
16	209	313	140	1825	2737	550	7169	10753
18	235	352	150	1955	2933	560	7299	10949
20	261	391	160	2085	3128	570	7429	11144
22	287	430	170	2216	3324	580	7560	11340
24	313	469	180	2346	3519	590	7690	11535
26	339	508	190	2476	3715	600	7821	11731
28	365	547	200	2607	3910	620	8081	12122
30	391	587	220	2868	4301	640	8342	12513
34	443	665	240	3128	4692	660	8603	12904
38	495	743	260	3389	5083	680	8863	13295
42	547	821	280	3650	5474	700	9124	13686
48	626	938	300	3910	5865	720	9385	14077
54	704	1056	320	4171	6256	740	9645	14468
60	782	1173	340	4432	6647	760	9906	14859
66	860	1290	360	4692	7038	780	10167	15250
72	938	1408	380	4953	7429	800	10427	15641
78	1017	1525	400	5214	7821	840	10949	16423
84	1095	1642	420	5474	8212	880	11470	17205
90	1173	1760	460	5996	8994	920	11991	17987
96	1251	1877	480	6256	9385	960	12513	18769
100	1303	1955	500	6517	9776	1000	13034	19551

Table C-7: June Cumulative ≥ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	66	99	102	3369	5053	502	16578	24868
4	132	198	104	3435	5152	504	16644	24967
6	198	297	106	3501	5251	506	16711	25066
8	264	396	108	3567	5350	510	16843	25264
10	330	495	110	3633	5449	520	17173	25759
12	396	594	120	3963	5944	530	17503	26255
14	462	694	130	4293	6440	540	17833	26750
16	528	793	140	4623	6935	550	18164	27245
18	594	892	150	4954	7431	560	18494	27741
20	660	991	160	5284	7926	570	18824	28236
22	727	1090	170	5614	8421	580	19154	28732
24	793	1189	180	5944	8917	590	19485	29227
26	859	1288	190	6275	9412	600	19815	29722
28	925	1387	200	6605	9907	620	20475	30713
30	991	1486	220	7265	10898	640	21136	31704
34	1123	1684	240	7926	11889	660	21796	32695
38	1255	1882	260	8586	12880	680	22457	33685
42	1387	2081	280	9247	13870	700	23117	34676
48	1585	2378	300	9907	14861	720	23778	35667
54	1783	2675	320	10568	15852	740	24438	36657
60	1981	2972	340	11228	16843	760	25099	37648
66	2180	3269	360	11889	17833	780	25759	38639
72	2378	3567	380	12549	18824	800	26420	39630
78	2576	3864	400	13210	19815	840	27741	41611
84	2774	4161	420	13870	20806	880	29062	43593
90	2972	4458	460	15191	22787	920	30383	45574
96	3170	4756	480	15852	23778	960	31704	47556
100	3302	4954	500	16512	24769	1000	33025	49537

Table C-8: July Cumulative ≥ 20 mm Juvenile Incidental Take by FMWT Index Lookup Table

FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take	FMWT Index	Concern Level	Incidental Take
2	75	112	102	3822	5732	502	18808	28213
4	150	225	104	3897	5845	504	18883	28325
6	225	337	106	3971	5957	506	18958	28437
8	300	450	108	4046	6070	510	19108	28662
10	375	562	110	4121	6182	520	19483	29224
12	450	674	120	4496	6744	530	19857	29786
14	525	787	130	4871	7306	540	20232	30348
16	599	899	140	5245	7868	550	20607	30910
18	674	1012	150	5620	8430	560	20981	31472
20	749	1124	160	5995	8992	570	21356	32034
22	824	1236	170	6369	9554	580	21731	32596
24	899	1349	180	6744	10116	590	22105	33158
26	974	1461	190	7119	10678	600	22480	33720
28	1049	1574	200	7493	11240	620	23229	34844
30	1124	1686	220	8243	12364	640	23979	35968
34	1274	1911	240	8992	13488	660	24728	37092
38	1424	2136	260	9741	14612	680	25477	38216
42	1574	2360	280	10491	15736	700	26227	39340
48	1798	2698	300	11240	16860	720	26976	40464
54	2023	3035	320	11989	17984	740	27725	41588
60	2248	3372	340	12739	19108	760	28475	42712
66	2473	3709	360	13488	20232	780	29224	43836
72	2698	4046	380	14237	21356	800	29973	44960
78	2922	4384	400	14987	22480	840	31472	47208
84	3147	4721	420	15736	23604	880	32971	49456
90	3372	5058	460	17235	25852	920	34469	51704
96	3597	5395	480	17984	26976	960	35968	53952
100	3747	5620	500	18733	28100	1000	37467	56200