

Upper Basin Pallid Sturgeon Survival Estimation Project

2015 Update

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Background

Currently, pallid sturgeon (*Scaphirhynchus albus*) are listed as endangered under the Endangered Species Act. One component of the Recovery Plan for the species is the artificial propagation and release of pallid sturgeon. Each year, tens to hundreds of thousands of juveniles are propagated in captivity and then released in various locations throughout the Upper Basin according to a stocking and augmentation plan (USFWS 2008). These individuals are considered by the USFWS to be members of the listed species. Thus, there is interest in knowing the contribution of hatchery-origin fish to the population. One key step in measuring that contribution is to estimate the probability that a fish reared in captivity and released into the wild will survive to various ages of interest.

Hadley and Rotella (2009) estimated apparent survival for pallid sturgeon on 3 RPMA's using data collected via mark-release-recapture studies of hatchery-reared individuals. The data they used were collected during 1998-2007. Rotella (2010) analyzed updated data that included data from 4 new trapping occasions in each of the RPMA's during 2008-2009. Rotella (2012) analyzed updated data that included data collected through September of 2010. In this addendum to the Hadley and Rotella (2009) and Rotella (2010, 2012) reports, results are updated after incorporating data collected through September of 2013 and running the models employed in previous efforts unless otherwise noted below. Throughout, results are presented for each release cohort to allow estimates of the number that were predicted to have been alive in October 2013. However, the models evaluated here did not include cohort identity as a factor influencing survival or detection. Rather, models considered factors such as release type, age, season, and disease status. Such features vary across cohorts but all cohorts contributed to the estimation of the relationships between survival (and capture probability) and those factors.

Analysis methods

As was true in previous reports, I estimated apparent annual survival (hereafter survival) and capture probabilities and also evaluated the relationships between covariates of interest and survival and capture probabilities for all mark-recapture data sets that were available for pallid sturgeon in Upper Basin RPMAs using Cormack-Jolly-Seber capture-recapture models (Pollock et al. 1990, Lebreton et al. 1992, Williams et al. 2002). All analyses were done using Program MARK (White and Burnham 1999) with the addition that for this report all analyses were done via computer scripts that execute Program MARK through the RMark package (Laake 2010) in the software program R (R Development Core Team 2010). References, more detailed methods, competing model lists, and methods and measures of overdispersion are provided in Hadley and Rotella (2009).

Assumptions of Analysis Approach

1. Every marked animal present in population at sampling period i has same capture probability (p_i) & apparent survival rate (ϕ_i).
 - a. Bias in estimates of ϕ_i from heterogeneity in capture probability is usually negative and small. The models used here incorporated a variety of covariates such as age, RPMA, release type, occasion, season of year and others to model possible sources of heterogeneity.
 - b. Bias in estimates of ϕ_i from heterogeneity in survival probability is usually positive except in the case of transients being in the release sample. Transients are fish that are released and then move to locations that are never subject to sampling or in which they

cannot be caught. Transients have apparent survival rates of 0 and cause negative bias in estimates of ϕ_i . The models used here incorporated a variety of covariates such as age, RPMA, release type, occasion, season of year, disease status and others to model possible sources of heterogeneity. However, it is not known to what extent heterogeneity in survival rates might exist due to variation within in age class (e.g., due to differences in size) or due to transient behavior.

2. Marks are not lost, overlooked, or misread. If marks are lost, estimates of ϕ_i are biased downwards. Such bias can be corrected if estimates of tag loss exist. Estimates of tag loss were obtained for the spring yearlings and summer yearlings released in RPMA 2 and used to adjust estimates of survival in the analyses presented here. Tag-loss rates were not available for other release groups, but can be incorporated quite easily in the future if they become available.
3. Sampling is instantaneous and animals are released immediately upon capture. If sampling is not instantaneous, then the intervals between sampling occasions are different lengths for different fish, which creates heterogeneity in survival probabilities (because different fish are exposed to mortality for different lengths of time), and, as noted above, the effect of such heterogeneity on bias in apparent survival rates is usually positive. In earlier work, Hadley and Rotella (2009) tried to establish sampling occasions that prevented using excessively long sampling windows while also avoiding eliminating too much recapture data when the start and ending dates of sampling occasions were moved closer together in time. It is not known how much mortality might be occurring during the sampling windows.
4. All emigration is permanent. Temporary emigration causes extreme heterogeneity in capture probability for those individuals that are away from the sampling areas during sampling, i.e., their $p = 0$ on those occasions. If the probability that a fish will be away from the sampling areas is the same for fish that are outside the study area as it is for a fish that is inside the sampling area (i.e., the probability of being temporary emigrant does not depend on the individual's current location), no bias in survival estimation is expected. Otherwise, temporary emigration can cause negative bias in estimates of ϕ_i .
5. Animal fates with respect to capture and survival are independent. If this is not true, then model-selection procedures tend to choose overly complex models and estimates of precision tend to be too small or overly optimistic. The analyses presented here incorporate the estimates of overdispersion calculated by Hadley and Rotella (2009), which means that model selection and precision estimation were adjusted for estimated lack of independence that might have occurred in the data. It is notable that levels of overdispersion were estimated to be quite modest in these data.

Report Organization

This report is provided as an addendum to Hadley and Rotella (2009) and Rotella (2010, 2012). It is not intended to stand-alone. Rather, it is assumed that the reader will be familiar with the earlier reports to be able to take full advantage of the material in this report. This report provides information for one RPMA at a time.

For each RPMA, I first summarize the data that were available on numbers released and recaptured over the course of the study. I then provide estimates for each release type (e.g., fingerlings, spring yearlings, etc.) starting with the youngest release type and ending with the oldest. For each release type, I first present estimates based on the first cohort that was released in healthy condition (longest time since release for a healthy cohort). I then provide the estimates of survival rates and surviving numbers of fish for each release cohort based on the actual covariate conditions for each cohort, i.e., their true disease status, river of origin and any other covariates found to be important in the modeling. Finally, I present summaries of the results for all released cohorts of a given release type. I then go on to the results for the next type of release. After results for all release types in a given RPMA are provided, I summarize results by age class across all release types. Finally, I end with summary tables shown together for each RPMA. Throughout the results, I try to emphasize providing the reader with estimated survival rates, surviving proportions, and surviving numbers through time.

The first time the report provides a given table type, key details are provided about what is in the table. Thus, if questions arise about information in a given table, it is perhaps worthwhile to review the 1st version of such a table in the RPMA portion of the report.

RPMA 1

Dates and numbers for releases and recapture work on RPMA 1.

Occ	Begin	End	Midpoint	Release Numbers for Each Fish Type			
				Spring		Summer	
1	08/18/98	08/18/98	08/18/98			1	731
2	09/23/98	10/30/98	10/11/98				
3	04/13/99	04/13/99	04/13/99				
4	08/31/99	09/21/99	09/10/99				
5	09/25/00	09/28/00	09/26/00				
6	09/25/01	10/31/01	10/13/01				
7	07/23/02	07/23/02	07/23/02			2	2,038
8	08/20/02	09/25/02	09/07/02				
9	04/08/03	05/30/03	05/04/03				
10	08/19/03	10/17/03	09/17/03				
11	03/23/04	05/26/04	04/24/04				
12	08/20/04	10/15/04	09/17/04			3	3,128
13	03/29/05	05/25/05	04/26/05	1	521		
14	08/19/05	11/01/05	09/25/05			4	186
15	04/13/06	05/17/06	04/30/06	2	4,714		
16	08/23/06	10/25/06	09/23/06				
17	04/03/07	05/31/07	05/02/07	3	4,461		
18	09/24/07	10/24/07	10/09/07				
19	04/08/08	05/21/08	04/30/08	4	6,791		
20	07/23/08	10/24/08	09/07/08				
21	04/13/09	05/20/09	05/01/09	5	6,292		
22	09/10/09	10/23/09	10/01/09				
23	03/31/10	04/23/10	04/11/10	6	6,095		
24	08/03/10	10/14/10	09/08/10				
25	04/12/11	05/10/11	04/26/11	7	752		
26	08/01/11	11/02/11	09/16/11				
27	04/03/12	05/22/12	04/28/12				
28	08/01/12	10/30/12	09/15/12				
29	04/01/13	05/01/13	04/16/13	8	465		
30	07/23/13	10/29/13	09/10/13				

For RPMA 1, the top model of the mark-recapture data included the following covariates of survival: release type (spring versus summer yearlings), age of fish, fin curl status, the interaction of release type with fish age and with fin curl status, and the proportion of the interval between sampling occasions that was in winter months. The model of capture probability included fish age (on the natural log scale) and capture occasion. In this report, a number of new models were added to previously used models. The new models evaluated whether or not information on the number of trammel nets and setlines as well as angler activity was helpful for modeling capture probability. Models including effort metrics were not as well supported as models that allowed capture probability to vary with occasion independently.

Results for Releases of Spring Yearlings in RPMA 1

Data on the number of spring yearlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 31,474 releases and re-releases of fish originally released as spring yearlings had been conducted, which resulted in 1,530 recaptures. The results presented below are based on the analyses of the data for those fish released, recaptured, and released in RPMA 1 up through October 2013.

Occ. $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 Total					
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
13	521	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13				
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
15	4714	0	0	0	0	0	0	0	0	0	0	0	0	0	26	49	28	27	19	53	15	35	16	23	24	23	7	26	11	382				
16	27	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1				
17	4512	0	0	0	0	0	0	0	0	0	0	0	0	0	12	31	16	36	40	69	14	19	31	35	24	27	16	370	0	0				
18	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
19	6851	0	0	0	0	0	0	0	0	0	0	0	0	0	5	30	13	29	12	20	14	15	12	13	15	178	0	0	0	0	0			
20	42	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	1	0	0	1	0	0	1	0	0	0	0	0	0			
21	6416	0	0	0	0	0	0	0	0	0	0	0	0	0	31	48	19	29	16	33	22	43	25	266	0	0	0	0	0	0	0	0		
22	102	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	3	0	1	4	0	1	4	0	1	14	0	0	0	0	0			
23	6283	0	0	0	0	0	0	0	0	0	0	0	0	0	22	38	14	36	16	42	55	223	0	0	0	0	0	0	0	0	0	0		
24	85	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	0	1	0	7	0	0	0	0	0	0	0	0	0	0	0		
25	888	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	8	12	14	42	0	0	0	0	0	0	0	0	0	0	0	0		
26	102	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	638	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Estimates of survival for the 1st release cohort of healthy spring yearlings (~9.5 months old at time of release, which was ~4/26/2005) in RPMA 1 (cohort= 521 fish, Fin Curl status = 0). Estimates are for a fish without fin curl. *The estimates here indicate relatively high values for monthly survival rates that vary depending on fish age (survival improves gradually with age) and season of year (lower survival in winter season). Also, they indicate that approximately one fourth of fish were still alive by the time they reached 7 years of age. Recaptures in recent years have continued to accumulate over multiple release cohorts and provide new first recaptures of a number of new individuals. That recapture information was used here.*

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)	
04/26/05	09/25/05	5.1	9.5	14.6	0.996	(0.004)	0.98	(0.02)	(0.94	to 1.00)
09/25/05	04/30/06	7.2	14.6	21.8	0.942	(0.007)	0.64	(0.04)	(0.56	to 0.72)
04/30/06	09/23/06	4.9	21.8	26.7	0.998	(0.002)	0.63	(0.04)	(0.54	to 0.72)
09/23/06	05/02/07	7.4	26.7	34.0	0.963	(0.003)	0.48	(0.04)	(0.40	to 0.55)
05/02/07	10/09/07	5.3	34.0	39.4	0.998	(0.002)	0.47	(0.04)	(0.39	to 0.55)
10/09/07	04/30/08	6.8	39.4	46.2	0.969	(0.004)	0.38	(0.03)	(0.32	to 0.45)
04/30/08	09/07/08	4.3	46.2	50.5	0.999	(0.001)	0.38	(0.03)	(0.31	to 0.45)
09/07/08	05/01/09	7.9	50.5	58.4	0.980	(0.003)	0.32	(0.03)	(0.26	to 0.39)
05/01/09	10/01/09	5.1	58.4	63.5	0.999	(0.001)	0.32	(0.03)	(0.26	to 0.39)
10/01/09	04/11/10	6.4	63.5	69.9	0.968	(0.009)	0.26	(0.03)	(0.20	to 0.32)
04/11/10	09/08/10	5.0	69.9	74.9	0.999	(0.001)	0.26	(0.03)	(0.20	to 0.32)
09/08/10	04/26/11	7.7	74.9	82.5	0.984	(0.003)	0.23	(0.03)	(0.17	to 0.29)
04/26/11	09/16/11	4.8	82.5	87.3	0.999	(0.001)	0.23	(0.03)	(0.17	to 0.29)
09/16/11	04/28/12	7.5	87.3	94.8	0.985	(0.004)	0.20	(0.03)	(0.14	to 0.27)
04/28/12	09/15/12	4.7	94.8	99.5	0.999	(0.001)	0.20	(0.03)	(0.14	to 0.26)
09/15/12	04/16/13	7.1	99.5	106.6	0.983	(0.005)	0.18	(0.03)	(0.12	to 0.24)
04/16/13	09/10/13	4.9	106.6	111.5	0.999	(0.001)	0.18	(0.03)	(0.12	to 0.24)

¹The monthly survival rate for each month in the interval represented on a given row of the table. The interval-specific survival rate can be calculated by raising the monthly survival rate to the number of months in the interval, e.g., $0.996^{5.1} = 0.98$ (for the 1st interval) or $0.942^{7.2} = 0.65$ (for the 2nd interval).

²The proportion of a release cohort still alive, which is calculated based on monthly survival estimates for each interval, the resulting interval-specific estimates of survival, and the product of interval-specific estimates. For example, for the 1st interval, the interval-specific survival rate was $0.996^{5.1} = 0.98$, and for the 2nd interval, the interval-specific survival rate was $0.942^{7.2} = 0.65$. Thus, the proportion still alive at the end of the 1st interval is 0.98 and the proportion still alive at the end of 2nd interval is $0.98 \times 0.65 = 0.64$.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. In the table below, the survival rate was ~0.64 for the period from initial release of Spring Yearlings in the ~1 year post release. For the next year, the rate was 0.75, and so on. Rates generally follow a smooth progression. However, as (a) intervals are not all exactly 1 year apart and (b) features that affect survival such as season or (for this instance) proportion of the interval in winter, rates won't always change smoothly from interval to the next.*

After the last interval reported, either there are no more estimates available or (more typically) the estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.03	12.3	0.64	0.04
2.04	24.5	0.75	0.14
3.06	36.7	0.79	0.15
4.08	48.9	0.84	0.15
5.03	60.4	0.81	0.18
6.08	73	0.89	0.20
7.11	85.3	0.87	0.23
8.09	97.1	0.90	0.25

When the number of fish released in a cohort is taken into account, it is possible to estimate the number of fish from each cohort that are estimated to be alive through time. The tables below do this for each release type and cohort using **the average value for disease status within each release cohort.**

Estimates of survival for the 1st release cohort of spring yearlings in RPMA 1 (cohort= 521 fish, average fin curl value in cohort = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SPR	04/26/05	09/25/05	9.5	14.6	0.98	0.02	512	489	to	521
1	SPR	09/25/05	04/30/06	14.6	21.8	0.64	0.04	331	290	to	373
1	SPR	04/30/06	09/23/06	21.8	26.7	0.63	0.04	328	283	to	373
1	SPR	09/23/06	05/02/07	26.7	34.0	0.48	0.04	248	208	to	287
1	SPR	05/02/07	10/09/07	34.0	39.4	0.47	0.04	246	204	to	287
1	SPR	10/09/07	04/30/08	39.4	46.2	0.38	0.03	199	165	to	233
1	SPR	04/30/08	09/07/08	46.2	50.5	0.38	0.03	198	163	to	232
1	SPR	09/07/08	05/01/09	50.5	58.4	0.32	0.03	169	136	to	201
1	SPR	05/01/09	10/01/09	58.4	63.5	0.32	0.03	168	135	to	201
1	SPR	10/01/09	04/11/10	63.5	69.9	0.26	0.03	137	107	to	167
1	SPR	04/11/10	09/08/10	69.9	74.9	0.26	0.03	136	106	to	166
1	SPR	09/08/10	04/26/11	74.9	82.5	0.23	0.03	120	89	to	151
1	SPR	04/26/11	09/16/11	82.5	87.3	0.23	0.03	120	89	to	150
1	SPR	09/16/11	04/28/12	87.3	94.8	0.20	0.03	107	75	to	138
1	SPR	04/28/12	09/15/12	94.8	99.5	0.20	0.03	106	75	to	138
1	SPR	09/15/12	04/16/13	99.5	106.6	0.18	0.03	94	61	to	127
1	SPR	04/16/13	09/10/13	106.6	111.5	0.18	0.03	94	61	to	127

Estimates of survival for the 2nd release cohort of spring yearlings in RPMA 1 (cohort= 4,714 fish, average fin curl value in cohort = 0.71).

Release	Type	Start Date	End Date	int. start (mos.)	int end (mos.)	Ppn. Still Alive	(SE)	Interval End	(95% CI for N at Inteval End)		
2	SPR	04/30/06	09/23/06	9.5	14.4	0.97	0.03	4,596	4,322	to	4,714
2	SPR	09/23/06	05/02/07	14.4	21.7	0.53	0.05	2,489	2,053	to	2,926
2	SPR	05/02/07	10/09/07	21.7	27.1	0.52	0.05	2,442	1,953	to	2,931
2	SPR	10/09/07	04/30/08	27.1	33.9	0.35	0.04	1,649	1,320	to	1,978
2	SPR	04/30/08	09/07/08	33.9	38.2	0.35	0.04	1,634	1,292	to	1,976
2	SPR	09/07/08	05/01/09	38.2	46.1	0.26	0.03	1,240	970	to	1,509
2	SPR	05/01/09	10/01/09	46.1	51.2	0.26	0.03	1,228	948	to	1,509
2	SPR	10/01/09	04/11/10	51.2	57.6	0.19	0.02	873	699	to	1,047
2	SPR	04/11/10	09/08/10	57.6	62.6	0.18	0.02	867	694	to	1,040
2	SPR	09/08/10	04/26/11	62.6	70.2	0.15	0.02	706	544	to	869
2	SPR	04/26/11	09/16/11	70.2	75.0	0.15	0.02	702	540	to	864
2	SPR	09/16/11	04/28/12	75.0	82.5	0.12	0.02	585	424	to	746
2	SPR	04/28/12	09/15/12	82.5	87.2	0.12	0.02	582	422	to	742
2	SPR	09/15/12	04/16/13	87.2	94.3	0.10	0.02	483	317	to	648
2	SPR	04/16/13	09/10/13	94.3	99.2	0.10	0.02	480	316	to	645

Estimates of survival for the 3rd release cohort of spring yearlings in RPMA 1 (cohort= 4,461 fish, average fin curl value in cohort = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SPR	05/02/07	10/09/07	9.5	14.8	0.98	0.03	4,355	4,123	to	4,461
3	SPR	10/09/07	04/30/08	14.8	21.6	0.64	0.04	2,865	2,518	to	3,213
3	SPR	04/30/08	09/07/08	21.6	26	0.64	0.04	2,840	2,465	to	3,216
3	SPR	09/07/08	05/01/09	26	33.8	0.49	0.04	2,205	1,829	to	2,580
3	SPR	05/01/09	10/01/09	33.8	38.9	0.49	0.05	2,188	1,792	to	2,583
3	SPR	10/01/09	04/11/10	38.9	45.3	0.37	0.03	1,638	1,369	to	1,906
3	SPR	04/11/10	09/08/10	45.3	50.3	0.36	0.03	1,628	1,360	to	1,896
3	SPR	09/08/10	04/26/11	50.3	58.0	0.31	0.03	1,378	1,121	to	1,636
3	SPR	04/26/11	09/16/11	58.0	62.8	0.31	0.03	1,372	1,114	to	1,629
3	SPR	09/16/11	04/28/12	62.8	70.3	0.27	0.03	1,187	931	to	1,443
3	SPR	04/28/12	09/15/12	70.3	74.9	0.27	0.03	1,182	926	to	1,438
3	SPR	09/15/12	04/16/13	74.9	82	0.23	0.03	1,022	758	to	1,286
3	SPR	04/16/13	09/10/13	82.0	86.9	0.23	0.03	1,018	755	to	1,282

Estimates of survival for the 4th release cohort of spring yearlings in RPMA 1 (cohort= 6,791 fish, average fin curl value in cohort = 0.20).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SPR	04/30/08	09/07/08	9.5	13.8	0.98	0.02	6,674	6,400	to	6,791
4	SPR	09/07/08	05/01/09	13.8	21.7	0.64	0.06	4,316	3,580	to	5,052
4	SPR	05/01/09	10/01/09	21.7	26.8	0.63	0.06	4,265	3,450	to	5,080
4	SPR	10/01/09	04/11/10	26.8	33.2	0.41	0.03	2,816	2,383	to	3,250
4	SPR	04/11/10	09/08/10	33.2	38.2	0.41	0.03	2,793	2,356	to	3,230
4	SPR	09/08/10	04/26/11	38.2	45.9	0.33	0.03	2,232	1,852	to	2,612
4	SPR	04/26/11	09/16/11	45.9	50.6	0.33	0.03	2,218	1,835	to	2,602
4	SPR	09/16/11	04/28/12	50.6	58.1	0.27	0.03	1,841	1,495	to	2,187
4	SPR	04/28/12	09/15/12	58.1	62.8	0.27	0.03	1,831	1,484	to	2,179
4	SPR	09/15/12	04/16/13	62.8	69.9	0.22	0.03	1,526	1,193	to	1,859
4	SPR	04/16/13	09/10/13	69.9	74.8	0.22	0.02	1,519	1,187	to	1,851

Estimates of survival for the 5th release cohort of spring yearlings in RPMA 1 (cohort= 6,292 fish, average fin curl value in cohort = 0.27).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	SPR	05/01/09	10/01/09	9.5	14.6	0.98	0.03	6,155	5,839	to	6,292
5	SPR	10/01/09	04/11/10	14.6	21	0.51	0.05	3,206	2,594	to	3,819
5	SPR	04/11/10	09/08/10	21	26	0.50	0.05	3,169	2,602	to	3,735
5	SPR	09/08/10	04/26/11	26	33.7	0.37	0.04	2,337	1,874	to	2,800
5	SPR	04/26/11	09/16/11	33.7	38.4	0.37	0.04	2,318	1,871	to	2,765
5	SPR	09/16/11	04/28/12	38.4	45.9	0.29	0.03	1,834	1,461	to	2,206
5	SPR	04/28/12	09/15/12	45.9	50.6	0.29	0.03	1,822	1,458	to	2,186
5	SPR	09/15/12	04/16/13	50.6	57.7	0.23	0.03	1,462	1,130	to	1,795
5	SPR	04/16/13	09/10/13	57.7	62.6	0.23	0.03	1,454	1,130	to	1,778

Estimates of survival for the 6th release cohort of spring yearlings in RPMA 1 (cohort= 6,095 fish, average fin curl value in cohort = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	SPR	04/11/10	09/08/10	9.5	14.5	0.98	0.02	5,986	5,730	to	6,095
6	SPR	09/08/10	04/26/11	14.5	22.2	0.66	0.05	4,013	3,439	to	4,587
6	SPR	04/26/11	09/16/11	22.2	26.9	0.65	0.05	3,975	3,344	to	4,607
6	SPR	09/16/11	04/28/12	26.9	34.4	0.50	0.05	3,057	2,503	to	3,610
6	SPR	04/28/12	09/15/12	34.4	39.1	0.50	0.05	3,036	2,455	to	3,618
6	SPR	09/15/12	04/16/13	39.1	46.2	0.40	0.04	2,412	1,975	to	2,850
6	SPR	04/16/13	09/10/13	46.2	51.1	0.39	0.04	2,399	1,947	to	2,850

Estimates of survival for the 7th release cohort of spring yearlings in RPMA 1 (cohort= 752 fish, average fin curl value in cohort = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	SPR	04/26/11	09/16/11	9.5	14.3	0.98	0.02	739	709	to	752
7	SPR	09/16/11	04/28/12	14.3	21.8	0.65	0.05	491	422	to	559
7	SPR	04/28/12	09/15/12	21.8	26.4	0.65	0.05	486	411	to	561
7	SPR	09/15/12	04/16/13	26.4	33.5	0.48	0.04	359	301	to	417
7	SPR	04/16/13	09/10/13	33.5	38.4	0.47	0.04	356	296	to	417

Estimates of survival for the 8th release cohort of spring yearlings in RPMA 1 (cohort= 465 fish, average fin curl value in cohort = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
8	SPR	04/16/13	09/10/13	9.5	14.4	0.98	0.02	457	438	to	465

Summary information for Spring Yearlings released in RPMA 1.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as spring yearlings are estimated to still be alive. At the time of the last estimation date (09/10/2013), ~7,777 fish released as spring yearlings were estimated to have been still alive in the river. Of these ~6% were <3 years old, ~54% (4,209) were ~3-5 years old, ~39% (3,017) were 6-8 years old, and 1% (94) were ≥9 years old.

Estimates of surviving proportions and numbers for spring yearling releases in RPMA 1.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 521	SPR	09/10/13	111.5	9.3	0.18	0.03	94	61	to	127
2: 4,714	SPR	09/10/13	99.2	8.3	0.10	0.02	480	316	to	645
3: 4,461	SPR	09/10/13	86.9	7.2	0.23	0.03	1,018	755	to	1,282
4: 6,791	SPR	09/10/13	74.8	6.2	0.22	0.02	1,519	1,187	to	1,851
5: 6,292	SPR	09/10/13	62.6	5.2	0.23	0.03	1,454	1,130	to	1,778
6: 6,095	SPR	09/10/13	51.1	4.3	0.39	0.04	2,399	1,947	to	2,850
7: 752	SPR	09/10/13	38.4	3.2	0.47	0.04	356	296	to	417
8: 465	SPR	09/10/13	14.4	1.2	0.98	0.02	457	438	to	465

Results for Releases of Summer Yearlings in RPMA 1

Data on the number of summer yearlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 6,420 releases and re-releases of fish originally released as summer yearlings had been conducted, which resulted in 346 recaptures. The results presented below are based on the analyses of the data resulting from those releases, recaptures, and re-releases.

Occ. $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 Total		
1	731																												4	220	
2	3	0																												0	1
3	1	0																												0	0
4	2																													0	0
5	4																													0	0
6	5																													0	0
7	2038																													0	9
8	13																													0	3
9	10																													0	3
10	9																													0	4
11	84																													0	9
12	3138																													0	18
13	30																													0	7
14	193																													0	7
15	12																													0	5
16	14																													0	5
17	20																													0	10
18	19																													0	5
19	25																													0	10
20	11																													0	4
21	11																													0	2
22	12																													0	6
23	23																													0	5
24	7																													0	2
25	3																													0	2
26	12																													0	3
27	15																													0	2
28	7																													0	3
29	18																													0	0

Estimates of survival for the 1st release cohort of summer yearlings (~14.2 months old at time of release, which was ~8/18/1998) in RPMA 1 (cohort= 731 fish, average fin curl value in cohort = 0).

Estimates are for a fish without fin curl. *The estimates presented here are slightly lower than what was presented in the most recent report (Rotella 2010) but still indicate that substantial proportions of healthy releases of summer yearlings remain alive long after release. As before, the estimation indicates that survival is very high once fish are several years old.*

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)
08/18/98	10/11/98	1.8	14.2	16.0	0.998	(0.002)	1.00	(0.00)	(0.99 to 1.00)
10/11/98	04/13/99	6.1	16.0	22.2	0.966	(0.011)	0.81	(0.05)	(0.70 to 0.91)
04/13/99	09/10/99	5.0	22.2	27.2	0.999	(0.001)	0.80	(0.05)	(0.70 to 0.90)
09/10/99	09/26/00	12.7	27.2	39.9	0.994	(0.002)	0.75	(0.05)	(0.65 to 0.84)
09/26/00	10/13/01	12.7	39.9	52.6	0.994	(0.002)	0.70	(0.05)	(0.60 to 0.79)
10/13/01	07/23/02	9.4	52.6	62.1	0.993	(0.002)	0.65	(0.05)	(0.55 to 0.75)
07/23/02	09/07/02	1.5	62.0	63.6	0.999	(0.001)	0.65	(0.05)	(0.55 to 0.75)
09/07/02	05/04/03	8.0	63.6	71.5	0.987	(0.001)	0.59	(0.05)	(0.49 to 0.68)
05/04/03	09/17/03	4.5	71.5	76.1	0.999	(0.001)	0.59	(0.05)	(0.49 to 0.68)
09/17/03	04/24/04	7.3	76.1	83.4	0.985	(0.002)	0.52	(0.04)	(0.44 to 0.61)
04/24/04	09/17/04	4.9	83.4	88.3	0.999	(0.001)	0.52	(0.04)	(0.44 to 0.61)
09/17/04	04/26/05	7.4	88.3	95.7	0.986	(0.002)	0.47	(0.04)	(0.40 to 0.55)
04/26/05	09/25/05	5.1	95.7	100.7	0.999	(0.001)	0.47	(0.04)	(0.39 to 0.54)
09/25/05	04/30/06	7.2	100.7	108.0	0.986	(0.003)	0.42	(0.04)	(0.35 to 0.49)
04/30/06	09/23/06	4.9	108.0	112.8	0.999	(0.001)	0.42	(0.04)	(0.35 to 0.49)
09/23/06	05/02/07	7.4	112.8	120.2	0.987	(0.003)	0.38	(0.03)	(0.32 to 0.45)
05/02/07	10/09/07	5.3	120.2	125.5	0.999	(0.001)	0.38	(0.03)	(0.31 to 0.45)
10/09/07	04/30/08	6.8	125.5	132.3	0.986	(0.003)	0.35	(0.03)	(0.28 to 0.41)
04/30/08	09/07/08	4.3	132.3	136.7	0.999	(0.001)	0.35	(0.03)	(0.28 to 0.41)
09/07/08	05/01/09	7.9	136.7	144.5	0.990	(0.002)	0.32	(0.03)	(0.25 to 0.39)
05/01/09	10/01/09	5.1	144.5	149.6	0.999	(0.001)	0.32	(0.03)	(0.25 to 0.39)
10/01/09	04/11/10	6.4	149.6	156.0	0.981	(0.006)	0.28	(0.04)	(0.21 to 0.35)
04/11/10	09/08/10	5.0	156.0	161.0	0.999	(0.001)	0.28	(0.04)	(0.21 to 0.35)
09/08/10	04/26/11	7.7	161.0	168.7	0.989	(0.003)	0.26	(0.04)	(0.18 to 0.33)
04/26/11	09/16/11	4.8	168.7	173.5	0.999	(0.001)	0.26	(0.04)	(0.18 to 0.33)
09/16/11	04/28/12	7.5	173.5	181.0	0.989	(0.003)	0.24	(0.04)	(0.16 to 0.31)
04/28/12	09/15/12	4.7	181.0	185.6	0.999	(0.001)	0.24	(0.04)	(0.16 to 0.31)
09/15/12	04/16/13	7.1	185.6	192.7	0.987	(0.004)	0.22	(0.04)	(0.14 to 0.29)
04/16/13	09/10/13	4.9	192.7	197.6	0.999	(0.001)	0.22	(0.04)	(0.14 to 0.29)

From these results, it can be seen that monthly survival rates for fish released as summer yearlings without fin curl are estimated to have relatively high monthly survival rates, the monthly survival rates increase gradually as the fish get older and that monthly rates are estimated quite precisely. It can also be seen that approximately 59% of the original release cohort is estimated to remain alive when the fish are ~6 years of age, and 38% are estimated to still be alive when the fish are ~10 years of age.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.08	13	0.80	0.05
2.14	25.7	0.94	0.10
3.20	38.4	0.93	0.11
3.99	47.9	0.93	0.11
5.16	61.9	0.91	0.13
6.18	74.1	0.88	0.13
7.21	86.5	0.90	0.13
8.22	98.6	0.89	0.14
8.83	106	0.91	0.14
9.84	118.1	0.92	0.13
10.86	130.3	0.91	0.14
11.82	141.8	0.88	0.20
12.88	154.5	0.93	0.23
13.90	166.8	0.92	0.25
14.88	178.5	0.92	0.27

When the number of fish released in a cohort is taken into account, it is possible to estimate the number of fish from each cohort that are estimated to be alive through time. The tables below do this for each release type and cohort using **the average value for disease status in each release cohort.**

Estimates of survival for the 1st release cohort of summer yearlings in RPMA 1 (cohort= 731 fish, average fin curl value in cohort = 0). *Estimates in this report are similar to what was in the previous report though the point estimates presented here are slightly lower point than the corresponding estimates for this cohort in the previous report (e.g., 0.33 [SE=0.07] of the release cohort were estimated to be still alive on 09/08/2010 in the previous report [226 fish; 95% CI = 130 to 321], whereas below the corresponding numbers are: 0.22 [SE=0.04] and 205 fish [95% CI = 153 to 257]).*

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SUM	08/18/98	10/11/98	14.2	16.0	1.00	0.00	728	723	to	731
1	SUM	10/11/98	04/13/99	16.0	22.2	0.81	0.05	589	511	to	666
1	SUM	04/13/99	09/10/99	22.2	27.2	0.80	0.05	586	511	to	660
1	SUM	09/10/99	09/26/00	27.2	39.9	0.75	0.05	546	476	to	615
1	SUM	09/26/00	10/13/01	39.9	52.6	0.70	0.05	509	437	to	581
1	SUM	10/13/01	07/23/02	52.6	62.1	0.65	0.05	476	401	to	550
1	SUM	07/23/02	09/07/02	62.0	63.6	0.65	0.05	475	401	to	550
1	SUM	09/07/02	05/04/03	63.6	71.5	0.59	0.05	430	361	to	498
1	SUM	05/04/03	09/17/03	71.5	76.1	0.59	0.05	428	358	to	498
1	SUM	09/17/03	04/24/04	76.1	83.4	0.52	0.04	384	323	to	445
1	SUM	04/24/04	09/17/04	83.4	88.3	0.52	0.04	382	321	to	444
1	SUM	09/17/04	04/26/05	88.3	95.7	0.47	0.04	344	289	to	399
1	SUM	04/26/05	09/25/05	95.7	100.7	0.47	0.04	343	288	to	398
1	SUM	09/25/05	04/30/06	100.7	108.0	0.42	0.04	309	259	to	360
1	SUM	04/30/06	09/23/06	108.0	112.8	0.42	0.04	308	258	to	359
1	SUM	09/23/06	05/02/07	112.8	120.2	0.38	0.03	280	231	to	329
1	SUM	05/02/07	10/09/07	120.2	125.5	0.38	0.03	279	230	to	328
1	SUM	10/09/07	04/30/08	125.5	132.3	0.35	0.03	254	205	to	302
1	SUM	04/30/08	09/07/08	132.3	136.7	0.35	0.03	253	204	to	302
1	SUM	09/07/08	05/01/09	136.7	144.5	0.32	0.03	233	184	to	282
1	SUM	05/01/09	10/01/09	144.5	149.6	0.32	0.03	232	183	to	282
1	SUM	10/01/09	04/11/10	149.6	156.0	0.28	0.04	206	153	to	258
1	SUM	04/11/10	09/08/10	156.0	161.0	0.28	0.04	205	153	to	257
1	SUM	09/08/10	04/26/11	161.0	168.7	0.26	0.04	189	135	to	243
1	SUM	04/26/11	09/16/11	168.7	173.5	0.26	0.04	188	135	to	242
1	SUM	09/16/11	04/28/12	173.5	181.0	0.24	0.04	174	118	to	229
1	SUM	04/28/12	09/15/12	181.0	185.6	0.24	0.04	173	118	to	229
1	SUM	09/15/12	04/16/13	185.6	192.7	0.22	0.04	158	101	to	216
1	SUM	04/16/13	09/10/13	192.7	197.6	0.22	0.04	158	101	to	215

Estimates of survival for the 2nd release cohort of summer yearlings in RPMA 1 (cohort= 2,038 fish, average fin curl value in cohort = 1). *As in previous reports, the survival of fish with high levels of fin curl are not estimated to survive long and the current report estimates no survivors from any of the summer yearlings released with fin curl by Fall 2013.*

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	SUM	07/23/02	09/07/02	14.2	15.8	0.98	0.02	2,002	1,923	to	2,038
2	SUM	09/07/02	05/04/03	15.8	23.7	0.22	0.05	452	272	to	633
2	SUM	05/04/03	09/17/03	23.7	28.3	0.21	0.05	432	234	to	630
2	SUM	09/17/03	04/24/04	28.3	35.6	0.05	0.01	104	45	to	162
2	SUM	04/24/04	09/17/04	35.6	40.5	0.05	0.02	99	39	to	160
2	SUM	09/17/04	04/26/05	40.5	47.8	0.01	0.00	27	7	to	47
2	SUM	04/26/05	09/25/05	47.8	52.9	0.01	0.01	26	6	to	46
2	SUM	09/25/05	04/30/06	52.9	60.1	0.00	0.00	8	0	to	15
2	SUM	04/30/06	09/23/06	60.1	65.0	0.00	0.00	7	0	to	15
2	SUM	09/23/06	05/02/07	65.0	72.4	0.00	0.00	2	0	to	6
2	SUM	05/02/07	10/09/07	72.4	77.7	0.00	0.00	2	0	to	5
2	SUM	10/09/07	04/30/08	77.7	84.5	0.00	0.00	1	0	to	2
2	SUM	04/30/08	09/07/08	84.5	88.8	0.00	0.00	1	0	to	2
2	SUM	09/07/08	05/01/09	88.8	96.7	0.00	0.00	0	0	to	1
2	SUM	05/01/09	10/01/09	96.7	101.8	0.00	0.00	0	0	to	1
2	SUM	10/01/09	04/11/10	101.8	108.2	0.00	0.00	0	0	to	0
2	SUM	04/11/10	09/08/10	108.2	113.2	0.00	0.00	0	0	to	0
2	SUM	09/08/10	04/26/11	113.2	120.9	0.00	0.00	0	0	to	0
2	SUM	04/26/11	09/16/11	120.9	125.6	0.00	0.00	0	0	to	0
2	SUM	09/16/11	04/28/12	125.6	133.1	0.00	0.00	0	0	to	0
2	SUM	04/28/12	09/15/12	133.1	137.8	0.00	0.00	0	0	to	0
2	SUM	09/15/12	04/16/13	137.8	144.9	0.00	0.00	0	0	to	0
2	SUM	04/16/13	09/10/13	144.9	149.8	0.00	0.00	0	0	to	0

Estimates of survival for the 3rd release cohort of summer yearlings in RPMA 1 (cohort= 3,128 fish, average fin curl value in cohort = 1).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SUM	09/17/04	04/26/05	14.2	21.6	0.18	0.04	553	307	to	800
3	SUM	04/26/05	09/25/05	21.6	26.7	0.17	0.04	525	289	to	761
3	SUM	09/25/05	04/30/06	26.7	33.9	0.04	0.01	119	46	to	193
3	SUM	04/30/06	09/23/06	33.9	38.8	0.04	0.01	114	44	to	185
3	SUM	09/23/06	05/02/07	38.8	46.1	0.01	0.00	31	8	to	54
3	SUM	05/02/07	10/09/07	46.1	51.5	0.01	0.00	29	7	to	51
3	SUM	10/09/07	04/30/08	51.5	58.3	0.00	0.00	9	0	to	17
3	SUM	04/30/08	09/07/08	58.3	62.6	0.00	0.00	8	0	to	17
3	SUM	09/07/08	05/01/09	62.6	70.5	0.00	0.00	3	0	to	7
3	SUM	05/01/09	10/01/09	70.5	75.6	0.00	0.00	3	0	to	7
3	SUM	10/01/09	04/11/10	75.6	82.0	0.00	0.00	1	0	to	2
3	SUM	04/11/10	09/08/10	82.0	87.0	0.00	0.00	1	0	to	2
3	SUM	09/08/10	04/26/11	87.0	94.6	0.00	0.00	0	0	to	1
3	SUM	04/26/11	09/16/11	94.6	99.4	0.00	0.00	0	0	to	1
3	SUM	09/16/11	04/28/12	99.4	106.9	0.00	0.00	0	0	to	0
3	SUM	04/28/12	09/15/12	106.9	111.6	0.00	0.00	0	0	to	0
3	SUM	09/15/12	04/16/13	111.6	118.7	0.00	0.00	0	0	to	0
3	SUM	04/16/13	09/10/13	118.7	123.6	0.00	0.00	0	0	to	0

Estimates of survival for the 4th release cohort of summer yearlings in RPMA 1 (cohort= 186 fish, average fin curl value in cohort = 1).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SUM	09/25/05	04/30/06	14.2	21.5	0.17	0.04	32	17	to	47
4	SUM	04/30/06	09/23/06	21.5	26.3	0.16	0.04	31	17	to	44
4	SUM	09/23/06	05/02/07	26.3	33.7	0.04	0.01	7	3	to	11
4	SUM	05/02/07	10/09/07	33.7	39.0	0.04	0.01	7	3	to	11
4	SUM	10/09/07	04/30/08	39.0	45.8	0.01	0.00	2	0	to	3
4	SUM	04/30/08	09/07/08	45.8	50.2	0.01	0.00	2	0	to	3
4	SUM	09/07/08	05/01/09	50.2	58.0	0.00	0.00	1	0	to	1
4	SUM	05/01/09	10/01/09	58.0	63.1	0.00	0.00	1	0	to	1
4	SUM	10/01/09	04/11/10	63.1	69.5	0.00	0.00	0	0	to	0
4	SUM	04/11/10	09/08/10	69.5	74.5	0.00	0.00	0	0	to	0
4	SUM	09/08/10	04/26/11	74.5	82.2	0.00	0.00	0	0	to	0
4	SUM	04/26/11	09/16/11	82.2	87.0	0.00	0.00	0	0	to	0
4	SUM	09/16/11	04/28/12	87.0	94.5	0.00	0.00	0	0	to	0
4	SUM	04/28/12	09/15/12	94.5	99.1	0.00	0.00	0	0	to	0
4	SUM	09/15/12	04/16/13	99.1	106.2	0.00	0.00	0	0	to	0
4	SUM	04/16/13	09/10/13	106.2	111.1	0.00	0.00	0	0	to	0

Summary information for Summer Yearlings released in RPMA 1.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as summer yearlings are estimated to still have been alive at the end of the time considered here. There are estimated to be ~158 fish released as summer yearlings alive in the river at the time of the last estimation date (09/10/2013). All of these were ~16.5 years old at that time.

Estimates of surviving proportions and numbers for summer yearling releases in RPMA 1.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 731	SUM	09/10/13	197.6	16.5	0.22	0.04	158	101	to	215
2: 2,038	SUM	09/10/13	149.8	12.5	0.00	0.00	0	0	to	0
3: 3,128	SUM	09/10/13	123.6	10.3	0.00	0.00	0	0	to	0
4: 186	SUM	09/10/13	111.1	9.3	0.00	0.00	0	0	to	0

Summary of number alive as of 09/10/2013 across all releases of fish in RPMA 1.

The previous reports did not provide such information and so such information is new for these analyses. Accordingly, comparisons with previous results cannot be made and will not appear for any RPMA.

Release*	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)	
8: 465	SPR	09/10/13	14.4	1.2	0.98	0.02	457	438	to 465
7: 752	SPR	09/10/13	38.4	3.2	0.47	0.04	356	296	to 417
6: 6,095	SPR	09/10/13	51.1	4.3	0.39	0.04	2,399	1,947	to 2,850
5: 6,292	SPR	09/10/13	62.6	5.2	0.23	0.03	1,454	1,130	to 1,778
4: 6,791	SPR	09/10/13	74.8	6.2	0.22	0.02	1,519	1,187	to 1,851
3: 4,461	SPR	09/10/13	86.9	7.2	0.23	0.03	1,018	755	to 1,282
2: 4,714	SPR	09/10/13	99.2	8.3	0.10	0.02	480	316	to 645
4: 186	SUM	09/10/13	111.1	9.3	0.00	0	0	0	to 0
1: 521	SPR	09/10/13	111.5	9.3	0.18	0.03	94	61	to 127
3: 3,128	SUM	09/10/13	123.6	10.3	0.00	0.00	0	0	to 0
2: 2,038	SUM	09/10/13	149.8	12.5	0.00	0.00	0	0	to 0
1: 731	SUM	09/10/13	197.6	16.5	0.22	0.04	158	101	to 215

**The Release column represents (a) the release cohort for the specific type of release and (b) the number of individuals in that release cohort.*

When summarized by age class, the estimates indicate that ~7,935 (95 CI: 6,231 to 9,630) of the fish that were released from hatcheries in recent years in RPMA 1 were still alive there in September of 2013. The age distribution of these fish is presented in the table below.

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N Alive)	
1	09/10/13	1 to 2	457	5.8	438	to 465
1	09/10/13	3 to 5	4,209	53.0	3,373	to 5,045
1	09/10/13	6 to 8	3,017	38.0	2,258	to 3,778
1	09/10/13	≥9	252	3.2	162	to 342

RPMA 2

Dates and numbers for releases and recapture work on RPMA 2.

Occ	Begin	End	Midpoint	Release Numbers for Each Fish Type			
				Fingerlings		Spring	Summer
1	08/11/98	08/11/98	08/11/98				1 796
2	10/11/00	10/17/00	10/14/00				2 481
3	07/18/02	09/18/02	08/18/02				3 3,138
4	08/07/03	08/28/03	08/17/03				4 4,058
5	04/13/04	04/13/04	04/13/04			1 822	
6	08/16/04	10/21/04	09/21/04	1	16,810		5 1,600
7	04/12/05	05/18/05	04/30/05			2 874	
8	08/15/05	11/02/05	09/23/05	2	12,519		6 175
9	03/28/06	05/31/06	04/29/06			3 6,729	
10	07/13/06	07/13/06	07/13/06				7 1,369
11	08/14/06	11/08/06	09/27/06	3	7,042		
12	04/03/07	05/31/07	05/02/07			4 4,011	
13	08/14/07	10/31/07	09/22/07	4	41,496		
14	03/26/08	06/04/08	04/30/08			5 8,045	
15	07/17/08	07/30/08	07/22/08				8 3,279
16	08/04/08	10/29/08	09/16/08	5	59,027		
17	04/13/09	06/03/09	05/08/09			6 4,964	
18	07/22/09	07/22/09	07/22/09				9 3,810
19	08/03/09	10/28/09	09/15/09	6	41,175		
20	04/05/10	06/02/10	05/04/10			7 10,679	
21	07/28/10	10/21/10	09/08/10	7	4,055		10 1,909
22	04/19/11	06/06/11	05/09/11			8 3,324	
23	08/01/11	10/25/11	09/12/11				11 980
24	04/09/12	06/07/12	05/08/12				
25	07/20/12	10/24/12	09/06/12				
26	04/18/13	06/11/13	05/05/13			9 767	
27	08/12/13	10/29/13	09/20/13				

Dates and numbers for releases and recapture work on RPMA 2 split out by which river the fish were released on. *There are slightly fewer fish presented in this table than in the table above as river or release information was not available for some fish (e.g., 15 fingerlings, 92 spring yearlings, and 101 summer yearlings). Data for all fish were analyzed (fish without river-of-release information were assigned a covariate value of ~0.5 for each river, i.e., treated as being average with respect to river of release). Fish without river-of-release information could not be accounted for when making river-of-release-specific estimates of fish still alive in tables that follow.*

Occ	Midpoint	Release Numbers for Each Fish Type & River of Release								
		Fingerlings		Spring		Summer				
		Miss. R.	Yell. R.	Miss. R.	Yell. R.	Miss. R.	Yell. R.			
1	08/11/98							1	300	486
2	10/14/00							2	180	301
3	08/18/02							3	1,299	1,797
4	08/17/03							4	2,086	1,933
5	04/13/04				1		822			
6	09/21/04	1	11,342	5,468				5	906	685
7	04/30/05				2	562	309			
8	09/23/05	2	8,492	4,027				6		175
9	04/29/06				3	4,411	2,288			
10	07/13/06							7	916	453
11	09/27/06	3	4,733	2,308						
12	05/02/07				4	1,961	1,995			
13	09/22/07	4	20,284	21,211						
14	04/30/08				5	4,984	3,059			
15	07/22/08							8	692	2,586
16	09/16/08	5	27,427	31,591						
17	05/08/09				6	1,821	3,141			
18	07/22/09							9	2,014	1,796
19	09/15/09	6	20,315	20,856						
20	05/04/10				7	5,407	5,272			
21	09/08/10	7	2,022	2,033				10	819	1,090
22	05/09/11				8	1,661	1,663			
23	09/12/11							11	531	449
24	05/08/12									
25	09/06/12									
26	05/05/13				9	378	389			
27	09/20/13									

For RPMA 2, the top model of the mark-recapture data included the following covariates of survival: release type, age of fish, an interaction between release type and age of fish, release site (Missouri vs Yellowstone River), and fin curl status at release. The model of capture probability included release type, fish age, season of year (spring versus fall), river of release (Missouri vs Yellowstone River), an interaction between season of year and river of release, and a measure of total capture effort expended each season (with total effort values standardized to have a mean = 0 and sd = 1). NOTE: fingerlings from the 1st release cohort, which had iridovirus, were dropped from analyses here as the sparse recapture data ($n = 6$ individuals out of 16,810 fish released) caused problems including IV in the models.

In this report, the survival of each cohort in each river of release is presented. For fin curl and iridovirus values, the average values in each cohort for fish released in a given river of release were used.

In the analyses presented here, a small proportion of fish lost their PIT tags between the time of release and the time of first recapture. Such fish could no longer be assigned to a specific river of release, and thus had an unknown covariate value for river of release. These fish were typically able to be assigned based on other markers and attributes to a release occasion and stocking-age class. For those cases, the fish were assigned an average river of release value (~0.5 Missouri, 0.5 Yellowstone) so that these recaptured fish were not ignored in analyzes, which would have biased estimates downwards given that all were recaptured at least once. These fish were not, however, included in calculations of the number of fish remaining alive as that work required knowing river of release. At this time, the numbers of such fish are low enough that this is expected to have a minimal impact on the numbers presented here.

Results for Releases of Fingerlings in RPMA 2

Data on the number of fingerlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 183,604 releases and re-releases of fish originally released as fingerlings had been conducted, which resulted in 1,480 recaptures. The results presented below are based on the analyses of the data for those fish.

Occ. $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27 Total	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	16810																										6
7	0																										0
8	12519	1																									218
9	1	0																									1
10	0																										0
11	7054	1																									372
12	4																										0
13	41579																										84
14	24																										2
15	0																										0
16	59101																										400
17	26																										1
18	0																										0
19	41347	3																									403
20	37																										1
21	4480																										76
22	23																										4
23	183																										8
24	176																										10
25	138																										6
26	102																										1

Fingerlings released in RPMA2 in the Missouri River

Estimates of survival for the 1st healthy release cohort of fingerlings (~2.7 months old at time of release, which was the 3rd cohort of fingerlings) in RPMA 2 in the Missouri River (cohort= 4,733 fish, IV status = 0, Fin Curl status = 0). Estimates are for fish without disease problems (no fin curl or iridovirus) and released in Missouri River. The estimates are for the 1st healthy release (cohort 3 for fingerlings) so as to provide estimates for as many ages as possible for a healthy release cohort.

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)
09/27/06	05/02/07	7.2	2.7	9.9	0.934	(0.013)	0.61	(0.06)	(0.49 to 0.73)
05/02/07	09/22/07	4.8	9.9	14.7	0.960	(0.007)	0.50	(0.07)	(0.37 to 0.64)
09/22/07	04/30/08	7.4	14.7	22.1	0.972	(0.005)	0.41	(0.07)	(0.27 to 0.54)
04/30/08	07/22/08	2.8	22.1	24.8	0.983	(0.004)	0.39	(0.07)	(0.26 to 0.52)
07/22/08	09/16/08	1.9	24.8	26.7	0.986	(0.003)	0.38	(0.07)	(0.25 to 0.51)
09/16/08	05/08/09	7.8	26.7	34.5	0.988	(0.003)	0.34	(0.06)	(0.22 to 0.47)
05/08/09	07/22/09	2.5	34.5	37.0	0.993	(0.002)	0.34	(0.06)	(0.21 to 0.46)
07/22/09	09/15/09	1.8	37.0	38.8	0.994	(0.002)	0.33	(0.06)	(0.21 to 0.46)
09/15/09	05/04/10	7.7	38.8	46.5	0.995	(0.002)	0.32	(0.06)	(0.20 to 0.44)
05/04/10	09/08/10	4.2	46.5	50.8	0.997	(0.001)	0.32	(0.06)	(0.20 to 0.44)
09/08/10	05/09/11	8.1	50.8	58.9	0.998	(0.001)	0.31	(0.06)	(0.19 to 0.43)
05/09/11	09/12/11	4.2	58.9	63.1	0.999	(0.001)	0.31	(0.06)	(0.19 to 0.43)
09/12/11	05/08/12	8.0	63.0	71.0	0.999	(0.001)	0.31	(0.06)	(0.19 to 0.43)
05/08/12	09/06/12	4.0	71.0	75.1	1.000	(0.000)	0.31	(0.06)	(0.19 to 0.43)
09/06/12	05/05/13	8.0	75.1	83.1	1.000	(0.000)	0.31	(0.06)	(0.19 to 0.43)
05/05/13	09/20/13	4.6	83.1	87.7	1.000	(0.000)	0.31	(0.06)	(0.19 to 0.43)

From these results, it can be seen that monthly survival rates for fish released as fingerlings are estimated to have relatively high monthly survival rates, and that monthly rates are estimated quite precisely.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.0	12.0	0.50	0.07
2.0	24.0	0.76	0.30
3.0	36.1	0.87	0.30
4.0	48.1	0.97	0.27
5.0	60.4	0.97	0.28
6.0	72.4	1.00	0.00

When the number of fish released in a cohort is taken into account, it is possible to estimate the number of fish from each cohort that are estimated to be alive through time. The tables below do this for each release type, cohort, and river of release using **the average value for the cohort's disease status**.

Estimates of survival for the 1st release cohort of fingerlings in RPMA 2 in the Missouri River (cohort= 11,342 fish, IV status = 1, Fin Curl status = 0). *Previous estimates of survival were very low indicating that a very low proportion of this cohort would still be alive. In the current analyses, models including the IV status of fingerlings had estimation problems including lack of convergence. Given the sparse nature of recaptures for this group and the associated computational difficulties that were encountered in running models including IV status, fish from this release cohort were not included in the analyses here. It seems readily apparent from previous analyses that few members of this group are likely to have been alive by 2013.*

Estimates of survival for the 2nd release cohort of fingerlings in RPMA 2 in the Missouri River (cohort= 8,492 fish, IV status = 0, Fin Curl status = 0.13).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	FNG	09/23/05	04/29/06	2.7	9.9	0.57	0.07	4,818	3,712	to	5,924
2	FNG	04/29/06	07/13/06	9.9	12.4	0.51	0.07	4,290	3,152	to	5,427
2	FNG	07/13/06	09/27/06	12.4	15.0	0.46	0.07	3,889	2,750	to	5,028
2	FNG	09/27/06	05/02/07	15.0	22.2	0.36	0.07	3,079	1,982	to	4,176
2	FNG	05/02/07	09/22/07	22.2	27.0	0.33	0.06	2,810	1,749	to	3,871
2	FNG	09/22/07	04/30/08	27.0	34.4	0.30	0.06	2,544	1,523	to	3,564
2	FNG	04/30/08	07/22/08	34.4	37.1	0.29	0.06	2,489	1,478	to	3,500
2	FNG	07/22/08	09/16/08	37.1	39.0	0.29	0.06	2,459	1,453	to	3,465
2	FNG	09/16/08	05/08/09	39.0	46.8	0.28	0.06	2,354	1,363	to	3,344
2	FNG	05/08/09	07/22/09	46.8	49.3	0.27	0.06	2,335	1,347	to	3,323
2	FNG	07/22/09	09/15/09	49.3	51.1	0.27	0.06	2,324	1,337	to	3,311
2	FNG	09/15/09	05/04/10	51.1	58.8	0.27	0.06	2,283	1,300	to	3,265
2	FNG	05/04/10	09/08/10	58.8	63.0	0.27	0.06	2,270	1,289	to	3,252
2	FNG	09/08/10	05/09/11	63.0	71.1	0.27	0.06	2,253	1,272	to	3,233
2	FNG	05/09/11	09/12/11	71.2	75.4	0.26	0.06	2,248	1,267	to	3,228
2	FNG	09/12/11	05/08/12	75.4	83.3	0.26	0.06	2,241	1,260	to	3,221
2	FNG	05/08/12	09/06/12	83.3	87.4	0.26	0.06	2,239	1,258	to	3,219
2	FNG	09/06/12	05/05/13	87.4	95.4	0.26	0.06	2,236	1,255	to	3,216
2	FNG	05/05/13	09/20/13	95.4	100.0	0.26	0.06	2,235	1,254	to	3,216

**Estimates of survival for the 3rd release cohort of fingerlings in RPMA 2 in the Missouri River
(cohort= 4,733 fish, IV status = 0, Fin Curl status = 0).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	FNG	09/27/06	05/02/07	2.7	9.9	0.61	0.06	2,888	2,300	to	3,476
3	FNG	05/02/07	09/22/07	9.9	14.7	0.50	0.07	2,378	1,747	to	3,009
3	FNG	09/22/07	04/30/08	14.7	22.1	0.41	0.07	1,922	1,298	to	2,547
3	FNG	04/30/08	07/22/08	22.1	24.8	0.39	0.07	1,834	1,218	to	2,450
3	FNG	07/22/08	09/16/08	24.8	26.7	0.38	0.07	1,788	1,177	to	2,398
3	FNG	09/16/08	05/08/09	26.7	34.5	0.34	0.06	1,627	1,035	to	2,220
3	FNG	05/08/09	07/22/09	34.5	37.0	0.34	0.06	1,600	1,011	to	2,189
3	FNG	07/22/09	09/15/09	37.0	38.8	0.33	0.06	1,583	997	to	2,170
3	FNG	09/15/09	05/04/10	38.8	46.5	0.32	0.06	1,524	944	to	2,104
3	FNG	05/04/10	09/08/10	46.5	50.8	0.32	0.06	1,506	928	to	2,084
3	FNG	09/08/10	05/09/11	50.8	58.9	0.31	0.06	1,481	904	to	2,057
3	FNG	05/09/11	09/12/11	58.9	63.1	0.31	0.06	1,474	898	to	2,050
3	FNG	09/12/11	05/08/12	63.0	71.0	0.31	0.06	1,464	888	to	2,040
3	FNG	05/08/12	09/06/12	71.0	75.1	0.31	0.06	1,461	885	to	2,037
3	FNG	09/06/12	05/05/13	75.1	83.1	0.31	0.06	1,457	881	to	2,033
3	FNG	05/05/13	09/20/13	83.1	87.7	0.31	0.06	1,456	880	to	2,032

**Estimates of survival for the 4th release cohort of fingerlings in RPMA 2 in the Missouri River
(cohort= 20,284 fish, IV status = 0, Fin Curl status = 0).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	FNG	09/22/07	04/30/08	2.7	10.1	0.60	0.06	12,259	9,713	to	14,805
4	FNG	04/30/08	07/22/08	10.1	12.8	0.54	0.07	10,963	8,303	to	13,623
4	FNG	07/22/08	09/16/08	12.8	14.7	0.51	0.07	10,307	7,625	to	12,989
4	FNG	09/16/08	05/08/09	14.7	22.5	0.41	0.07	8,230	5,567	to	10,893
4	FNG	05/08/09	07/22/09	22.5	25.0	0.39	0.07	7,900	5,269	to	10,531
4	FNG	07/22/09	09/15/09	25.0	26.8	0.38	0.07	7,705	5,096	to	10,315
4	FNG	09/15/09	05/04/10	26.8	34.5	0.35	0.06	7,029	4,492	to	9,566
4	FNG	05/04/10	09/08/10	34.5	38.8	0.34	0.06	6,830	4,317	to	9,343
4	FNG	09/08/10	05/09/11	38.8	46.9	0.32	0.06	6,559	4,074	to	9,044
4	FNG	05/09/11	09/12/11	46.9	51.1	0.32	0.06	6,484	4,005	to	8,963
4	FNG	09/12/11	05/08/12	51.0	59.0	0.31	0.06	6,380	3,908	to	8,852
4	FNG	05/08/12	09/06/12	59.0	63.1	0.31	0.06	6,351	3,880	to	8,823
4	FNG	09/06/12	05/05/13	63.0	71.1	0.31	0.06	6,309	3,838	to	8,779
4	FNG	05/05/13	09/20/13	71.1	75.7	0.31	0.06	6,295	3,824	to	8,766

**Estimates of survival for the 5th release cohort of fingerlings in RPMA 2 in the Missouri River
(cohort= 27,427 fish, IV status = 0, Fin Curl status = 0.14).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	FNG	09/16/08	05/08/09	2.7	10.5	0.55	0.07	15,149	11,495	to	18,803
5	FNG	05/08/09	07/22/09	10.5	13.0	0.50	0.07	13,584	9,863	to	17,306
5	FNG	07/22/09	09/15/09	13.0	14.8	0.46	0.07	12,708	8,994	to	16,422
5	FNG	09/15/09	05/04/10	14.8	22.5	0.36	0.07	9,939	6,369	to	13,508
5	FNG	05/04/10	09/08/10	22.5	26.7	0.34	0.06	9,200	5,735	to	12,665
5	FNG	09/08/10	05/09/11	26.7	34.8	0.30	0.06	8,253	4,936	to	11,570
5	FNG	05/09/11	09/12/11	34.8	39.0	0.29	0.06	8,000	4,726	to	11,273
5	FNG	09/12/11	05/08/12	39.0	47.0	0.28	0.06	7,659	4,439	to	10,879
5	FNG	05/08/12	09/06/12	47.0	51.0	0.28	0.06	7,566	4,359	to	10,773
5	FNG	09/06/12	05/05/13	51.0	59.1	0.27	0.06	7,430	4,239	to	10,620
5	FNG	05/05/13	09/20/13	59.1	63.7	0.27	0.06	7,387	4,200	to	10,573

**Estimates of survival for the 6th release cohort of fingerlings in RPMA 2 in the Missouri River
(cohort= 20,315 fish, IV status = 0, Fin Curl status = 0).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	FNG	09/15/09	05/04/10	2.7	10.4	0.59	0.07	12,004	9,399	to	14,609
6	FNG	05/04/10	09/08/10	10.4	14.6	0.50	0.07	10,162	7,431	to	12,893
6	FNG	09/08/10	05/09/11	14.6	22.7	0.40	0.07	8,034	5,347	to	10,721
6	FNG	05/09/11	09/12/11	22.7	26.9	0.37	0.07	7,508	4,881	to	10,136
6	FNG	09/12/11	05/08/12	26.9	34.9	0.34	0.06	6,831	4,289	to	9,374
6	FNG	05/08/12	09/06/12	34.9	38.9	0.33	0.06	6,651	4,135	to	9,168
6	FNG	09/06/12	05/05/13	38.9	46.9	0.31	0.06	6,393	3,910	to	8,877
6	FNG	05/05/13	09/20/13	46.9	51.5	0.31	0.06	6,313	3,839	to	8,788

Estimates of survival for the 7th release cohort of fingerlings in RPMA 2 in the Missouri River (cohort= 2,022 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	FNG	09/08/10	05/09/11	2.7	10.8	0.57	0.07	1,163	897	<i>to</i>	1,428
7	FNG	05/09/11	09/12/11	10.8	15.0	0.49	0.07	990	716	<i>to</i>	1,264
7	FNG	09/12/11	05/08/12	15.0	22.9	0.39	0.07	790	522	<i>to</i>	1,059
7	FNG	05/08/12	09/06/12	22.9	27.0	0.37	0.07	742	479	<i>to</i>	1,004
7	FNG	09/06/12	05/05/13	27.0	35.0	0.33	0.06	675	421	<i>to</i>	928
7	FNG	05/05/13	09/20/13	35.0	39.6	0.32	0.06	655	404	<i>to</i>	905

Summary information for Fingerlings released in RPMA 2 in the Missouri River.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort (except those from the 1st cohort) are assembled, one can review how many fish released as fingerlings in the Missouri River are estimated to still be alive. The estimates indicate that substantial proportions of cohorts and numbers of fish are still alive in RPMA 2 from Missouri River releases. There are estimated to be ~24,341 fish (excluding any that might remain from the initial release – see above) released as fingerlings alive in the river at the time of the last estimation date (09/20/2013). Of these ~59% (14,355) were ~3- to ~5-years old, ~41% (9,986) were ~6- to ~8-years old, and none were ≥9 years old.

Estimates of surviving proportions and numbers for fingerling releases in RPMA 2 in the Missouri River.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 11,342	FNG	09/20/13	112.2	9.4						
2: 8,492	FNG	09/20/13	100.0	8.3	0.26	0.06	2,235	1,254	<i>to</i>	3,216
3: 4,733	FNG	09/20/13	87.7	7.3	0.31	0.06	1,456	880	<i>to</i>	2,032
4: 20,284	FNG	09/20/13	75.7	6.3	0.31	0.06	6,295	3,824	<i>to</i>	8,766
5: 27,427	FNG	09/20/13	63.7	5.3	0.27	0.06	7,387	4,200	<i>to</i>	10,573
6: 20,315	FNG	09/20/13	51.5	4.3	0.31	0.06	6,313	3,839	<i>to</i>	8,788
7: 2,022	FNG	09/20/13	39.6	3.3	0.32	0.06	655	404	<i>to</i>	905

Fingerlings released in RPMA2 in the Yellowstone River

Estimates of survival for the 1st healthy release cohort of fingerlings (~2.7 months old at time of release, which was the 3rd cohort of fingerlings) in RPMA 2 in the Yellowstone River (cohort= 2,308 fish, IV status = 0, Fin Curl status = 0). Estimates are for fish without disease problems (no fin curl or iridovirus) and released in Yellowstone River. The estimates are for the 1st healthy release (cohort 3 for fingerlings) so as to provide estimates for as many ages as possible for a healthy release cohort.

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)	
09/27/06	05/02/07	7.2	2.7	9.9	0.868	(0.017)	0.36	(0.05)	0.26	to 0.46
05/02/07	09/22/07	4.8	9.9	14.7	0.918	(0.006)	0.24	(0.04)	0.16	to 0.32
09/22/07	04/30/08	7.4	14.7	22.1	0.941	(0.004)	0.15	(0.03)	0.10	to 0.20
04/30/08	07/22/08	2.8	22.1	24.8	0.965	(0.005)	0.14	(0.02)	0.09	to 0.18
07/22/08	09/16/08	1.9	24.8	26.7	0.971	(0.005)	0.13	(0.02)	0.09	to 0.17
09/16/08	05/08/09	7.8	26.7	34.5	0.975	(0.005)	0.11	(0.02)	0.07	to 0.14
05/08/09	07/22/09	2.5	34.5	37.0	0.986	(0.004)	0.10	(0.02)	0.07	to 0.14
07/22/09	09/15/09	1.8	37.0	38.8	0.988	(0.004)	0.10	(0.02)	0.07	to 0.13
09/15/09	05/04/10	7.7	38.8	46.5	0.989	(0.004)	0.09	(0.01)	0.07	to 0.12
05/04/10	09/08/10	4.2	46.5	50.8	0.994	(0.003)	0.09	(0.01)	0.06	to 0.12
09/08/10	05/09/11	8.1	50.8	58.9	0.996	(0.002)	0.09	(0.01)	0.06	to 0.11
05/09/11	09/12/11	4.2	58.9	63.1	0.998	(0.001)	0.09	(0.01)	0.06	to 0.11
09/12/11	05/08/12	8.0	63.0	71.0	0.998	(0.001)	0.09	(0.01)	0.06	to 0.11
05/08/12	09/06/12	4.0	71.0	75.1	0.999	(0.001)	0.09	(0.01)	0.06	to 0.11
09/06/12	05/05/13	8.0	75.1	83.1	0.999	(0.001)	0.08	(0.01)	0.06	to 0.11
05/05/13	09/20/13	4.6	83.1	87.7	1.000	(0.000)	0.08	(0.01)	0.06	to 0.11

Rates for the fingerlings released on the Yellowstone River are lower than those for fish released on the Missouri River over the same intervals and ages.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.0	12.0	0.24	0.04
2.0	24.0	0.54	0.42
3.0	36.1	0.77	0.33
4.0	48.1	0.90	0.25

Estimates of survival for the 1st release cohort of fingerlings in RPMA 2 in the Yellowstone River (cohort= 5,468 fish, IV status = 1, Fin Curl status = 0). *Previous estimates of survival were very low indicating that a very low proportion of this cohort would still be alive. In the current analyses, models including the IV status of fingerlings had estimation problems including lack of convergence. Given the sparse nature of recaptures for this group and the associated computational difficulties that were encountered in running models including IV status, fish from this release cohort were not included in the analyses here. It seems readily apparent from previous analyses that few members of this group are likely to have been alive by 2013.*

**Estimates of survival for the 2nd release cohort of fingerlings in RPMA 2 in the Yellowstone River
(cohort= 4,027 fish, IV status = 0, Fin Curl status = 0.14).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	FNG	09/23/05	04/29/06	2.7	9.9	0.31	0.05	1,231	852	<i>to</i>	1,611
2	FNG	04/29/06	07/13/06	9.9	12.4	0.24	0.04	962	639	<i>to</i>	1,285
2	FNG	07/13/06	09/27/06	12.4	15.0	0.19	0.03	780	507	<i>to</i>	1,053
2	FNG	09/27/06	05/02/07	15.0	22.2	0.12	0.02	473	300	<i>to</i>	645
2	FNG	05/02/07	09/22/07	22.2	27.0	0.10	0.02	388	251	<i>to</i>	525
2	FNG	09/22/07	04/30/08	27.0	34.4	0.08	0.01	313	208	<i>to</i>	418
2	FNG	04/30/08	07/22/08	34.4	37.1	0.07	0.01	298	199	<i>to</i>	397
2	FNG	07/22/08	09/16/08	37.1	39.0	0.07	0.01	291	195	<i>to</i>	387
2	FNG	09/16/08	05/08/09	39.0	46.8	0.07	0.01	264	177	<i>to</i>	352
2	FNG	05/08/09	07/22/09	46.8	49.3	0.06	0.01	260	174	<i>to</i>	346
2	FNG	07/22/09	09/15/09	49.3	51.1	0.06	0.01	257	171	<i>to</i>	342
2	FNG	09/15/09	05/04/10	51.1	58.8	0.06	0.01	247	163	<i>to</i>	331
2	FNG	05/04/10	09/08/10	58.8	63.0	0.06	0.01	244	160	<i>to</i>	328
2	FNG	09/08/10	05/09/11	63.0	71.1	0.06	0.01	240	156	<i>to</i>	324
2	FNG	05/09/11	09/12/11	71.2	75.4	0.06	0.01	239	155	<i>to</i>	323
2	FNG	09/12/11	05/08/12	75.4	83.3	0.06	0.01	237	153	<i>to</i>	322
2	FNG	05/08/12	09/06/12	83.3	87.4	0.06	0.01	237	153	<i>to</i>	321
2	FNG	09/06/12	05/05/13	87.4	95.4	0.06	0.01	236	152	<i>to</i>	321
2	FNG	05/05/13	09/20/13	95.4	100.0	0.06	0.01	236	151	<i>to</i>	321

**Estimates of survival for the 3rd release cohort of fingerlings in RPMA 2 in the Yellowstone River
(cohort= 2,308 fish, IV status = 0, Fin Curl status = 0).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	FNG	09/27/06	05/02/07	2.7	9.9	0.36	0.05	832	607	to	1,057
3	FNG	05/02/07	09/22/07	9.9	14.7	0.24	0.04	554	377	to	731
3	FNG	09/22/07	04/30/08	14.7	22.1	0.15	0.03	354	235	to	473
3	FNG	04/30/08	07/22/08	22.1	24.8	0.14	0.02	320	215	to	426
3	FNG	07/22/08	09/16/08	24.8	26.7	0.13	0.02	303	205	to	401
3	FNG	09/16/08	05/08/09	26.7	34.5	0.11	0.02	248	172	to	325
3	FNG	05/08/09	07/22/09	34.5	37.0	0.10	0.02	239	167	to	312
3	FNG	07/22/09	09/15/09	37.0	38.8	0.10	0.02	234	163	to	305
3	FNG	09/15/09	05/04/10	38.8	46.5	0.09	0.01	216	151	to	281
3	FNG	05/04/10	09/08/10	46.5	50.8	0.09	0.01	210	147	to	274
3	FNG	09/08/10	05/09/11	50.8	58.9	0.09	0.01	203	141	to	265
3	FNG	05/09/11	09/12/11	58.9	63.1	0.09	0.01	201	139	to	263
3	FNG	09/12/11	05/08/12	63.0	71.0	0.09	0.01	198	136	to	260
3	FNG	05/08/12	09/06/12	71.0	75.1	0.09	0.01	197	135	to	259
3	FNG	09/06/12	05/05/13	75.1	83.1	0.08	0.01	196	134	to	258
3	FNG	05/05/13	09/20/13	83.1	87.7	0.08	0.01	196	134	to	258

**Estimates of survival for the 4th release cohort of fingerlings in RPMA 2 in the Yellowstone River
(cohort= 21,211 fish, IV status = 0, Fin Curl status = 0).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	FNG	09/22/07	04/30/08	2.7	10.1	0.35	0.05	7,500	5,432	to	9,568
4	FNG	04/30/08	07/22/08	10.1	12.8	0.28	0.04	5,935	4,139	to	7,731
4	FNG	07/22/08	09/16/08	12.8	14.7	0.25	0.04	5,212	3,593	to	6,832
4	FNG	09/16/08	05/08/09	14.7	22.5	0.15	0.03	3,244	2,174	to	4,313
4	FNG	05/08/09	07/22/09	22.5	25.0	0.14	0.02	2,974	2,013	to	3,935
4	FNG	07/22/09	09/15/09	25.0	26.8	0.13	0.02	2,820	1,923	to	3,717
4	FNG	09/15/09	05/04/10	26.8	34.5	0.11	0.02	2,319	1,616	to	3,023
4	FNG	05/04/10	09/08/10	34.5	38.8	0.10	0.02	2,181	1,530	to	2,833
4	FNG	09/08/10	05/09/11	38.8	46.9	0.09	0.01	2,001	1,405	to	2,597
4	FNG	05/09/11	09/12/11	46.9	51.1	0.09	0.01	1,952	1,367	to	2,537
4	FNG	09/12/11	05/08/12	51.0	59.0	0.09	0.01	1,886	1,311	to	2,460
4	FNG	05/08/12	09/06/12	59.0	63.1	0.09	0.01	1,867	1,294	to	2,441
4	FNG	09/06/12	05/05/13	63.0	71.1	0.09	0.01	1,841	1,267	to	2,414
4	FNG	05/05/13	09/20/13	71.1	75.7	0.09	0.01	1,832	1,258	to	2,407

**Estimates of survival for the 5th release cohort of fingerlings in RPMA 2 in the Yellowstone River
(cohort= 31,491 fish, IV status = 0, Fin Curl status = 0.18).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	FNG	09/16/08	05/08/09	2.7	10.5	0.27	0.05	8,500	5,606	to	11,394
5	FNG	05/08/09	07/22/09	10.5	13.0	0.21	0.04	6,647	4,219	to	9,075
5	FNG	07/22/09	09/15/09	13.0	14.8	0.18	0.03	5,715	3,581	to	7,850
5	FNG	09/15/09	05/04/10	14.8	22.5	0.10	0.02	3,270	1,991	to	4,549
5	FNG	05/04/10	09/08/10	22.5	26.7	0.09	0.02	2,740	1,707	to	3,773
5	FNG	09/08/10	05/09/11	26.7	34.8	0.07	0.01	2,135	1,374	to	2,895
5	FNG	05/09/11	09/12/11	34.8	39.0	0.06	0.01	1,986	1,292	to	2,681
5	FNG	09/12/11	05/08/12	39.0	47.0	0.06	0.01	1,797	1,172	to	2,421
5	FNG	05/08/12	09/06/12	47.0	51.0	0.06	0.01	1,746	1,137	to	2,356
5	FNG	09/06/12	05/05/13	51.0	59.1	0.05	0.01	1,674	1,080	to	2,269
5	FNG	05/05/13	09/20/13	59.1	63.7	0.05	0.01	1,652	1,060	to	2,244

**Estimates of survival for the 6th release cohort of fingerlings in RPMA 2 in the Yellowstone River
(cohort= 20,856 fish, IV status = 0, Fin Curl status = 0).**

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	FNG	09/15/09	05/04/10	2.7	10.4	0.34	0.05	7,039	5,012	to	9,067
6	FNG	05/04/10	09/08/10	10.4	14.6	0.24	0.04	4,964	3,345	to	6,584
6	FNG	09/08/10	05/09/11	14.6	22.7	0.15	0.03	3,025	1,980	to	4,070
6	FNG	05/09/11	09/12/11	22.7	26.9	0.13	0.02	2,620	1,744	to	3,496
6	FNG	09/12/11	05/08/12	26.9	34.9	0.10	0.02	2,143	1,464	to	2,822
6	FNG	05/08/12	09/06/12	34.9	38.9	0.10	0.02	2,024	1,395	to	2,654
6	FNG	09/06/12	05/05/13	38.9	46.9	0.09	0.01	1,860	1,289	to	2,432
6	FNG	05/05/13	09/20/13	46.9	51.5	0.09	0.01	1,811	1,254	to	2,368

Estimates of survival for the 7th release cohort of fingerlings in RPMA 2 in the Yellowstone River (cohort= 2,033 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	FNG	09/08/10	05/09/11	2.7	10.8	0.32	0.05	649	452	to	845
7	FNG	05/09/11	09/12/11	10.8	15.0	0.23	0.04	463	307	to	619
7	FNG	09/12/11	05/08/12	15.0	22.9	0.14	0.03	288	187	to	389
7	FNG	05/08/12	09/06/12	22.9	27.0	0.12	0.02	252	166	to	337
7	FNG	09/06/12	05/05/13	27.0	35.0	0.10	0.02	206	140	to	272
7	FNG	05/05/13	09/20/13	35.0	39.6	0.09	0.02	193	132	to	253

Summary information for Fingerlings released in RPMA 2 in the Yellowstone River.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as fingerlings in the Yellowstone River are estimated to still be alive. The estimates indicate that substantial proportions of cohorts and numbers of fish are still alive in RPMA 2 from Yellowstone River releases. There are estimated to be ~5,920 fish released as fingerlings alive in the river at the time of the last estimation date (09/208/2013). Of these ~62% (3,656) were ~3- to ~5-years old, ~38% (2,264) were ~6- to ~8-years old, and none were ≥ 9 years old.

Estimates of surviving proportions and numbers for fingerling releases in RPMA 2 in the Yellowstone River.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 5,468	FNG	09/20/13	112.2	9.4						
2: 4,027	FNG	09/20/13	100.0	8.3	0.06	0.01	236	151	to	321
3: 2,308	FNG	09/20/13	87.7	7.3	0.08	0.01	196	134	to	258
4: 21,211	FNG	09/20/13	75.7	6.3	0.09	0.01	1,832	1,258	to	2,407
5: 31,591	FNG	09/20/13	63.7	5.3	0.05	0.01	1,652	1,060	to	2,244
6: 20,856	FNG	09/20/13	51.5	4.3	0.09	0.01	1,811	1,254	to	2,368
7: 2,033	FNG	09/20/13	39.6	3.3	0.09	0.02	193	132	to	253

Summary information for Fingerlings released in RPMA 2 in the Missouri & Yellowstone Rivers.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as fingerlings in the Missouri and Yellowstone River are estimated to have still been alive in September 2013. The estimates indicate that substantial proportions of cohorts and numbers of fish were still alive in RPMA 2 from those releases. Approximately 30,261 fish released as fingerlings were estimated to have been alive in the river at the time of the last estimation date (09/20/2013). Of these ~60% (18,011) were ~3- to ~5-years old, ~40% (12,250) were ~6- to ~8-years old, and none were ≥ 9 years old.

	Release	Type	Date	Age in months	Age in years	N Alive	(95% CI for N Alive)		
<i>1</i>	16,810	FNG	09/20/13	112.2	9.4				
<i>2</i>	12,519	FNG	09/20/13	100.0	8.3	2,471	1,405	<i>to</i>	3,537
<i>3</i>	7,042	FNG	09/20/13	87.7	7.3	1,652	1,014	<i>to</i>	2,290
<i>4</i>	41,496	FNG	09/20/13	75.7	6.3	8,127	5,082	<i>to</i>	11,173
<i>5</i>	59,027	FNG	09/20/13	63.7	5.3	9,039	5,260	<i>to</i>	12,817
<i>6</i>	41,175	FNG	09/20/13	51.5	4.3	8,124	5,093	<i>to</i>	11,156
<i>7</i>	4,055	FNG	09/20/13	39.6	3.3	848	536	<i>to</i>	1,158

Results for Releases of Spring Yearlings in RPMA 2

Data on the number of spring yearlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 41,741 releases and re-releases of fish originally released as spring yearlings had been conducted, which resulted in 1,526 recaptures. The results presented below are based on those data.

Occ.	$R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27 Total			
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	822	0	0	0	0	0	0	0	0	0	1	0	1	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	6	
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7	874	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	1	2	0	1	12	0	
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	6729	0	0	0	0	0	0	0	0	0	39	2	29	8	0	8	3	0	27	5	47	2	20	7	13	2	14	226	0	
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	41	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	3	
12	4013	0	0	0	0	0	0	0	0	0	0	44	10	0	19	10	0	35	11	76	1	11	6	20	2	20	265	0		
13	75	0	0	0	0	0	0	0	0	0	0	2	0	1	0	1	0	0	1	0	3	0	0	0	0	0	0	0	7	
14	8065	0	0	0	0	0	0	0	0	0	0	0	0	0	40	15	0	41	5	58	2	10	5	6	4	13	199	0		
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
16	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	
17	4992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81	5	60	7	27	9	20	10	9	228	0	
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19	193	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0
20	10705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0
21	487	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0
22	3348	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0
23	234	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0
24	97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0
25	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0
26	832	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0

Spring Yearlings released in RPMA2 in the Missouri River

Estimates of survival for the 1st healthy release cohort of spring yearlings (~9.6 months old at time of release, which was 4/30/2005) in RPMA 2 in the Missouri River. Estimates are for fish without disease problems (no fin curl or iridovirus) and released in the Missouri River.

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)
04/30/05	09/23/05	4.9	9.6	14.4	0.973	(0.004)	0.87	(0.02)	(0.84 to 0.91)
09/23/05	04/29/06	7.3	14.4	21.7	0.974	(0.004)	0.72	(0.04)	(0.65 to 0.80)
04/29/06	07/13/06	2.5	21.7	24.2	0.977	(0.003)	0.68	(0.04)	(0.60 to 0.76)
07/13/06	09/27/06	2.5	24.2	26.7	0.977	(0.003)	0.64	(0.04)	(0.56 to 0.73)
09/27/06	05/02/07	7.2	26.7	34.0	0.978	(0.003)	0.55	(0.05)	(0.45 to 0.65)
05/02/07	09/22/07	4.8	34.0	38.7	0.980	(0.003)	0.50	(0.05)	(0.40 to 0.60)
09/22/07	04/30/08	7.4	38.7	46.1	0.981	(0.003)	0.43	(0.05)	(0.33 to 0.54)
04/30/08	07/22/08	2.8	46.1	48.9	0.983	(0.003)	0.41	(0.05)	(0.31 to 0.52)
07/22/08	09/16/08	1.9	48.9	50.7	0.983	(0.003)	0.40	(0.05)	(0.29 to 0.51)
09/16/08	05/08/09	7.8	50.7	58.5	0.984	(0.003)	0.35	(0.05)	(0.25 to 0.46)
05/08/09	07/22/09	2.5	58.5	61.0	0.985	(0.003)	0.34	(0.05)	(0.23 to 0.44)
07/22/09	09/15/09	1.8	61.0	62.9	0.986	(0.003)	0.33	(0.05)	(0.22 to 0.44)
09/15/09	05/04/10	7.7	62.9	70.6	0.986	(0.003)	0.30	(0.05)	(0.19 to 0.40)
05/04/10	09/08/10	4.2	70.6	74.8	0.987	(0.003)	0.28	(0.05)	(0.17 to 0.38)
09/08/10	05/09/11	8.1	74.8	82.9	0.988	(0.003)	0.25	(0.05)	(0.15 to 0.36)
05/09/11	09/12/11	4.2	82.9	87.1	0.989	(0.003)	0.24	(0.05)	(0.14 to 0.35)
09/12/11	05/08/12	8.0	87.1	95.1	0.990	(0.003)	0.22	(0.05)	(0.12 to 0.33)
05/08/12	09/06/12	4.0	95.1	99.1	0.991	(0.003)	0.21	(0.05)	(0.11 to 0.32)
09/06/12	05/05/13	8.0	99.1	107.1	0.991	(0.003)	0.20	(0.05)	(0.09 to 0.30)
05/05/13	09/20/13	4.6	107.1	111.7	0.992	(0.003)	0.19	(0.05)	(0.09 to 0.30)

From these results, it can be seen that monthly survival rates for fish released as spring yearlings are estimated to have relatively high monthly survival rates, and that monthly rates are estimated quite precisely.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.0	12.1	0.72	0.04
2.0	24.4	0.76	0.14
3.0	36.5	0.78	0.19
4.1	48.9	0.81	0.23
5.1	61.0	0.86	0.26
6.1	73.3	0.83	0.31
7.1	85.5	0.88	0.34
8.1	97.5	0.91	0.37

When the number of fish released in a cohort is taken into account, it is possible to estimate the number of fish from each cohort that are estimated to be alive through time. The tables below do this for each release type, cohort, and river of release using **the average value for the cohort's disease status.**

Estimates of survival for the 1st release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 562 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SPR	04/30/05	09/23/05	9.6	14.4	0.87	0.02	492	470	<i>to</i>	513
1	SPR	09/23/05	04/29/06	14.4	21.7	0.72	0.04	407	366	<i>to</i>	449
1	SPR	04/29/06	07/13/06	21.7	24.2	0.68	0.04	384	338	<i>to</i>	430
1	SPR	07/13/06	09/27/06	24.2	26.7	0.64	0.04	362	313	<i>to</i>	412
1	SPR	09/27/06	05/02/07	26.7	34	0.55	0.05	309	253	<i>to</i>	364
1	SPR	05/02/07	09/22/07	34	38.7	0.50	0.05	280	222	<i>to</i>	338
1	SPR	09/22/07	04/30/08	38.7	46.1	0.43	0.05	243	184	<i>to</i>	303
1	SPR	04/30/08	07/22/08	46.1	48.9	0.41	0.05	232	172	<i>to</i>	291
1	SPR	07/22/08	09/16/08	48.9	50.7	0.40	0.05	225	165	<i>to</i>	284
1	SPR	09/16/08	05/08/09	50.7	58.5	0.35	0.05	197	138	<i>to</i>	257
1	SPR	05/08/09	07/22/09	58.5	61	0.34	0.05	190	131	<i>to</i>	250
1	SPR	07/22/09	09/15/09	61	62.9	0.33	0.05	185	126	<i>to</i>	245
1	SPR	09/15/09	05/04/10	62.9	70.6	0.30	0.05	166	107	<i>to</i>	225
1	SPR	05/04/10	09/08/10	70.6	74.8	0.28	0.05	157	98	<i>to</i>	216
1	SPR	09/08/10	05/09/11	74.8	82.9	0.25	0.05	142	84	<i>to</i>	201
1	SPR	05/09/11	09/12/11	82.9	87.1	0.24	0.05	136	77	<i>to</i>	195
1	SPR	09/12/11	05/08/12	87.1	95.1	0.22	0.05	125	66	<i>to</i>	184
1	SPR	05/08/12	09/06/12	95.1	99.1	0.21	0.05	120	62	<i>to</i>	179
1	SPR	09/06/12	05/05/13	99.1	107.1	0.20	0.05	112	53	<i>to</i>	171
1	SPR	05/05/13	09/20/13	107.1	111.7	0.19	0.05	108	49	<i>to</i>	167

Estimates of survival for the 2nd release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 4,411 fish, IV status = 0, Fin Curl status = 0.24).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	SPR	04/29/06	07/13/06	9.6	12.1	0.91	0.01	4,036	3,924	to	4,148
2	SPR	07/13/06	09/27/06	12.1	14.6	0.84	0.02	3,699	3,499	to	3,899
2	SPR	09/27/06	05/02/07	14.6	21.8	0.66	0.04	2,905	2,543	to	3,268
2	SPR	05/02/07	09/22/07	21.8	26.6	0.57	0.05	2,511	2,098	to	2,924
2	SPR	09/22/07	04/30/08	26.6	34	0.46	0.05	2,031	1,584	to	2,478
2	SPR	04/30/08	07/22/08	34	36.7	0.43	0.05	1,888	1,438	to	2,339
2	SPR	07/22/08	09/16/08	36.7	38.6	0.41	0.05	1,800	1,350	to	2,251
2	SPR	09/16/08	05/08/09	38.6	46.4	0.34	0.05	1,483	1,038	to	1,929
2	SPR	05/08/09	07/22/09	46.4	48.9	0.32	0.05	1,402	961	to	1,843
2	SPR	07/22/09	09/15/09	48.9	50.7	0.31	0.05	1,347	909	to	1,785
2	SPR	09/15/09	05/04/10	50.7	58.4	0.26	0.05	1,142	719	to	1,566
2	SPR	05/04/10	09/08/10	58.4	62.7	0.24	0.05	1,052	637	to	1,468
2	SPR	09/08/10	05/09/11	62.7	70.8	0.21	0.05	906	505	to	1,307
2	SPR	05/09/11	09/12/11	70.8	75	0.19	0.05	845	451	to	1,239
2	SPR	09/12/11	05/08/12	75	82.9	0.17	0.04	745	361	to	1,128
2	SPR	05/08/12	09/06/12	82.9	87	0.16	0.04	703	324	to	1,082
2	SPR	09/06/12	05/05/13	87	95	0.14	0.04	630	259	to	1,001
2	SPR	05/05/13	09/20/13	95	99.6	0.13	0.04	595	228	to	962

Estimates of survival for the 3rd release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 1,961 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SPR	05/02/07	09/22/07	9.6	14.3	0.88	0.02	1,720	1,646	to	1,795
3	SPR	09/22/07	04/30/08	14.3	21.7	0.72	0.04	1,421	1,276	to	1,567
3	SPR	04/30/08	07/22/08	21.7	24.5	0.68	0.04	1,331	1,170	to	1,493
3	SPR	07/22/08	09/16/08	24.5	26.3	0.65	0.04	1,276	1,106	to	1,446
3	SPR	09/16/08	05/08/09	26.3	34.1	0.55	0.05	1,072	877	to	1,267
3	SPR	05/08/09	07/22/09	34.1	36.6	0.52	0.05	1,019	820	to	1,218
3	SPR	07/22/09	09/15/09	36.6	38.5	0.50	0.05	983	782	to	1,184
3	SPR	09/15/09	05/04/10	38.5	46.2	0.43	0.05	848	640	to	1,055
3	SPR	05/04/10	09/08/10	46.2	50.4	0.40	0.05	787	579	to	996
3	SPR	09/08/10	05/09/11	50.4	58.5	0.35	0.05	689	480	to	897
3	SPR	05/09/11	09/12/11	58.5	62.7	0.33	0.05	647	439	to	854
3	SPR	09/12/11	05/08/12	62.7	70.7	0.29	0.05	577	371	to	784
3	SPR	05/08/12	09/06/12	70.7	74.7	0.28	0.05	548	342	to	754
3	SPR	09/06/12	05/05/13	74.7	82.7	0.25	0.05	497	292	to	702
3	SPR	05/05/13	09/20/13	82.7	87.3	0.24	0.05	472	267	to	677

Estimates of survival for the 4th release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 4,984 fish, IV status = 0, Fin Curl status = 0.26).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SPR	04/30/08	07/22/08	9.6	12.3	0.91	0.01	4,533	4,398	to	4,668
4	SPR	07/22/08	09/16/08	12.3	14.2	0.85	0.02	4,261	4,054	to	4,468
4	SPR	09/16/08	05/08/09	14.2	22	0.66	0.04	3,311	2,902	to	3,720
4	SPR	05/08/09	07/22/09	22	24.5	0.62	0.05	3,076	2,635	to	3,517
4	SPR	07/22/09	09/15/09	24.5	26.3	0.59	0.05	2,920	2,461	to	3,379
4	SPR	09/15/09	05/04/10	26.3	34	0.47	0.05	2,356	1,851	to	2,861
4	SPR	05/04/10	09/08/10	34	38.2	0.42	0.05	2,117	1,606	to	2,628
4	SPR	09/08/10	05/09/11	38.2	46.4	0.35	0.05	1,742	1,234	to	2,250
4	SPR	05/09/11	09/12/11	46.3	50.5	0.32	0.05	1,590	1,088	to	2,092
4	SPR	09/12/11	05/08/12	50.5	58.5	0.27	0.05	1,349	862	to	1,836
4	SPR	05/08/12	09/06/12	58.5	62.5	0.25	0.05	1,251	772	to	1,730
4	SPR	09/06/12	05/05/13	62.5	70.6	0.22	0.05	1,084	620	to	1,549
4	SPR	05/05/13	09/20/13	70.6	75.2	0.20	0.05	1,007	550	to	1,464

Estimates of survival for the 5th release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 1,821 fish, IV status = 0, Fin Curl status = 0.23).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	SPR	05/08/09	07/22/09	9.6	12.1	0.93	0.01	1,700	1,662	to	1,739
5	SPR	07/22/09	09/15/09	12.1	13.9	0.89	0.02	1,619	1,557	to	1,681
5	SPR	09/15/09	05/04/10	13.9	21.6	0.73	0.04	1,325	1,191	to	1,459
5	SPR	05/04/10	09/08/10	21.6	25.8	0.66	0.04	1,199	1,043	to	1,355
5	SPR	09/08/10	05/09/11	25.8	33.9	0.55	0.05	1,000	819	to	1,180
5	SPR	05/09/11	09/12/11	33.9	38.1	0.50	0.05	918	731	to	1,105
5	SPR	09/12/11	05/08/12	38.1	46.1	0.43	0.05	787	594	to	980
5	SPR	05/08/12	09/06/12	46.1	50.1	0.40	0.05	733	540	to	927
5	SPR	09/06/12	05/05/13	50.1	58.1	0.35	0.05	642	448	to	835
5	SPR	05/05/13	09/20/13	58.1	62.7	0.33	0.05	599	406	to	792

Estimates of survival for the 6th release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 5,407 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	SPR	05/04/10	09/08/10	9.6	13.8	0.89	0.02	4,814	4,630	to	4,998
6	SPR	09/08/10	05/09/11	13.8	21.9	0.72	0.04	3,898	3,491	to	4,305
6	SPR	05/09/11	09/12/11	21.9	26.1	0.65	0.04	3,530	3,061	to	3,999
6	SPR	09/12/11	05/08/12	26.1	34.1	0.55	0.05	2,953	2,414	to	3,493
6	SPR	05/08/12	09/06/12	34	38.1	0.50	0.05	2,722	2,166	to	3,278
6	SPR	09/06/12	05/05/13	38.1	46.1	0.43	0.05	2,331	1,758	to	2,904
6	SPR	05/05/13	09/20/13	46.1	50.7	0.40	0.05	2,151	1,576	to	2,726

Estimates of survival for the 7th release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 1,661 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	SPR	05/09/11	09/12/11	9.6	13.8	0.89	0.02	1,480	1,424	to	1,536
7	SPR	09/12/11	05/08/12	13.8	21.7	0.72	0.04	1,202	1,078	to	1,326
7	SPR	05/08/12	09/06/12	21.7	25.8	0.66	0.04	1,093	950	to	1,236
7	SPR	09/06/12	05/05/13	25.8	33.8	0.55	0.05	913	747	to	1,078
7	SPR	05/05/13	09/20/13	33.8	38.4	0.50	0.05	831	660	to	1,002

Estimates of survival for the 8th release cohort of spring yearlings in RPMA 2 in the Missouri River (cohort= 378 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
8	SPR	05/05/13	09/20/13	9.6	14.2	0.88	0.02	333	319	to	347

Summary information for Spring Yearlings released in RPMA 2 in the Missouri River.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as spring yearlings are estimated to still be alive. Point estimates indicate that from those spring yearlings released in the Missouri River in RPMA 2 ~6,096 fish of different ages were still alive in September 2013 and that ~5% (333 fish) were ~1 year old, ~59% (3,581) of those were ~3- to 5-years old, ~34% (2,074) were 6- to 8-years old, and ~2% (108) were ~9 years old at that time.

Estimates of surviving proportions and numbers for spring yearlings released in RPMA 2 in the Missouri River.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 562	SPR	09/20/13	111.7	9.3	0.19	0.05	108	49	to	167
2: 4,411	SPR	09/20/13	99.6	8.3	0.13	0.04	595	228	to	962
3: 1,961	SPR	09/20/13	87.3	7.3	0.24	0.05	472	267	to	677
4: 4,984	SPR	09/20/13	75.2	6.3	0.20	0.05	1,007	550	to	1,464
5: 1,821	SPR	09/20/13	62.7	5.2	0.33	0.05	599	406	to	792
6: 5,407	SPR	09/20/13	50.7	4.2	0.40	0.05	2,151	1,576	to	2,726
7: 1,661	SPR	09/20/13	38.4	3.2	0.50	0.05	831	660	to	1,002
8: 378	SPR	09/20/13	14.2	1.2	0.88	0.02	333	319	to	347

Spring Yearlings released in RPMA2 in the Yellowstone River

Estimates of survival for the 1st healthy release cohort of spring yearlings (~9.6 months old at time of release, which was 4/13/2004) in RPMA 2 in the Yellowstone River. Estimates are for fish without disease problems (no fin curl or iridovirus) and released in the Missouri River.

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)	
04/13/04	09/21/04	5.4	9.6	14.9	0.942	(0.006)	0.73	(0.03)	<i>(0.68 to 0.78)</i>	
09/21/04	04/30/05	7.4	14.9	22.3	0.946	(0.005)	0.48	(0.04)	<i>(0.41 to 0.55)</i>	
04/30/05	09/23/05	4.9	22.3	27.2	0.950	(0.003)	0.38	(0.03)	<i>(0.31 to 0.44)</i>	
09/23/05	04/29/06	7.3	27.2	34.4	0.953	(0.003)	0.27	(0.03)	<i>(0.21 to 0.32)</i>	
04/29/06	07/13/06	2.5	34.4	36.9	0.957	(0.002)	0.24	(0.03)	<i>(0.19 to 0.29)</i>	
07/13/06	09/27/06	2.5	36.9	39.5	0.958	(0.002)	0.21	(0.02)	<i>(0.17 to 0.26)</i>	
09/27/06	05/02/07	7.2	39.5	46.7	0.959	(0.003)	0.16	(0.02)	<i>(0.12 to 0.20)</i>	
05/02/07	09/22/07	4.8	46.7	51.5	0.963	(0.003)	0.13	(0.02)	<i>(0.10 to 0.16)</i>	
09/22/07	04/30/08	7.4	51.5	58.8	0.965	(0.003)	0.10	(0.01)	<i>(0.08 to 0.13)</i>	
04/30/08	07/22/08	2.8	58.8	61.6	0.968	(0.004)	0.09	(0.01)	<i>(0.07 to 0.12)</i>	
07/22/08	09/16/08	1.9	61.6	63.5	0.969	(0.004)	0.09	(0.01)	<i>(0.06 to 0.11)</i>	
09/16/08	05/08/09	7.8	63.5	71.3	0.970	(0.004)	0.07	(0.01)	<i>(0.05 to 0.09)</i>	
05/08/09	07/22/09	2.5	71.3	73.8	0.972	(0.005)	0.06	(0.01)	<i>(0.04 to 0.08)</i>	
07/22/09	09/15/09	1.8	73.8	75.6	0.973	(0.005)	0.06	(0.01)	<i>(0.04 to 0.08)</i>	
09/15/09	05/04/10	7.7	75.6	83.3	0.974	(0.005)	0.05	(0.01)	<i>(0.03 to 0.07)</i>	
05/04/10	09/08/10	4.2	83.3	87.5	0.976	(0.006)	0.04	(0.01)	<i>(0.03 to 0.06)</i>	
09/08/10	05/09/11	8.1	87.5	95.6	0.977	(0.006)	0.04	(0.01)	<i>(0.02 to 0.05)</i>	
05/09/11	09/12/11	4.2	95.6	99.8	0.979	(0.006)	0.03	(0.01)	<i>(0.02 to 0.05)</i>	
09/12/11	05/08/12	8.0	99.8	107.8	0.980	(0.006)	0.03	(0.01)	<i>(0.01 to 0.05)</i>	
05/08/12	09/06/12	4.0	107.8	111.8	0.982	(0.006)	0.03	(0.01)	<i>(0.01 to 0.04)</i>	
09/06/12	05/05/13	8.0	111.8	119.9	0.983	(0.006)	0.02	(0.01)	<i>(0.01 to 0.04)</i>	
05/05/13	09/20/13	4.6	119.9	124.5	0.985	(0.006)	0.02	(0.01)	<i>(0.01 to 0.04)</i>	

From these results, it can be seen that monthly survival rates for fish released as spring yearlings are estimated to have relatively high monthly survival rates, and that monthly rates are estimated quite precisely.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.1	12.7	0.49	0.03
2.1	24.8	0.55	0.23
3.1	37.1	0.63	0.26
4.1	49.2	0.65	0.23
5.1	61.7	0.64	0.27
6.1	73.7	0.71	0.34
7.2	86.0	0.80	0.40
8.2	98.2	0.75	0.56
9.2	110.3	1.00	0.47

When the number of fish released in a cohort is taken into account, it is possible to estimate the number of fish from each cohort that are estimated to be alive through time. The tables below do this for each release type, cohort, and river of release using **the average value for the cohort's disease status.**

Estimates of survival for the 1st release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 822 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SPR	04/13/04	09/21/04	9.6	14.9	0.73	0.03	602	562	to	643
1	SPR	09/21/04	04/30/05	14.9	22.3	0.49	0.03	404	347	to	460
1	SPR	04/30/05	09/23/05	22.3	27.2	0.39	0.03	317	263	to	371
1	SPR	09/23/05	04/29/06	27.2	34.4	0.27	0.03	226	179	to	272
1	SPR	04/29/06	07/13/06	34.4	36.9	0.25	0.03	203	160	to	246
1	SPR	07/13/06	09/27/06	36.9	39.5	0.22	0.02	183	143	to	222
1	SPR	09/27/06	05/02/07	39.5	46.7	0.17	0.02	137	105	to	168
1	SPR	05/02/07	09/22/07	46.7	51.5	0.14	0.02	115	87	to	142
1	SPR	09/22/07	04/30/08	51.5	58.8	0.11	0.01	89	66	to	111
1	SPR	04/30/08	07/22/08	58.8	61.6	0.10	0.01	81	60	to	102
1	SPR	07/22/08	09/16/08	61.6	63.5	0.09	0.01	77	57	to	97
1	SPR	09/16/08	05/08/09	63.5	71.3	0.07	0.01	61	43	to	78
1	SPR	05/08/09	07/22/09	71.3	73.8	0.07	0.01	57	40	to	74
1	SPR	07/22/09	09/15/09	73.8	75.6	0.07	0.01	54	37	to	71
1	SPR	09/15/09	05/04/10	75.6	83.3	0.05	0.01	44	29	to	60
1	SPR	05/04/10	09/08/10	83.3	87.5	0.05	0.01	40	25	to	56
1	SPR	09/08/10	05/09/11	87.5	95.6	0.04	0.01	34	18	to	49
1	SPR	05/09/11	09/12/11	95.6	99.8	0.04	0.01	31	16	to	46
1	SPR	09/12/11	05/08/12	99.8	107.8	0.03	0.01	26	12	to	41
1	SPR	05/08/12	09/06/12	107.8	111.8	0.03	0.01	25	10	to	40
1	SPR	09/06/12	05/05/13	111.8	119.9	0.03	0.01	22	7	to	36
1	SPR	05/05/13	09/20/13	119.9	124.5	0.02	0.01	20	5	to	35

Estimates of survival for the 2nd release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 309 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	SPR	04/30/05	09/23/05	9.6	14.4	0.75	0.02	233	219	to	247
2	SPR	09/23/05	04/29/06	14.4	21.7	0.51	0.03	157	136	to	178
2	SPR	04/29/06	07/13/06	21.7	24.2	0.45	0.03	138	117	to	159
2	SPR	07/13/06	09/27/06	24.2	26.7	0.40	0.03	122	102	to	143
2	SPR	09/27/06	05/02/07	26.7	34	0.28	0.03	87	70	to	105
2	SPR	05/02/07	09/22/07	34	38.7	0.23	0.03	71	56	to	86
2	SPR	09/22/07	04/30/08	38.7	46.1	0.17	0.02	53	40	to	65
2	SPR	04/30/08	07/22/08	46.1	48.9	0.15	0.02	47	36	to	59
2	SPR	07/22/08	09/16/08	48.9	50.7	0.14	0.02	44	34	to	55
2	SPR	09/16/08	05/08/09	50.7	58.5	0.11	0.01	34	25	to	42
2	SPR	05/08/09	07/22/09	58.5	61	0.10	0.01	31	23	to	39
2	SPR	07/22/09	09/15/09	61	62.9	0.10	0.01	29	22	to	37
2	SPR	09/15/09	05/04/10	62.9	70.6	0.08	0.01	23	17	to	30
2	SPR	05/04/10	09/08/10	70.6	74.8	0.07	0.01	21	14	to	27
2	SPR	09/08/10	05/09/11	74.8	82.9	0.05	0.01	17	11	to	23
2	SPR	05/09/11	09/12/11	82.9	87.1	0.05	0.01	15	9	to	21
2	SPR	09/12/11	05/08/12	87.1	95.1	0.04	0.01	13	7	to	19
2	SPR	05/08/12	09/06/12	95.1	99.1	0.04	0.01	12	6	to	17
2	SPR	09/06/12	05/05/13	99.1	107.1	0.03	0.01	10	4	to	16
2	SPR	05/05/13	09/20/13	107.1	111.7	0.03	0.01	9	4	to	15

Estimates of survival for the 3rd release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 2,288 fish, IV status = 0, Fin Curl status = 0.24).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SPR	04/29/06	07/13/06	9.6	12.1	0.83	0.02	1,901	1,828	to	1,974
3	SPR	07/13/06	09/27/06	12.1	14.6	0.69	0.03	1,585	1,470	to	1,700
3	SPR	09/27/06	05/02/07	14.6	21.8	0.42	0.03	957	805	to	1,109
3	SPR	05/02/07	09/22/07	21.8	26.6	0.31	0.03	705	567	to	844
3	SPR	09/22/07	04/30/08	26.6	34	0.20	0.02	452	344	to	561
3	SPR	04/30/08	07/22/08	34	36.7	0.17	0.02	388	291	to	485
3	SPR	07/22/08	09/16/08	36.7	38.6	0.15	0.02	351	262	to	441
3	SPR	09/16/08	05/08/09	38.6	46.4	0.10	0.01	234	170	to	298
3	SPR	05/08/09	07/22/09	46.4	48.9	0.09	0.01	208	150	to	266
3	SPR	07/22/09	09/15/09	48.9	50.7	0.08	0.01	191	137	to	245
3	SPR	09/15/09	05/04/10	50.7	58.4	0.06	0.01	135	94	to	176
3	SPR	05/04/10	09/08/10	58.4	62.7	0.05	0.01	114	78	to	150
3	SPR	09/08/10	05/09/11	62.7	70.8	0.04	0.01	83	53	to	113
3	SPR	05/09/11	09/12/11	70.8	75	0.03	0.01	72	44	to	99
3	SPR	09/12/11	05/08/12	75	82.9	0.02	0.01	55	30	to	80
3	SPR	05/08/12	09/06/12	82.9	87	0.02	0.01	49	24	to	73
3	SPR	09/06/12	05/05/13	87	95	0.02	0.01	39	16	to	61
3	SPR	05/05/13	09/20/13	95	99.6	0.01	0	34	12	to	56

Estimates of survival for the 4th release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 1,995 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SPR	05/02/07	09/22/07	9.6	14.3	0.76	0.02	1,513	1,422	to	1,604
4	SPR	09/22/07	04/30/08	14.3	21.7	0.51	0.03	1,011	876	to	1,147
4	SPR	04/30/08	07/22/08	21.7	24.5	0.44	0.03	881	746	to	1,015
4	SPR	07/22/08	09/16/08	24.5	26.3	0.40	0.03	805	674	to	936
4	SPR	09/16/08	05/08/09	26.3	34.1	0.28	0.03	557	444	to	669
4	SPR	05/08/09	07/22/09	34.1	36.6	0.25	0.03	500	395	to	605
4	SPR	07/22/09	09/15/09	36.6	38.5	0.23	0.03	463	364	to	562
4	SPR	09/15/09	05/04/10	38.5	46.2	0.17	0.02	339	261	to	417
4	SPR	05/04/10	09/08/10	46.2	50.4	0.15	0.02	290	221	to	358
4	SPR	09/08/10	05/09/11	50.4	58.5	0.11	0.01	218	163	to	273
4	SPR	05/09/11	09/12/11	58.5	62.7	0.10	0.01	191	141	to	240
4	SPR	09/12/11	05/08/12	62.7	70.7	0.08	0.01	150	107	to	193
4	SPR	05/08/12	09/06/12	70.7	74.7	0.07	0.01	134	93	to	175
4	SPR	09/06/12	05/05/13	74.7	82.7	0.05	0.01	109	70	to	147
4	SPR	05/05/13	09/20/13	82.7	87.3	0.05	0.01	98	60	to	135

Estimates of survival for the 5th release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 3,059 fish, IV status = 0, Fin Curl status = 0.34).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	SPR	04/30/08	07/22/08	9.6	12.3	0.80	0.02	2,433	2,319	to	2,547
5	SPR	07/22/08	09/16/08	12.3	14.2	0.68	0.03	2,095	1,940	to	2,251
5	SPR	09/16/08	05/08/09	14.2	22	0.37	0.03	1,139	935	to	1,343
5	SPR	05/08/09	07/22/09	22	24.5	0.31	0.03	953	762	to	1,145
5	SPR	07/22/09	09/15/09	24.5	26.3	0.27	0.03	840	660	to	1,020
5	SPR	09/15/09	05/04/10	26.3	34	0.16	0.02	499	366	to	632
5	SPR	05/04/10	09/08/10	34	38.2	0.13	0.02	385	276	to	494
5	SPR	09/08/10	05/09/11	38.2	46.4	0.08	0.01	240	166	to	314
5	SPR	05/09/11	09/12/11	46.3	50.5	0.06	0.01	192	131	to	253
5	SPR	09/12/11	05/08/12	50.5	58.5	0.04	0.01	129	84	to	173
5	SPR	05/08/12	09/06/12	58.5	62.5	0.03	0.01	107	68	to	146
5	SPR	09/06/12	05/05/13	62.5	70.6	0.02	0.01	75	44	to	107
5	SPR	05/05/13	09/20/13	70.6	75.2	0.02	0	63	35	to	91

Estimates of survival for the 6th release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 3,141 fish, IV status = 0, Fin Curl status = 0.36).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	SPR	05/08/09	07/22/09	9.6	12.1	0.81	0.02	2,541	2,431	to	2,651
6	SPR	07/22/09	09/15/09	12.1	13.9	0.70	0.03	2,186	2,030	to	2,341
6	SPR	09/15/09	05/04/10	13.9	21.6	0.37	0.03	1,176	965	to	1,387
6	SPR	05/04/10	09/08/10	21.6	25.8	0.27	0.03	862	674	to	1,050
6	SPR	09/08/10	05/09/11	25.8	33.9	0.16	0.02	490	355	to	625
6	SPR	05/09/11	09/12/11	33.9	38.1	0.12	0.02	376	266	to	486
6	SPR	09/12/11	05/08/12	38.1	46.1	0.07	0.01	233	158	to	307
6	SPR	05/08/12	09/06/12	46.1	50.1	0.06	0.01	187	125	to	249
6	SPR	09/06/12	05/05/13	50.1	58.1	0.04	0.01	123	79	to	167
6	SPR	05/05/13	09/20/13	58.1	62.7	0.03	0.01	99	62	to	137

Estimates of survival for the 7th release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 5,272 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	SPR	05/04/10	09/08/10	9.6	13.8	0.78	0.02	4,126	3,907	to	4,346
7	SPR	09/08/10	05/09/11	13.8	21.9	0.50	0.03	2,642	2,281	to	3,004
7	SPR	05/09/11	09/12/11	21.9	26.1	0.41	0.03	2,143	1,791	to	2,495
7	SPR	09/12/11	05/08/12	26.1	34.1	0.28	0.03	1,469	1,168	to	1,771
7	SPR	05/08/12	09/06/12	34	38.1	0.23	0.03	1,236	968	to	1,503
7	SPR	09/06/12	05/05/13	38.1	46.1	0.17	0.02	890	681	to	1,099
7	SPR	05/05/13	09/20/13	46.1	50.7	0.14	0.02	750	570	to	931

Estimates of survival for the 8th release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 1,663 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
8	SPR	05/09/11	09/12/11	9.6	13.8	0.78	0.02	1,304	1,235	to	1,373
8	SPR	09/12/11	05/08/12	13.8	21.7	0.51	0.03	841	727	to	954
8	SPR	05/08/12	09/06/12	21.7	25.8	0.41	0.03	687	576	to	799
8	SPR	09/06/12	05/05/13	25.8	33.8	0.28	0.03	469	373	to	565
8	SPR	05/05/13	09/20/13	33.8	38.4	0.23	0.03	385	301	to	469

Estimates of survival for the 9th release cohort of spring yearlings in RPMA 2 in the Yellowstone River (cohort= 389 fish, IV status = 0, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
9	SPR	05/05/13	09/20/13	9.6	14.2	0.77	0.02	298	281	<i>to</i>	315

Summary information for Spring Yearlings released in RPMA 2 in the Yellowstone River.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as spring yearlings are estimated to have still been alive in September 2013. The point estimates indicate that ~1,756 fish of different ages were still alive from spring yearlings released in RPMA 2 in the Yellowstone River and that 17% (298 fish) were ~1 year old, ~70% (1,234) of those were ~3- to 5-years old, ~11% (195) were 6- to 8-years old, and ~2% (29) were ≥ 9 years old.

Estimates of surviving proportions and numbers for spring yearlings released in RPMA 2 in the Yellowstone River.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 822	SPR	09/20/13	124.5	10.4	0.02	0.01	20	5	<i>to</i>	35
2: 309	SPR	09/20/13	111.7	9.3	0.03	0.01	9	4	<i>to</i>	15
3: 2,288	SPR	09/20/13	99.6	8.3	0.01	0	34	12	<i>to</i>	56
4: 1,995	SPR	09/20/13	87.3	7.3	0.05	0.01	98	60	<i>to</i>	135
5: 3,059	SPR	09/20/13	75.2	6.3	0.02	0	63	35	<i>to</i>	91
6: 3,141	SPR	09/20/13	62.7	5.2	0.03	0.01	99	62	<i>to</i>	137
7: 5,272	SPR	09/20/13	50.7	4.2	0.14	0.02	750	570	<i>to</i>	931
8: 1,663	SPR	09/20/13	38.4	3.2	0.23	0.03	385	301	<i>to</i>	469
9: 389	SPR	09/20/13	14.2	1.2	0.77	0.02	298	281	<i>to</i>	315

Summary information for Spring Yearlings released in RPMA 2 in the Missouri & Yellowstone Rivers.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as spring yearlings in the Missouri and Yellowstone River are estimated to still be alive. The estimates indicate that substantial proportions of cohorts and numbers of fish were still alive in RPMA 2 from those releases as of September 2013. An estimated ~7,852 fish released as spring yearlings in RPMA 2 were predicted to have been alive in the river at the time of the last estimation date (09/208/2013). Of these 8% (631 fish) were ~1 year old, ~61% (4,815) were ~3- to ~5-years old, ~29% (2,269) were ~6- to ~8-years old, and ~2% (137) were ≥ 9 years old.

	Release	Type	Date	Age in months	Age in years	N Alive	(95% CI for N Alive)		
1	822	SPR	09/20/13	124.5	10.4	20	5	to	35
2	874	SPR	09/20/13	111.7	9.3	117	53	to	182
3	6,729	SPR	09/20/13	99.6	8.3	629	240	to	1,018
4	4,011	SPR	09/20/13	87.3	7.3	570	327	to	812
5	8,045	SPR	09/20/13	75.2	6.3	1,070	585	to	1,555
6	4,964	SPR	09/20/13	62.7	5.2	698	468	to	929
7	10,679	SPR	09/20/13	50.7	4.2	2,901	2,146	to	3,657
8	3,324	SPR	09/20/13	38.4	3.2	1,216	961	to	1,471
9	767	SPR	09/20/13	14.2	1.2	631	600	to	662

Results for Releases of Summer Yearlings in RPMA 2

Data on the number of summer yearlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (occasion j) is provided in the table below. At the time of the analyses presented here, 22,347 releases and re-releases of fish originally released as summer yearlings had been conducted, which resulted in 752 recaptures. The results presented below are based on the analyses of those data.

Occ. $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27 Total		
1	796	0	0	0	0	0	0	0	0	2	0	1	2	0	3	0	0	4	12	8	0	0	2	0	4	1	0	46
2	481	0	0	0	2	0	1	0	0	0	0	1	0	0	1	0	0	4	0	6	0	0	0	1	1	0	1	18
3	3138	0	0	13	7	9	1	0	4	3	13	5	0	14	0	0	0	15	6	24	0	10	3	17	4	15	163	
4	4058	0	20	0	18	2	0	6	0	6	0	10	0	8	0	0	0	7	12	44	1	10	3	13	1	20	175	
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	1638	0	0	4	10	0	0	8	0	7	1	0	3	0	0	0	0	6	0	11	1	2	2	4	1	6	66	
7	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
8	216	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	5	
9	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10	1369	0	0	0	0	0	0	0	0	32	0	9	3	0	5	2	0	4	1	9	0	0	2	2	1	1	71	
11	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	
12	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	44	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	2	0	2	0	0	0	0	0	0	0	9
14	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	
15	3279	0	0	0	0	0	0	0	0	0	0	0	0	0	25	3	0	19	3	28	0	3	0	6	0	10	97	
16	63	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	6	0	1	1	1	1	0	1	14	
17	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
18	3810	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	38	1	12	12	0	2	3	74	
19	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	1	1	0	0	0	0	9	
20	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	5	
21	2096	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	6	7	3	11	46	
22	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
23	1042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	11	2	7	22	7	
24	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	
25	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	4	4	
26	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Summer Yearlings released in RPMA2 in the Missouri River

Estimates of survival for the 1st release cohort of summer yearlings (~13.9 months old at time of release, which was 8/11/1998) in RPMA 2 in the Missouri River. Estimates are for a fish without disease problems (no fin curl or iridovirus) released in the Missouri River.

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)
08/11/98	10/14/00	26.5	13.9	40.4	0.971	(0.005)	0.46	(0.06)	(0.34 to 0.57)
10/14/00	08/18/02	22.4	40.4	62.8	0.985	(0.002)	0.33	(0.05)	(0.22 to 0.44)
08/18/02	08/17/03	12.1	62.8	74.9	0.992	(0.002)	0.30	(0.05)	(0.20 to 0.40)
08/17/03	04/13/04	8.0	74.9	82.9	0.994	(0.002)	0.29	(0.05)	(0.18 to 0.39)
04/13/04	09/21/04	5.4	82.9	88.3	0.995	(0.002)	0.28	(0.05)	(0.18 to 0.38)
09/21/04	04/30/05	7.4	88.3	95.7	0.996	(0.002)	0.27	(0.05)	(0.17 to 0.37)
04/30/05	09/23/05	4.9	95.7	100.5	0.997	(0.001)	0.27	(0.05)	(0.17 to 0.37)
09/23/05	04/29/06	7.3	100.5	107.8	0.997	(0.001)	0.26	(0.05)	(0.16 to 0.36)
04/29/06	07/13/06	2.5	107.8	110.3	0.998	(0.001)	0.26	(0.05)	(0.16 to 0.36)
07/13/06	09/27/06	2.5	110.3	112.8	0.998	(0.001)	0.26	(0.05)	(0.16 to 0.36)
09/27/06	05/02/07	7.2	112.8	120.1	0.998	(0.001)	0.25	(0.05)	(0.15 to 0.35)
05/02/07	09/22/07	4.8	120.1	124.8	0.998	(0.001)	0.25	(0.05)	(0.15 to 0.35)
09/22/07	04/30/08	7.4	124.8	132.2	0.998	(0.001)	0.25	(0.05)	(0.15 to 0.35)
04/30/08	07/22/08	2.8	132.2	135.0	0.999	(0.001)	0.25	(0.05)	(0.15 to 0.35)
07/22/08	09/16/08	1.9	135.0	136.8	0.999	(0.001)	0.25	(0.05)	(0.14 to 0.35)
09/16/08	05/08/09	7.8	136.8	144.7	0.999	(0.001)	0.24	(0.05)	(0.14 to 0.35)
05/08/09	07/22/09	2.5	144.7	147.2	0.999	(0.001)	0.24	(0.05)	(0.14 to 0.35)
07/22/09	09/15/09	1.8	147.2	149.0	0.999	(0.001)	0.24	(0.05)	(0.14 to 0.34)
09/15/09	05/04/10	7.7	149.0	156.7	0.999	(0.001)	0.24	(0.05)	(0.14 to 0.34)
05/04/10	09/08/10	4.2	156.7	160.9	0.999	(0.000)	0.24	(0.05)	(0.14 to 0.34)
09/08/10	05/09/11	8.1	160.9	169.0	0.999	(0.000)	0.24	(0.05)	(0.14 to 0.34)
05/09/11	09/12/11	4.2	169.0	173.2	1.000	(0.000)	0.24	(0.05)	(0.14 to 0.34)
09/12/11	05/08/12	8.0	173.2	181.2	1.000	(0.000)	0.24	(0.05)	(0.14 to 0.34)
05/08/12	09/06/12	4.0	181.2	185.2	1.000	(0.000)	0.24	(0.05)	(0.13 to 0.34)
09/06/12	05/05/13	8.0	185.2	193.2	1.000	(0.000)	0.24	(0.05)	(0.13 to 0.34)
05/05/13	09/20/13	4.6	193.2	197.8	1.000	(0.000)	0.24	(0.05)	(0.13 to 0.34)

For summer yearlings, the estimates from the model that is best-supported by the data indicate that the proportion of fish released as summer yearlings that survive to later ages (e.g., ~0.28 [SE=0.05]) of individuals estimated to still be alive at age ~7 years old) is quite similar to what was found for healthy fish released as spring yearlings (~0.24 [SE=0.05]) and or as fingerlings (~0.31 [SE=0.06]) on the Missouri River. The estimates for fish released in the Missouri River are higher than those released on the Yellowstone River (see below).

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative. Annual rates for summer yearlings were based on the dates of surveys for the second release cohort because of a longer gap that occurred early in life between occasions for the 1st cohort.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.9	22.4	0.52	0.06
2.9	34.5	0.81	0.23
4.0	47.9	0.88	0.22
5.0	60.1	0.89	0.23
6.0	72.4	0.94	0.24
7.0	84.4	0.97	0.24
8.0	96.5	0.97	0.25
9.1	108.6	0.97	0.26
10.0	120.5	0.96	0.27

*0.52 raised to 1/1.9 yields an estimated annual rate of 0.70 during the 1st interval.

The tables below provide estimates for each release type and cohort **based on the actual river of releases and for disease status in each release cohort.** Thus, these represent estimates based on the average covariate conditions experienced by an actual release cohort.

Estimates of survival for the 1st release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 300 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SUM	08/11/98	10/14/00	13.9	40.4	0.46	0.06	138	103	to	172
1	SUM	10/14/00	08/18/02	40.4	62.8	0.33	0.05	99	67	to	131
1	SUM	08/18/02	08/17/03	62.8	74.9	0.30	0.05	90	59	to	121
1	SUM	08/17/03	04/13/04	74.9	82.9	0.29	0.05	86	55	to	116
1	SUM	04/13/04	09/21/04	82.9	88.3	0.28	0.05	83	53	to	114
1	SUM	09/21/04	04/30/05	88.3	95.7	0.27	0.05	81	51	to	111
1	SUM	04/30/05	09/23/05	95.7	100.5	0.27	0.05	80	50	to	110
1	SUM	09/23/05	04/29/06	100.5	107.8	0.26	0.05	78	48	to	108
1	SUM	04/29/06	07/13/06	107.8	110.3	0.26	0.05	77	47	to	108
1	SUM	07/13/06	09/27/06	110.3	112.8	0.26	0.05	77	47	to	107
1	SUM	09/27/06	05/02/07	112.8	120.1	0.25	0.05	76	46	to	106
1	SUM	05/02/07	09/22/07	120.1	124.8	0.25	0.05	75	45	to	105
1	SUM	09/22/07	04/30/08	124.8	132.2	0.25	0.05	74	44	to	105
1	SUM	04/30/08	07/22/08	132.2	135.0	0.25	0.05	74	44	to	104
1	SUM	07/22/08	09/16/08	135.0	136.8	0.25	0.05	74	43	to	104
1	SUM	09/16/08	05/08/09	136.8	144.7	0.24	0.05	73	43	to	104
1	SUM	05/08/09	07/22/09	144.7	147.2	0.24	0.05	73	42	to	104
1	SUM	07/22/09	09/15/09	147.2	149.0	0.24	0.05	73	42	to	103
1	SUM	09/15/09	05/04/10	149.0	156.7	0.24	0.05	72	42	to	103
1	SUM	05/04/10	09/08/10	156.7	160.9	0.24	0.05	72	42	to	103
1	SUM	09/08/10	05/09/11	160.9	169.0	0.24	0.05	72	41	to	103
1	SUM	05/09/11	09/12/11	169.0	173.2	0.24	0.05	72	41	to	103
1	SUM	09/12/11	05/08/12	173.2	181.2	0.24	0.05	71	41	to	102
1	SUM	05/08/12	09/06/12	181.2	185.2	0.24	0.05	71	40	to	102
1	SUM	09/06/12	05/05/13	185.2	193.2	0.24	0.05	71	40	to	102
1	SUM	05/05/13	09/20/13	193.2	197.8	0.24	0.05	71	40	to	102

Estimates of survival for the 2nd release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 180 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	SUM	10/14/00	08/18/02	13.9	36.3	0.52	0.06	93	73	to	113
2	SUM	08/18/02	08/17/03	36.3	48.4	0.42	0.06	76	57	to	96
2	SUM	08/17/03	04/13/04	48.4	56.4	0.39	0.05	69	50	to	89
2	SUM	04/13/04	09/21/04	56.4	61.8	0.37	0.05	66	47	to	85
2	SUM	09/21/04	04/30/05	61.8	69.2	0.34	0.05	62	43	to	81
2	SUM	04/30/05	09/23/05	69.2	74.0	0.33	0.05	60	41	to	79
2	SUM	09/23/05	04/29/06	74.0	81.3	0.32	0.05	57	39	to	76
2	SUM	04/29/06	07/13/06	81.3	83.8	0.32	0.05	57	38	to	75
2	SUM	07/13/06	09/27/06	83.8	86.3	0.31	0.05	56	37	to	75
2	SUM	09/27/06	05/02/07	86.3	93.6	0.30	0.05	54	36	to	73
2	SUM	05/02/07	09/22/07	93.6	98.3	0.30	0.05	53	35	to	72
2	SUM	09/22/07	04/30/08	98.3	105.7	0.29	0.05	52	33	to	71
2	SUM	04/30/08	07/22/08	105.7	108.5	0.29	0.05	52	33	to	71
2	SUM	07/22/08	09/16/08	108.5	110.4	0.29	0.05	52	33	to	70
2	SUM	09/16/08	05/08/09	110.4	118.2	0.28	0.05	51	32	to	70
2	SUM	05/08/09	07/22/09	118.2	120.7	0.28	0.05	50	31	to	69
2	SUM	07/22/09	09/15/09	120.7	122.5	0.28	0.05	50	31	to	69
2	SUM	09/15/09	05/04/10	122.5	130.2	0.28	0.05	50	30	to	69
2	SUM	05/04/10	09/08/10	130.2	134.4	0.27	0.05	49	30	to	69
2	SUM	09/08/10	05/09/11	134.4	142.5	0.27	0.06	49	29	to	68
2	SUM	05/09/11	09/12/11	142.5	146.7	0.27	0.06	49	29	to	68
2	SUM	09/12/11	05/08/12	146.7	154.7	0.27	0.06	48	29	to	68
2	SUM	05/08/12	09/06/12	154.7	158.7	0.27	0.06	48	28	to	68
2	SUM	09/06/12	05/05/13	158.7	166.7	0.27	0.06	48	28	to	68
2	SUM	05/05/13	09/20/13	166.7	171.3	0.27	0.06	48	28	to	68

Estimates of survival for the 3rd release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 1,299 fish, IV status not considered, Fin Curl status = 0.05).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SUM	08/18/02	08/17/03	13.9	26.0	0.70	0.04	909	805	to	1,014
3	SUM	08/17/03	04/13/04	26.0	34.0	0.59	0.05	766	643	to	889
3	SUM	04/13/04	09/21/04	34.0	39.4	0.54	0.05	698	570	to	827
3	SUM	09/21/04	04/30/05	39.4	46.7	0.48	0.05	625	493	to	757
3	SUM	04/30/05	09/23/05	46.7	51.6	0.45	0.05	588	455	to	721
3	SUM	09/23/05	04/29/06	51.6	58.9	0.42	0.05	543	409	to	678
3	SUM	04/29/06	07/13/06	58.9	61.4	0.41	0.05	531	396	to	666
3	SUM	07/13/06	09/27/06	61.4	63.9	0.40	0.05	520	385	to	655
3	SUM	09/27/06	05/02/07	63.9	71.1	0.38	0.05	491	355	to	628
3	SUM	05/02/07	09/22/07	71.1	75.9	0.37	0.05	476	339	to	614
3	SUM	09/22/07	04/30/08	75.9	83.3	0.35	0.05	456	317	to	596
3	SUM	04/30/08	07/22/08	83.3	86.0	0.35	0.05	451	311	to	590
3	SUM	07/22/08	09/16/08	86.1	87.9	0.34	0.06	447	307	to	587
3	SUM	09/16/08	05/08/09	87.9	95.7	0.33	0.06	433	290	to	575
3	SUM	05/08/09	07/22/09	95.7	98.2	0.33	0.06	429	286	to	572
3	SUM	07/22/09	09/15/09	98.2	100.0	0.33	0.06	426	283	to	570
3	SUM	09/15/09	05/04/10	100.1	107.8	0.32	0.06	417	271	to	562
3	SUM	05/04/10	09/08/10	107.8	112.0	0.32	0.06	412	266	to	559
3	SUM	09/08/10	05/09/11	112.0	120.1	0.31	0.06	405	256	to	553
3	SUM	05/09/11	09/12/11	120.1	124.3	0.31	0.06	402	252	to	551
3	SUM	09/12/11	05/08/12	124.3	132.2	0.31	0.06	397	245	to	548
3	SUM	05/08/12	09/06/12	132.2	136.3	0.30	0.06	395	243	to	547
3	SUM	09/06/12	05/05/13	136.3	144.3	0.30	0.06	391	237	to	545
3	SUM	05/05/13	09/20/13	144.3	148.9	0.30	0.06	389	235	to	544

Estimates of survival for the 4th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 2,086 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SUM	08/17/03	04/13/04	13.9	21.9	0.79	0.03	1,649	1,524	to	1,774
4	SUM	04/13/04	09/21/04	21.9	27.2	0.70	0.04	1,451	1,288	to	1,614
4	SUM	09/21/04	04/30/05	27.2	34.6	0.60	0.05	1,245	1,054	to	1,436
4	SUM	04/30/05	09/23/05	34.6	39.5	0.55	0.05	1,146	946	to	1,346
4	SUM	09/23/05	04/29/06	39.5	46.8	0.49	0.05	1,028	819	to	1,236
4	SUM	04/29/06	07/13/06	46.8	49.2	0.48	0.05	996	786	to	1,206
4	SUM	07/13/06	09/27/06	49.2	51.8	0.46	0.05	967	756	to	1,179
4	SUM	09/27/06	05/02/07	51.8	59.0	0.43	0.05	894	679	to	1,110
4	SUM	05/02/07	09/22/07	59.0	63.8	0.41	0.05	857	639	to	1,074
4	SUM	09/22/07	04/30/08	63.8	71.1	0.39	0.05	808	588	to	1,029
4	SUM	04/30/08	07/22/08	71.2	73.9	0.38	0.05	794	572	to	1,016
4	SUM	07/22/08	09/16/08	73.9	75.8	0.38	0.05	785	562	to	1,008
4	SUM	09/16/08	05/08/09	75.8	83.6	0.36	0.06	750	524	to	977
4	SUM	05/08/09	07/22/09	83.6	86.1	0.36	0.06	742	514	to	969
4	SUM	07/22/09	09/15/09	86.1	87.9	0.35	0.06	736	507	to	964
4	SUM	09/15/09	05/04/10	87.9	95.6	0.34	0.06	712	480	to	945
4	SUM	05/04/10	09/08/10	95.6	99.9	0.34	0.06	702	468	to	937
4	SUM	09/08/10	05/09/11	99.9	108.0	0.33	0.06	685	447	to	924
4	SUM	05/09/11	09/12/11	108.0	112.2	0.33	0.06	678	438	to	918
4	SUM	09/12/11	05/08/12	112.2	120.1	0.32	0.06	666	422	to	910
4	SUM	05/08/12	09/06/12	120.1	124.2	0.32	0.06	661	416	to	907
4	SUM	09/06/12	05/05/13	124.2	132.2	0.31	0.06	653	404	to	902
4	SUM	05/05/13	09/20/13	132.2	136.8	0.31	0.06	649	398	to	900

Estimates of survival for the 5th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 906 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	SUM	09/21/04	04/30/05	13.9	21.2	0.79	0.03	720	670	to	770
5	SUM	04/30/05	09/23/05	21.2	26.1	0.70	0.04	638	574	to	703
5	SUM	09/23/05	04/29/06	26.1	33.4	0.60	0.04	547	471	to	623
5	SUM	04/29/06	07/13/06	33.4	35.9	0.58	0.04	524	446	to	602
5	SUM	07/13/06	09/27/06	35.9	38.4	0.56	0.04	504	425	to	583
5	SUM	09/27/06	05/02/07	38.4	45.6	0.50	0.05	454	371	to	536
5	SUM	05/02/07	09/22/07	45.6	50.4	0.47	0.05	429	345	to	513
5	SUM	09/22/07	04/30/08	50.4	57.8	0.44	0.05	399	313	to	485
5	SUM	04/30/08	07/22/08	57.8	60.5	0.43	0.05	390	304	to	477
5	SUM	07/22/08	09/16/08	60.5	62.4	0.43	0.05	385	298	to	472
5	SUM	09/16/08	05/08/09	62.4	70.2	0.40	0.05	365	276	to	454
5	SUM	05/08/09	07/22/09	70.2	72.7	0.40	0.05	360	271	to	450
5	SUM	07/22/09	09/15/09	72.7	74.5	0.39	0.05	357	267	to	448
5	SUM	09/15/09	05/04/10	74.5	82.2	0.38	0.05	345	252	to	437
5	SUM	05/04/10	09/08/10	82.2	86.5	0.37	0.05	339	246	to	433
5	SUM	09/08/10	05/09/11	86.5	94.6	0.37	0.05	331	235	to	426
5	SUM	05/09/11	09/12/11	94.6	98.8	0.36	0.05	327	231	to	424
5	SUM	09/12/11	05/08/12	98.8	106.8	0.36	0.06	322	223	to	420
5	SUM	05/08/12	09/06/12	106.8	110.8	0.35	0.06	320	220	to	419
5	SUM	09/06/12	05/05/13	110.8	118.8	0.35	0.06	316	215	to	417
5	SUM	05/05/13	09/20/13	118.8	123.4	0.35	0.06	314	212	to	416

Estimates of survival for the 6th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 916 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	SUM	07/13/06	09/27/06	13.9	16.4	0.93	0.01	850	830	to	871
6	SUM	09/27/06	05/02/07	16.4	23.6	0.76	0.03	697	637	to	757
6	SUM	05/02/07	09/22/07	23.6	28.4	0.68	0.04	625	553	to	698
6	SUM	09/22/07	04/30/08	28.4	35.8	0.59	0.05	539	455	to	623
6	SUM	04/30/08	07/22/08	35.8	38.5	0.56	0.05	515	429	to	601
6	SUM	07/22/08	09/16/08	38.5	40.4	0.55	0.05	500	413	to	588
6	SUM	09/16/08	05/08/09	40.4	48.2	0.49	0.05	446	355	to	538
6	SUM	05/08/09	07/22/09	48.2	50.7	0.47	0.05	433	341	to	526
6	SUM	07/22/09	09/15/09	50.7	52.5	0.46	0.05	424	332	to	517
6	SUM	09/15/09	05/04/10	52.5	60.2	0.43	0.05	391	296	to	486
6	SUM	05/04/10	09/08/10	60.2	64.5	0.41	0.05	377	281	to	473
6	SUM	09/08/10	05/09/11	64.5	72.6	0.39	0.05	354	256	to	451
6	SUM	05/09/11	09/12/11	72.6	76.8	0.38	0.05	345	246	to	443
6	SUM	09/12/11	05/08/12	76.8	84.7	0.36	0.06	330	229	to	430
6	SUM	05/08/12	09/06/12	84.7	88.8	0.35	0.06	324	223	to	425
6	SUM	09/06/12	05/05/13	88.8	96.8	0.34	0.06	313	210	to	416
6	SUM	05/05/13	09/20/13	96.8	101.4	0.34	0.06	309	204	to	413

Estimates of survival for the 7th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 692 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	SUM	07/22/08	09/16/08	13.9	15.7	0.95	0.01	655	643	to	667
7	SUM	09/16/08	05/08/09	15.7	23.5	0.76	0.03	527	481	to	572
7	SUM	05/08/09	07/22/09	23.5	26.0	0.72	0.04	497	447	to	548
7	SUM	07/22/09	09/15/09	26.0	27.9	0.69	0.04	478	424	to	532
7	SUM	09/15/09	05/04/10	27.9	35.6	0.59	0.05	409	345	to	472
7	SUM	05/04/10	09/08/10	35.6	39.8	0.55	0.05	381	315	to	447
7	SUM	09/08/10	05/09/11	39.8	47.9	0.49	0.05	338	269	to	407
7	SUM	05/09/11	09/12/11	47.9	52.1	0.46	0.05	321	251	to	391
7	SUM	09/12/11	05/08/12	52.1	60.1	0.43	0.05	295	223	to	366
7	SUM	05/08/12	09/06/12	60.1	64.1	0.41	0.05	284	212	to	357
7	SUM	09/06/12	05/05/13	64.1	72.1	0.39	0.05	267	194	to	341
7	SUM	05/05/13	09/20/13	72.1	76.7	0.37	0.05	259	185	to	334

Estimates of survival for the 8th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 2,014 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
8	SUM	07/22/09	09/15/09	13.9	15.7	0.95	0.01	1,909	1,875	to	1,942
8	SUM	09/15/09	05/04/10	15.7	23.4	0.76	0.03	1,538	1,408	to	1,669
8	SUM	05/04/10	09/08/10	23.4	27.6	0.69	0.04	1,396	1,240	to	1,553
8	SUM	09/08/10	05/09/11	27.6	35.7	0.59	0.05	1,183	997	to	1,368
8	SUM	05/09/11	09/12/11	35.7	39.9	0.55	0.05	1,103	910	to	1,296
8	SUM	09/12/11	05/08/12	39.9	47.9	0.49	0.05	980	778	to	1,182
8	SUM	05/08/12	09/06/12	47.9	51.9	0.46	0.05	934	729	to	1,138
8	SUM	09/06/12	05/05/13	51.9	60.0	0.42	0.05	856	648	to	1,064
8	SUM	05/05/13	09/20/13	60.0	64.6	0.41	0.05	822	612	to	1,033

Estimates of survival for the 9th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 819 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
9	SUM	09/08/10	05/09/11	13.9	22.0	0.79	0.03	645	596	to	695
9	SUM	05/09/11	09/12/11	22.0	26.2	0.71	0.04	584	523	to	645
9	SUM	09/12/11	05/08/12	26.2	34.1	0.60	0.05	493	418	to	568
9	SUM	05/08/12	09/06/12	34.1	38.2	0.56	0.05	460	382	to	538
9	SUM	09/06/12	05/05/13	38.2	46.2	0.50	0.05	406	324	to	488
9	SUM	05/05/13	09/20/13	46.2	50.8	0.47	0.05	383	300	to	466

Estimates of survival for the 10th release cohort of summer yearlings in RPMA 2 in the Missouri River (cohort= 531 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
10	SUM	09/12/11	05/08/12	13.9	21.8	0.79	0.03	420	388	to	452
10	SUM	05/08/12	09/06/12	21.8	25.9	0.72	0.04	382	342	to	421
10	SUM	09/06/12	05/05/13	25.9	33.9	0.60	0.05	321	273	to	369
10	SUM	05/05/13	09/20/13	33.9	38.5	0.56	0.05	296	246	to	347

Summary information for Summer Yearlings released in RPMA 2 in the Missouri River.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as summer yearlings in the Missouri River are estimated to still be alive. The point estimates indicate that ~3,540 fish of different ages were still alive in RPMA 2 at the time of the most recent survey used here (09/20/13) and that ~42% (1,501) of those were ~3- to ~5-years old, ~16% (568) were 5- to 8-years old, and ~42% (1,471) were \geq 9-years old.

Estimates of surviving proportions and numbers for summer yearlings released in RPMA 2 in the Missouri River.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)			
1: 300	SUM	09/20/13	197.8	16.5	0.24	0.05	71	40	to	102	
2: 180	SUM	09/20/13	171.3	14.3	0.27	0.06	48	28	to	68	
3: 1,299	SUM	09/20/13	148.9	12.4	0.30	0.06	389	235	to	544	
4: 2,086	SUM	09/20/13	136.8	11.4	0.31	0.06	649	398	to	900	
5: 906	SUM	09/20/13	123.4	10.3	0.35	0.06	314	212	to	416	
6: 916	SUM	09/20/13	101.4	8.5	0.34	0.06	309	204	to	413	
7: 692	SUM	09/20/13	76.7	6.4	0.37	0.05	259	185	to	334	
8: 2,014	SUM	09/20/13	64.6	5.4	0.41	0.05	822	612	to	1,033	
9: 819	SUM	09/20/13	50.9	4.2	0.47	0.05	383	300	to	466	
10: 531	SUM	09/20/13	38.5	3.2	0.56	0.05	296	246	to	347	

Summer Yearlings released in RPMA2 in the Yellowstone River

Estimates of survival for the 1st release cohort of summer yearlings (~13.9 months old at time of release, which was 8/11/1998) in RPMA 2 in the Yellowstone River. Estimates are for a fish without disease problems (no fin curl or iridovirus) released in the Yellowstone River.

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)
08/11/98	10/14/00	26.5	13.9	40.4	0.940	(0.008)	0.19	(0.04)	(0.11 to 0.27)
10/14/00	08/18/02	22.4	40.4	62.8	0.969	(0.002)	0.10	(0.02)	(0.05 to 0.14)
08/18/02	08/17/03	12.1	62.8	74.9	0.983	(0.003)	0.08	(0.02)	(0.05 to 0.11)
08/17/03	04/13/04	8.0	74.9	82.9	0.987	(0.003)	0.07	(0.01)	(0.04 to 0.10)
04/13/04	09/21/04	5.4	82.9	88.3	0.990	(0.003)	0.07	(0.01)	(0.04 to 0.09)
09/21/04	04/30/05	7.4	88.3	95.7	0.991	(0.003)	0.06	(0.01)	(0.04 to 0.09)
04/30/05	09/23/05	4.9	95.7	100.5	0.993	(0.002)	0.06	(0.01)	(0.04 to 0.08)
09/23/05	04/29/06	7.3	100.5	107.8	0.994	(0.002)	0.06	(0.01)	(0.04 to 0.08)
04/29/06	07/13/06	2.5	107.8	110.3	0.995	(0.002)	0.06	(0.01)	(0.04 to 0.08)
07/13/06	09/27/06	2.5	110.3	112.8	0.995	(0.002)	0.06	(0.01)	(0.04 to 0.08)
09/27/06	05/02/07	7.2	112.8	120.1	0.995	(0.002)	0.05	(0.01)	(0.04 to 0.07)
05/02/07	09/22/07	4.8	120.1	124.8	0.996	(0.002)	0.05	(0.01)	(0.03 to 0.07)
09/22/07	04/30/08	7.4	124.8	132.2	0.997	(0.002)	0.05	(0.01)	(0.03 to 0.07)
04/30/08	07/22/08	2.8	132.2	135.0	0.997	(0.002)	0.05	(0.01)	(0.03 to 0.07)
07/22/08	09/16/08	1.9	135.0	136.8	0.997	(0.001)	0.05	(0.01)	(0.03 to 0.07)
09/16/08	05/08/09	7.8	136.8	144.7	0.998	(0.001)	0.05	(0.01)	(0.03 to 0.07)
05/08/09	07/22/09	2.5	144.7	147.2	0.998	(0.001)	0.05	(0.01)	(0.03 to 0.07)
07/22/09	09/15/09	1.8	147.2	149.0	0.998	(0.001)	0.05	(0.01)	(0.03 to 0.07)
09/15/09	05/04/10	7.7	149.0	156.7	0.998	(0.001)	0.05	(0.01)	(0.03 to 0.07)
05/04/10	09/08/10	4.2	156.7	160.9	0.999	(0.001)	0.05	(0.01)	(0.03 to 0.07)
09/08/10	05/09/11	8.1	160.9	169.0	0.999	(0.001)	0.05	(0.01)	(0.03 to 0.07)
05/09/11	09/12/11	4.2	169.0	173.2	0.999	(0.001)	0.05	(0.01)	(0.03 to 0.07)
09/12/11	05/08/12	8.0	173.2	181.2	0.999	(0.001)	0.05	(0.01)	(0.03 to 0.07)
05/08/12	09/06/12	4.0	181.2	185.2	0.999	(0.001)	0.05	(0.01)	(0.03 to 0.07)
09/06/12	05/05/13	8.0	185.2	193.2	0.999	(0.001)	0.05	(0.01)	(0.03 to 0.07)
05/05/13	09/20/13	4.6	193.2	197.8	0.999	(0.000)	0.05	(0.01)	(0.03 to 0.07)

For summer yearlings, the estimates from the model that is best-supported by the data indicate that the proportion of fish released as summer yearlings that survive to later ages (e.g., ~0.06 [SE=0.01]) of individuals estimated to still be alive at age ~7 years old) is quite similar to what was found for fish released as spring yearlings (~0.05 [SE=0.01]) and or as fingerlings (~0.08 [SE=0.01]) on the Yellowstone River.

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative. Annual rates for summer yearlings were based on the dates of surveys for the second release cohort because of a longer gap that occurred early in life between occasions for the 1st cohort.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.9	22.4	0.25*	0.05
2.9	34.5	0.64	0.43
4.0	47.9	0.75	0.33
5.0	60.1	0.83	0.31
6.0	72.4	0.80	0.30
7.0	84.4	1.00	0.00
8.0	96.5	0.88	0.22
9.1	108.6	1.00	0.00
10.0	120.5	0.86	0.26

*0.25 raised to 1/1.9 yields an estimated annual rate of 0.48 during the 1st interval.

When the number of fish released in a cohort is taken into account, it is possible to estimate the number of fish from each cohort that was still alive through time. The tables below do this for each release type and cohort **based on the actual river of releases and for disease status in each release cohort**. Thus, these represent estimates based on the average covariate conditions experienced by an actual release cohort.

Estimates of survival for the 1st release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 486 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SUM	08/11/98	10/14/00	13.9	40.4	0.19	0.04	94	55	to	134
1	SUM	10/14/00	08/18/02	40.4	62.8	0.10	0.02	47	27	to	67
1	SUM	08/18/02	08/17/03	62.8	74.9	0.08	0.02	38	23	to	53
1	SUM	08/17/03	04/13/04	74.9	82.9	0.07	0.01	34	21	to	48
1	SUM	04/13/04	09/21/04	82.9	88.3	0.07	0.01	32	20	to	45
1	SUM	09/21/04	04/30/05	88.3	95.7	0.06	0.01	30	19	to	41
1	SUM	04/30/05	09/23/05	95.7	100.5	0.06	0.01	29	19	to	40
1	SUM	09/23/05	04/29/06	100.5	107.8	0.06	0.01	28	18	to	38
1	SUM	04/29/06	07/13/06	107.8	110.3	0.06	0.01	28	18	to	37
1	SUM	07/13/06	09/27/06	110.3	112.8	0.06	0.01	27	18	to	37
1	SUM	09/27/06	05/02/07	112.8	120.1	0.05	0.01	26	17	to	36
1	SUM	05/02/07	09/22/07	120.1	124.8	0.05	0.01	26	17	to	35
1	SUM	09/22/07	04/30/08	124.8	132.2	0.05	0.01	25	17	to	34
1	SUM	04/30/08	07/22/08	132.2	135.0	0.05	0.01	25	16	to	34
1	SUM	07/22/08	09/16/08	135.0	136.8	0.05	0.01	25	16	to	34
1	SUM	09/16/08	05/08/09	136.8	144.7	0.05	0.01	25	16	to	33
1	SUM	05/08/09	07/22/09	144.7	147.2	0.05	0.01	24	16	to	33
1	SUM	07/22/09	09/15/09	147.2	149.0	0.05	0.01	24	16	to	33
1	SUM	09/15/09	05/04/10	149.0	156.7	0.05	0.01	24	15	to	32
1	SUM	05/04/10	09/08/10	156.7	160.9	0.05	0.01	24	15	to	32
1	SUM	09/08/10	05/09/11	160.9	169.0	0.05	0.01	24	15	to	32
1	SUM	05/09/11	09/12/11	169.0	173.2	0.05	0.01	23	15	to	32
1	SUM	09/12/11	05/08/12	173.2	181.2	0.05	0.01	23	15	to	32
1	SUM	05/08/12	09/06/12	181.2	185.2	0.05	0.01	23	15	to	32
1	SUM	09/06/12	05/05/13	185.2	193.2	0.05	0.01	23	15	to	32
1	SUM	05/05/13	09/20/13	193.2	197.8	0.05	0.01	23	15	to	32

Estimates of survival for the 2nd release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 301 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	SUM	10/14/00	08/18/02	13.9	36.3	0.25	0.05	75	48	to	102
2	SUM	08/18/02	08/17/03	36.3	48.4	0.16	0.03	49	31	to	68
2	SUM	08/17/03	04/13/04	48.4	56.4	0.13	0.03	40	25	to	55
2	SUM	04/13/04	09/21/04	56.4	61.8	0.12	0.02	36	23	to	49
2	SUM	09/21/04	04/30/05	61.8	69.2	0.11	0.02	32	21	to	43
2	SUM	04/30/05	09/23/05	69.2	74.0	0.10	0.02	29	20	to	39
2	SUM	09/23/05	04/29/06	74.0	81.3	0.09	0.01	27	18	to	35
2	SUM	04/29/06	07/13/06	81.3	83.8	0.09	0.01	26	18	to	34
2	SUM	07/13/06	09/27/06	83.8	86.3	0.08	0.01	25	17	to	34
2	SUM	09/27/06	05/02/07	86.3	93.6	0.08	0.01	24	16	to	31
2	SUM	05/02/07	09/22/07	93.6	98.3	0.08	0.01	23	16	to	30
2	SUM	09/22/07	04/30/08	98.3	105.7	0.07	0.01	22	15	to	29
2	SUM	04/30/08	07/22/08	105.7	108.5	0.07	0.01	22	15	to	28
2	SUM	07/22/08	09/16/08	108.5	110.4	0.07	0.01	21	15	to	28
2	SUM	09/16/08	05/08/09	110.4	118.2	0.07	0.01	20	14	to	27
2	SUM	05/08/09	07/22/09	118.2	120.7	0.07	0.01	20	14	to	27
2	SUM	07/22/09	09/15/09	120.7	122.5	0.07	0.01	20	14	to	27
2	SUM	09/15/09	05/04/10	122.5	130.2	0.07	0.01	20	13	to	26
2	SUM	05/04/10	09/08/10	130.2	134.4	0.06	0.01	19	13	to	26
2	SUM	09/08/10	05/09/11	134.4	142.5	0.06	0.01	19	13	to	25
2	SUM	05/09/11	09/12/11	142.5	146.7	0.06	0.01	19	12	to	25
2	SUM	09/12/11	05/08/12	146.7	154.7	0.06	0.01	19	12	to	25
2	SUM	05/08/12	09/06/12	154.7	158.7	0.06	0.01	18	12	to	25
2	SUM	09/06/12	05/05/13	158.7	166.7	0.06	0.01	18	12	to	25
2	SUM	05/05/13	09/20/13	166.7	171.3	0.06	0.01	18	12	to	25

Estimates of survival for the 3rd release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 1,797 fish, IV status not considered, Fin Curl status = 0.09).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SUM	08/18/02	08/17/03	13.9	26.0	0.44	0.05	789	623	to	956
3	SUM	08/17/03	04/13/04	26.0	34.0	0.30	0.04	531	388	to	673
3	SUM	04/13/04	09/21/04	34.0	39.4	0.24	0.03	427	305	to	549
3	SUM	09/21/04	04/30/05	39.4	46.7	0.18	0.03	330	232	to	428
3	SUM	04/30/05	09/23/05	46.7	51.6	0.16	0.02	287	202	to	371
3	SUM	09/23/05	04/29/06	51.6	58.9	0.13	0.02	238	169	to	308
3	SUM	04/29/06	07/13/06	58.9	61.4	0.13	0.02	226	161	to	291
3	SUM	07/13/06	09/27/06	61.4	63.9	0.12	0.02	215	153	to	277
3	SUM	09/27/06	05/02/07	63.9	71.1	0.10	0.02	188	135	to	241
3	SUM	05/02/07	09/22/07	71.1	75.9	0.10	0.01	175	126	to	224
3	SUM	09/22/07	04/30/08	75.9	83.3	0.09	0.01	158	113	to	204
3	SUM	04/30/08	07/22/08	83.3	86.0	0.09	0.01	154	109	to	198
3	SUM	07/22/08	09/16/08	86.1	87.9	0.08	0.01	151	107	to	194
3	SUM	09/16/08	05/08/09	87.9	95.7	0.08	0.01	140	97	to	182
3	SUM	05/08/09	07/22/09	95.7	98.2	0.08	0.01	137	95	to	179
3	SUM	07/22/09	09/15/09	98.2	100.0	0.08	0.01	135	93	to	177
3	SUM	09/15/09	05/04/10	100.1	107.8	0.07	0.01	128	86	to	169
3	SUM	05/04/10	09/08/10	107.8	112.0	0.07	0.01	125	83	to	166
3	SUM	09/08/10	05/09/11	112.0	120.1	0.07	0.01	120	77	to	162
3	SUM	05/09/11	09/12/11	120.1	124.3	0.07	0.01	117	75	to	160
3	SUM	09/12/11	05/08/12	124.3	132.2	0.06	0.01	114	71	to	157
3	SUM	05/08/12	09/06/12	132.2	136.3	0.06	0.01	113	69	to	156
3	SUM	09/06/12	05/05/13	136.3	144.3	0.06	0.01	110	66	to	155
3	SUM	05/05/13	09/20/13	144.3	148.9	0.06	0.01	109	64	to	154

Estimates of survival for the 4th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 1,933 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SUM	08/17/03	04/13/04	13.9	21.9	0.61	0.04	1,178	1,029	to	1,327
4	SUM	04/13/04	09/21/04	21.9	27.2	0.46	0.04	898	740	to	1,056
4	SUM	09/21/04	04/30/05	27.2	34.6	0.34	0.04	650	507	to	793
4	SUM	04/30/05	09/23/05	34.6	39.5	0.28	0.03	545	418	to	672
4	SUM	09/23/05	04/29/06	39.5	46.8	0.22	0.03	432	327	to	538
4	SUM	04/29/06	07/13/06	46.8	49.2	0.21	0.03	405	306	to	504
4	SUM	07/13/06	09/27/06	49.2	51.8	0.20	0.02	380	287	to	473
4	SUM	09/27/06	05/02/07	51.8	59.0	0.17	0.02	322	243	to	400
4	SUM	05/02/07	09/22/07	59.0	63.8	0.15	0.02	294	223	to	365
4	SUM	09/22/07	04/30/08	63.8	71.1	0.13	0.02	259	196	to	322
4	SUM	04/30/08	07/22/08	71.2	73.9	0.13	0.02	249	189	to	310
4	SUM	07/22/08	09/16/08	73.9	75.8	0.13	0.02	244	184	to	303
4	SUM	09/16/08	05/08/09	75.8	83.6	0.11	0.01	221	165	to	277
4	SUM	05/08/09	07/22/09	83.6	86.1	0.11	0.01	216	160	to	271
4	SUM	07/22/09	09/15/09	86.1	87.9	0.11	0.01	212	157	to	267
4	SUM	09/15/09	05/04/10	87.9	95.6	0.10	0.01	198	143	to	253
4	SUM	05/04/10	09/08/10	95.6	99.9	0.10	0.01	192	137	to	247
4	SUM	09/08/10	05/09/11	99.9	108.0	0.09	0.01	182	127	to	237
4	SUM	05/09/11	09/12/11	108.0	112.2	0.09	0.01	178	122	to	234
4	SUM	09/12/11	05/08/12	112.2	120.1	0.09	0.02	172	114	to	229
4	SUM	05/08/12	09/06/12	120.1	124.2	0.09	0.02	169	111	to	227
4	SUM	09/06/12	05/05/13	124.2	132.2	0.09	0.02	164	105	to	224
4	SUM	05/05/13	09/20/13	132.2	136.8	0.08	0.02	162	102	to	222

Estimates of survival for the 5th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 685 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
5	SUM	09/21/04	04/30/05	13.9	21.2	0.63	0.04	434	383	to	485
5	SUM	04/30/05	09/23/05	21.2	26.1	0.49	0.04	338	283	to	393
5	SUM	09/23/05	04/29/06	26.1	33.4	0.36	0.04	243	192	to	295
5	SUM	04/29/06	07/13/06	33.4	35.9	0.32	0.04	222	173	to	270
5	SUM	07/13/06	09/27/06	35.9	38.4	0.30	0.03	203	157	to	249
5	SUM	09/27/06	05/02/07	38.4	45.6	0.23	0.03	160	122	to	198
5	SUM	05/02/07	09/22/07	45.6	50.4	0.21	0.03	141	107	to	174
5	SUM	09/22/07	04/30/08	50.4	57.8	0.17	0.02	118	90	to	146
5	SUM	04/30/08	07/22/08	57.8	60.5	0.16	0.02	112	85	to	138
5	SUM	07/22/08	09/16/08	60.5	62.4	0.16	0.02	108	82	to	134
5	SUM	09/16/08	05/08/09	62.4	70.2	0.14	0.02	94	71	to	117
5	SUM	05/08/09	07/22/09	70.2	72.7	0.13	0.02	91	69	to	113
5	SUM	07/22/09	09/15/09	72.7	74.5	0.13	0.02	89	67	to	110
5	SUM	09/15/09	05/04/10	74.5	82.2	0.12	0.02	80	60	to	100
5	SUM	05/04/10	09/08/10	82.2	86.5	0.11	0.01	77	57	to	97
5	SUM	09/08/10	05/09/11	86.5	94.6	0.10	0.01	71	52	to	91
5	SUM	05/09/11	09/12/11	94.6	98.8	0.10	0.01	69	50	to	89
5	SUM	09/12/11	05/08/12	98.8	106.8	0.10	0.01	66	46	to	85
5	SUM	05/08/12	09/06/12	106.8	110.8	0.09	0.01	64	44	to	84
5	SUM	09/06/12	05/05/13	110.8	118.8	0.09	0.02	62	41	to	82
5	SUM	05/05/13	09/20/13	118.8	123.4	0.09	0.02	61	40	to	81

Estimates of survival for the 6th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 175 fish, IV status not considered, Fin Curl status = 1).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
6	SUM	09/23/05	04/29/06	13.9	21.1	0.28	0.06	50	31	to	69
6	SUM	04/29/06	07/13/06	21.1	23.6	0.20	0.05	35	18	to	51
6	SUM	07/13/06	09/27/06	23.6	26.2	0.14	0.04	24	11	to	38
6	SUM	09/27/06	05/02/07	26.2	33.4	0.06	0.02	10	2	to	17
6	SUM	05/02/07	09/22/07	33.4	38.2	0.03	0.01	6	1	to	11
6	SUM	09/22/07	04/30/08	38.2	45.5	0.02	0.01	3	0	to	6
6	SUM	04/30/08	07/22/08	45.5	48.3	0.01	0.01	2	0	to	5
6	SUM	07/22/08	09/16/08	48.3	50.2	0.01	0.01	2	0	to	4
6	SUM	09/16/08	05/08/09	50.2	58.0	0.01	0	1	0	to	2
6	SUM	05/08/09	07/22/09	58.0	60.5	0.01	0	1	0	to	2
6	SUM	07/22/09	09/15/09	60.5	62.3	0.01	0	1	0	to	2
6	SUM	09/15/09	05/04/10	62.3	70.0	0.00	0	1	0	to	1
6	SUM	05/04/10	09/08/10	70.0	74.2	0.00	0	1	0	to	1
6	SUM	09/08/10	05/09/11	74.2	82.3	0.00	0	0	0	to	1
6	SUM	05/09/11	09/12/11	82.3	86.5	0.00	0	0	0	to	1
6	SUM	09/12/11	05/08/12	86.5	94.5	0.00	0	0	0	to	1
6	SUM	05/08/12	09/06/12	94.5	98.5	0.00	0	0	0	to	1
6	SUM	09/06/12	05/05/13	98.5	106.6	0.00	0	0	0	to	1
6	SUM	05/05/13	09/20/13	106.6	111.2	0.00	0	0	0	to	0

Estimates of survival for the 7th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 453 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
7	SUM	07/13/06	09/27/06	13.9	16.4	0.85	0.02	387	372	to	403
7	SUM	09/27/06	05/02/07	16.4	23.6	0.56	0.04	255	220	to	290
7	SUM	05/02/07	09/22/07	23.6	28.4	0.45	0.04	202	167	to	238
7	SUM	09/22/07	04/30/08	28.4	35.8	0.33	0.04	148	116	to	180
7	SUM	04/30/08	07/22/08	35.8	38.5	0.30	0.03	134	104	to	164
7	SUM	07/22/08	09/16/08	38.5	40.4	0.28	0.03	126	98	to	155
7	SUM	09/16/08	05/08/09	40.4	48.2	0.22	0.03	99	76	to	122
7	SUM	05/08/09	07/22/09	48.2	50.7	0.21	0.02	93	71	to	115
7	SUM	07/22/09	09/15/09	50.7	52.5	0.20	0.02	89	68	to	110
7	SUM	09/15/09	05/04/10	52.5	60.2	0.16	0.02	75	57	to	92
7	SUM	05/04/10	09/08/10	60.2	64.5	0.15	0.02	69	53	to	85
7	SUM	09/08/10	05/09/11	64.5	72.6	0.13	0.02	60	46	to	75
7	SUM	05/09/11	09/12/11	72.6	76.8	0.13	0.02	57	43	to	71
7	SUM	09/12/11	05/08/12	76.8	84.7	0.11	0.01	52	39	to	65
7	SUM	05/08/12	09/06/12	84.7	88.8	0.11	0.01	50	37	to	63
7	SUM	09/06/12	05/05/13	88.8	96.8	0.10	0.01	47	34	to	60
7	SUM	05/05/13	09/20/13	96.8	101.4	0.10	0.01	45	32	to	58

Estimates of survival for the 8th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 2,586 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
8	SUM	07/22/08	09/16/08	13.9	15.7	0.89	0.01	2,303	2,235	to	2,371
8	SUM	09/16/08	05/08/09	15.7	23.5	0.56	0.04	1,453	1,251	to	1,656
8	SUM	05/08/09	07/22/09	23.5	26.0	0.50	0.04	1,288	1,083	to	1,494
8	SUM	07/22/09	09/15/09	26.0	27.9	0.46	0.04	1,186	982	to	1,389
8	SUM	09/15/09	05/04/10	27.9	35.6	0.33	0.04	851	667	to	1,034
8	SUM	05/04/10	09/08/10	35.6	39.8	0.28	0.03	733	567	to	898
8	SUM	09/08/10	05/09/11	39.8	47.9	0.22	0.03	567	432	to	702
8	SUM	05/09/11	09/12/11	47.9	52.1	0.20	0.02	509	388	to	631
8	SUM	09/12/11	05/08/12	52.1	60.1	0.16	0.02	424	323	to	526
8	SUM	05/08/12	09/06/12	60.1	64.1	0.15	0.02	393	300	to	487
8	SUM	09/06/12	05/05/13	64.1	72.1	0.13	0.02	344	261	to	427
8	SUM	05/05/13	09/20/13	72.1	76.7	0.12	0.02	323	244	to	402

Estimates of survival for the 9th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 1,796 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
9	SUM	07/22/09	09/15/09	13.9	15.7	0.89	0.01	1,604	1,557	to	1,650
9	SUM	09/15/09	05/04/10	15.7	23.4	0.57	0.04	1,017	877	to	1,157
9	SUM	05/04/10	09/08/10	23.4	27.6	0.46	0.04	829	686	to	972
9	SUM	09/08/10	05/09/11	27.6	35.7	0.32	0.04	583	455	to	711
9	SUM	05/09/11	09/12/11	35.7	39.9	0.28	0.03	503	387	to	619
9	SUM	09/12/11	05/08/12	39.9	47.9	0.22	0.03	391	297	to	486
9	SUM	05/08/12	09/06/12	47.9	51.9	0.20	0.02	353	268	to	438
9	SUM	09/06/12	05/05/13	51.9	60.0	0.16	0.02	293	223	to	364
9	SUM	05/05/13	09/20/13	60.0	64.6	0.15	0.02	269	204	to	334

Estimates of survival for the 10th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 1,090 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
10	SUM	09/08/10	05/09/11	13.9	22.0	0.61	0.04	660	575	to	745
10	SUM	05/09/11	09/12/11	22.0	26.2	0.49	0.04	534	445	to	623
10	SUM	09/12/11	05/08/12	26.2	34.1	0.34	0.04	373	291	to	455
10	SUM	05/08/12	09/06/12	34.1	38.2	0.30	0.03	322	248	to	396
10	SUM	09/06/12	05/05/13	38.2	46.2	0.23	0.03	247	186	to	307
10	SUM	05/05/13	09/20/13	46.2	50.8	0.20	0.03	218	165	to	272

Estimates of survival for the 11th release cohort of summer yearlings in RPMA 2 in the Yellowstone River (cohort= 449 fish, IV status not considered, Fin Curl status = 0).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
11	SUM	09/12/11	05/08/12	13.9	21.8	0.61	0.04	274	239	to	309
11	SUM	05/08/12	09/06/12	21.8	25.9	0.5	0.04	224	187	to	260
11	SUM	09/06/12	05/05/13	25.9	33.9	0.35	0.04	155	122	to	189
11	SUM	05/05/13	09/20/13	33.9	38.5	0.29	0.03	131	101	to	161

Summary information for Summer Yearlings released in RPMA 2 in the Yellowstone River.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as summer yearlings in the Yellowstone River are estimated to have still been alive through time. The point estimates indicate that ~1,359 fish of different ages were still alive in RPMA 2 at the time of the most recent survey used here (09/20/13), that ~45% (618) of those were ~3- to ~5-years old, ~27% (368) were 5- to 8-years old, and ~27% (373) were ≥9-years old.

Estimates of surviving proportions and numbers for summer yearlings released in RPMA 2 in the Yellowstone River.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 486	SUM	09/20/13	197.8	16.5	0.05	0.01	23	15	to	32
2: 301	SUM	09/20/13	171.3	14.3	0.06	0.01	18	12	to	25
3: 1,797	SUM	09/20/13	148.9	12.4	0.06	0.01	109	64	to	154
4: 1,933	SUM	09/20/13	136.8	11.4	0.08	0.02	162	102	to	222
5: 685	SUM	09/20/13	123.4	10.3	0.09	0.02	61	40	to	81
6: 175	SUM	09/20/13	111.2	9.3	0.00	0	0	0	to	0
7: 453	SUM	09/20/13	101.4	8.5	0.10	0.01	45	32	to	58
8: 2,586	SUM	09/20/13	76.7	6.4	0.12	0.02	323	244	to	402
9: 1,796	SUM	09/20/13	64.6	5.4	0.15	0.02	269	204	to	334
10: 1,090	SUM	09/20/13	50.9	4.2	0.20	0.03	218	165	to	272
11: 449	SUM	09/20/13	38.5	3.2	0.29	0.03	131	101	to	161

Summary information for Summer Yearlings released in RPMA 2 in the Missouri & Yellowstone Rivers.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as summer yearlings in the Missouri and the Yellowstone River are estimated to still be alive. The point estimates indicate that ~4,899 fish of different ages were still alive in RPMA 2 at the time of the most recent survey used here (09/20/13), that ~43% (2,119) of those were ~3- to ~5-years old, ~19% (936) were 5- to 8-years old, and ~38% (1,844) were ≥9-years old.

	Release	Type	Date	Age in months	Age in years	N Alive	(95% CI for N Alive)		
1	796	SUM	09/20/13	197.8	16.5	94	55	to	134
2	481	SUM	09/20/13	171.3	14.3	66	40	to	93
3	3,138	SUM	09/20/13	148.9	12.4	498	299	to	698
4	4,058	SUM	09/20/13	136.8	11.4	811	500	to	1,122
5	1,600	SUM	09/20/13	123.4	10.3	375	252	to	497
6	175	SUM	09/20/13	111.2	9.3	0	0	to	0
7	1,369	SUM	09/20/13	101.4	8.5	354	236	to	471
8	3,279	SUM	09/20/13	76.7	6.4	582	429	to	736
9	3,810	SUM	09/20/13	64.6	5.4	1,091	816	to	1,367
10	1,909	SUM	09/20/13	50.9	4.2	601	465	to	738
11	980	SUM	09/20/13	38.5	3.2	427	347	to	508

Summary of number alive as of 09/20/2013 across all releases of fish in RPMA 2

#	Release	Type	Date	Age in months	Age in years	N Alive	(95% CI for N Alive)		
9	767	SPR	09/20/13	14.2	1.2	631	600	to	662
8	3,324	SPR	09/20/13	38.4	3.2	1,216	961	to	1,471
11	980	SUM	09/20/13	38.5	3.2	427	347	to	508
7	4,055	FNG	09/20/13	39.6	3.3	848	536	to	1,158
7	10,679	SPR	09/20/13	50.7	4.2	2,901	2,146	to	3,657
10	1,909	SUM	09/20/13	50.9	4.2	601	465	to	738
6	41,175	FNG	09/20/13	51.5	4.3	8,124	5,093	to	11,156
6	4,964	SPR	09/20/13	62.7	5.2	698	468	to	929
5	59,027	FNG	09/20/13	63.7	5.3	9,039	5,260	to	12,817
9	3,810	SUM	09/20/13	64.6	5.4	1,091	816	to	1,367
5	8,045	SPR	09/20/13	75.2	6.3	1,070	585	to	1,555
4	41,496	FNG	09/20/13	75.7	6.3	8,127	5,082	to	11,173
8	3,279	SUM	09/20/13	76.7	6.4	582	429	to	736
4	4,011	SPR	09/20/13	87.3	7.3	570	327	to	812
3	7,042	FNG	09/20/13	87.7	7.3	1,652	1,014	to	2,290
3	6,729	SPR	09/20/13	99.6	8.3	629	240	to	1,018
2	12,519	FNG	09/20/13	100.0	8.3	2,471	1,405	to	3,537
7	1,369	SUM	09/20/13	101.4	8.5	354	236	to	471
6	175	SUM	09/20/13	111.2	9.3	0	0	to	0
2	874	SPR	09/20/13	111.7	9.3	117	53	to	182
1	16,810	FNG	09/20/13	112.2	9.4				
5	1,600	SUM	09/20/13	123.4	10.3	375	252	to	497
1	822	SPR	09/20/13	124.5	10.4	20	5	to	35
4	4,058	SUM	09/20/13	136.8	11.4	811	500	to	1,122
3	3,138	SUM	09/20/13	148.9	12.4	498	299	to	698
2	481	SUM	09/20/13	171.3	14.3	66	40	to	93
1	796	SUM	09/20/13	197.8	16.5	94	55	to	134

**The 1st 2 columns column represents (a: #) the release cohort number for the specific type of release and (b: Release) the number of individuals in that release cohort.*

When summarized by age class, the estimates indicate that 43,012 of the 243,934 fish that were released from hatcheries from 1998 through September of 2013 in RPMA 2 were still alive in September of 2013. Of those fish: ~1% were estimated to be 1 year old, ~58% were estimated to be in the 3- to ~5-year-old class, ~36% were ~6- to 8-years old, and ~5% were ≥9 years old.

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N Alive)		
2	09/20/13	~1	631	1.47	600	to	662
2	09/20/13	3 to 5	24,945	58.00	16,092	to	33,801
2	09/20/13	6 to 8	15,455	35.93	9,318	to	21,592
2	09/20/13	≥9	1,981	4.61	1,204	to	2,761

RPMA 3

For RPMA 3, the top model of the mark-recapture data included the following covariates of survival: release type (categorized as spring yearlings, summer yearlings, or fish aged 2 or 3 years of age at time of release), age of fish, the proportion of the survival period that was in winter versus summer, and interactions between release type and age of fish. For survival, the top model's structure remained the same as the best-supported structure in Rotella (2012). The model of capture probability included the natural logarithm of fish age and capture session (different capture probabilities for different occasions). In Rotella (2012), the structure for capture probability was similar but used actual fish age rather than the natural logarithm of fish age at release.

For RPMA 3, neither diseases status nor river of release covariates were included in the model used to estimate survival rates. Thus, results are simply provided for each release cohort from time of release to the most recent date used in these analyses. The results below are for the release of 4,492 spring yearlings, 2,988 summer yearlings, 103 2-year-olds, and 650 3-year-olds (total = 8,233 fish).

Dates and numbers for releases and recapture work on RPMA 3.

Occ	Begin	End	Midpoint	Release Numbers for Each Fish Type							
				Spring		Summer		TwoYr		ThreeYr	
1	06/06/00	09/20/00	07/29/00					1	103	1	460
2	04/21/02	04/27/02	04/24/02	1	563					2	190
3	04/10/03	05/07/03	04/23/03								
4	07/26/03	07/26/03	07/26/03			1	607				
5	08/14/03	11/18/03	10/01/03								
6	04/15/04	05/19/04	05/02/04								
7	10/06/04	11/01/04	10/19/04			2	511				
8	03/13/05	05/26/05	04/19/05								
9	08/30/05	11/08/05	10/04/05			3	865				
10	03/30/06	05/17/06	04/23/06								
11	08/25/06	11/14/06	10/04/06			4	1,005				
12	04/01/07	05/09/07	04/20/07	2	601						
13	08/15/07	11/01/07	09/23/07								
14	04/08/08	05/15/08	04/26/08	3	1,171						
15	08/26/08	11/04/08	09/30/08								
16	04/08/09	05/29/09	05/03/09	4	636						
17	08/03/09	08/19/09	08/11/09								
18	04/11/10	06/15/10	05/13/10	5	840						
19	08/02/10	08/22/10	08/12/10								
20	4/14/2011	5/19/2011	5/11/2011	6	599						
21	3/26/2012	5/31/2012	4/28/2012								
22	7/10/2012	8/9/2012	7/25/2012								
23	4/1/2013	6/20/2013	5/11/2013								
24	08/26/13	09/11/13	09/03/13	7	82						

Results for Releases of Spring Yearlings in RPMA 3

Data on the number of spring yearlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 4,568 releases and re-releases of fish originally released as spring yearlings had been conducted, which resulted in 76 recaptures as well as the 82 newly released fish from late summer of 2013. The results presented below are based on the analyses of those data.

Occ. $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 Total	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	563	0	0	2	1	0	0	1	2	1	2	2	4	2	7	0	10	0	2	7	0	0	5	48
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
12	603	0	0	0	0	0	0	0	0	0	0	8	1	0	2	3	6	2	4	5	3	4	3	41
13	10	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2
14	1176	0	0	0	0	0	0	0	0	0	0	0	0	4	4	3	8	0	8	2	5	0	4	38
15	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
16	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	0	3	1	0	1	1	14
17	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
18	870	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	6	3	2	16
19	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	621	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	3	2	0	5
21	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
22	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Estimates of survival for the 1st release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3. *The estimates presented here indicate that survival is modest in the 1st year in the river and then that survival is 1.0 thereafter. These results are quite similar to those in the last report but are slightly more precise. The data on recaptures remains relatively sparse for this group as can be seen by looking at the column totals for columns j=2, 3, ..., 23 in the table on the previous page. Regardless, current estimates still indicate that ~18% of a release cohort remains alive by the time the fish are 6- to 8-years old, which is quite similar to what was reported previously.*

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)		
04/24/02	04/23/03	12.1	9.5	21.6	0.867	(0.012)	0.18	(0.03)	(0.12	to	0.23)
04/23/03	07/26/03	3.1	21.6	24.8	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
07/26/03	10/01/03	2.2	24.8	27.0	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
10/01/03	05/02/04	7.1	27.0	34.1	0.999	(0.002)	0.18	(0.03)	(0.12	to	0.23)
05/02/04	10/19/04	5.7	34.1	39.8	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
10/19/04	04/19/05	6.1	39.8	45.9	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
04/19/05	10/04/05	5.6	45.9	51.5	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
10/04/05	04/23/06	6.7	51.5	58.2	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
04/23/06	10/04/06	5.5	58.2	63.6	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
10/04/06	04/20/07	6.6	63.6	70.2	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
04/20/07	09/23/07	5.2	70.2	75.4	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
09/23/07	04/26/08	7.2	75.4	82.6	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
04/26/08	09/30/08	5.2	82.6	87.9	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
09/30/08	05/03/09	7.2	87.9	95.0	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
05/03/09	08/11/09	3.3	95.0	98.4	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
08/11/09	05/13/10	9.2	98.4	107.5	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
05/13/10	08/12/10	3.0	107.5	110.6	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
08/12/10	05/11/11	9.1	110.6	119.6	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
05/11/11	04/28/12	11.8	119.6	131.4	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
04/28/12	07/25/12	2.9	131.4	134.3	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
07/25/12	05/11/13	9.7	134.3	144.0	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)
05/11/13	09/03/13	3.8	144.0	147.8	1.000	(0.000)	0.18	(0.03)	(0.12	to	0.23)

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported.*

Years since release	Months Since Release	Interval Survival Rate	SE
1.01	12.1	0.18	0.03

Estimates of survival for the 1st release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort= 563 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	95% CI for N at Interval End		
1	SPR	04/24/02	04/23/03	9.5	21.6	0.18	0.03	100	68	to	132
1	SPR	04/23/03	07/26/03	21.6	24.8	0.18	0.03	100	68	to	132
1	SPR	07/26/03	10/01/03	24.8	27.0	0.18	0.03	100	68	to	132
1	SPR	10/01/03	05/02/04	27.0	34.1	0.18	0.03	99	68	to	130
1	SPR	05/02/04	10/19/04	34.1	39.8	0.18	0.03	99	68	to	130
1	SPR	10/19/04	04/19/05	39.8	45.9	0.18	0.03	99	68	to	130
1	SPR	04/19/05	10/04/05	45.9	51.5	0.18	0.03	99	68	to	130
1	SPR	10/04/05	04/23/06	51.5	58.2	0.18	0.03	99	68	to	130
1	SPR	04/23/06	10/04/06	58.2	63.6	0.18	0.03	99	68	to	130
1	SPR	10/04/06	04/20/07	63.6	70.2	0.18	0.03	99	68	to	130
1	SPR	04/20/07	09/23/07	70.2	75.4	0.18	0.03	99	68	to	130
1	SPR	09/23/07	04/26/08	75.4	82.6	0.18	0.03	99	68	to	130
1	SPR	04/26/08	09/30/08	82.6	87.9	0.18	0.03	99	68	to	130
1	SPR	09/30/08	05/03/09	87.9	95.0	0.18	0.03	99	68	to	130
1	SPR	05/03/09	08/11/09	95.0	98.4	0.18	0.03	99	68	to	130
1	SPR	08/11/09	05/13/10	98.4	107.5	0.18	0.03	99	68	to	130
1	SPR	05/13/10	08/12/10	107.5	110.6	0.18	0.03	99	68	to	130
1	SPR	08/12/10	05/11/11	110.6	119.6	0.18	0.03	99	68	to	130
1	SPR	05/11/11	04/28/12	119.6	131.4	0.18	0.03	99	68	to	130
1	SPR	04/28/12	07/25/12	131.4	134.3	0.18	0.03	99	68	to	130
1	SPR	07/25/12	05/11/13	134.3	144	0.18	0.03	99	68	to	130
1	SPR	05/11/13	09/03/13	144	147.8	0.18	0.03	99	68	to	130

Estimates of survival for the 2nd release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort= 601 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Interval End)		
2	SPR	04/20/07	09/23/07	9.5	14.7	0.98	0.02	587	566	to	601
2	SPR	09/23/07	04/26/08	14.7	21.9	0.24	0.05	147	94	to	200
2	SPR	04/26/08	09/30/08	21.9	27.1	0.24	0.05	147	94	to	200
2	SPR	09/30/08	05/03/09	27.1	34.3	0.24	0.05	145	92	to	199
2	SPR	05/03/09	08/11/09	34.3	37.6	0.24	0.05	145	92	to	199
2	SPR	08/11/09	05/13/10	37.6	46.8	0.24	0.05	145	92	to	199
2	SPR	05/13/10	08/12/10	46.8	49.8	0.24	0.05	145	92	to	199
2	SPR	08/12/10	05/11/11	49.8	58.9	0.24	0.05	145	92	to	199
2	SPR	05/11/11	04/28/12	58.9	70.7	0.24	0.05	145	92	to	199
2	SPR	04/28/12	07/25/12	70.7	73.6	0.24	0.05	145	92	to	199
2	SPR	07/25/12	05/11/13	73.6	83.3	0.24	0.05	145	92	to	199
2	SPR	05/11/13	09/03/13	83.3	87.1	0.24	0.05	145	92	to	199

Estimates of survival for the 3rd release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort= 1,171 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Interval End)		
3	SPR	04/26/08	09/30/08	9.5	14.7	0.98	0.02	1,144	1,102	to	1,171
3	SPR	09/30/08	05/03/09	14.7	21.9	0.25	0.05	292	187	to	397
3	SPR	05/03/09	08/11/09	21.9	25.2	0.25	0.05	292	187	to	397
3	SPR	08/11/09	05/13/10	25.2	34.4	0.25	0.05	290	184	to	396
3	SPR	05/13/10	08/12/10	34.4	37.4	0.25	0.05	290	184	to	396
3	SPR	08/12/10	05/11/11	37.4	46.5	0.25	0.05	290	184	to	396
3	SPR	05/11/11	04/28/12	46.5	58.3	0.25	0.05	290	184	to	396
3	SPR	04/28/12	07/25/12	58.3	61.2	0.25	0.05	290	184	to	396
3	SPR	07/25/12	05/11/13	61.2	70.9	0.25	0.05	290	184	to	396
3	SPR	05/11/13	09/03/13	70.9	74.7	0.25	0.05	290	184	to	396

Estimates of survival for the 4th release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort= 636 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Interval End)		
4	SPR	05/03/09	08/11/09	9.5	12.8	0.99	0.01	627	612	to	636
4	SPR	08/11/09	05/13/10	12.8	22	0.32	0.05	206	147	to	265
4	SPR	05/13/10	08/12/10	22	25	0.32	0.05	206	147	to	265
4	SPR	08/12/10	05/11/11	25	34.1	0.32	0.05	204	143	to	266
4	SPR	05/11/11	04/28/12	34.1	45.9	0.32	0.05	204	143	to	266
4	SPR	04/28/12	07/25/12	45.9	48.8	0.32	0.05	204	143	to	266
4	SPR	07/25/12	05/11/13	48.8	58.5	0.32	0.05	204	143	to	266
4	SPR	05/11/13	09/03/13	58.5	62.3	0.32	0.05	204	143	to	266

Estimates of survival for the 5th release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort= 840 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Interval End)		
5	SPR	05/13/10	08/12/10	9.5	12.5	0.99	0.01	829	811	to	840
5	SPR	08/12/10	05/11/11	12.5	21.6	0.29	0.04	241	178	to	304
5	SPR	05/11/11	04/28/12	21.6	33.4	0.28	0.04	238	170	to	305
5	SPR	04/28/12	07/25/12	33.4	36.3	0.28	0.04	238	170	to	305
5	SPR	07/25/12	05/11/13	36.3	46	0.28	0.04	238	170	to	305
5	SPR	05/11/13	09/03/13	46	49.8	0.28	0.04	238	170	to	305

Estimates of survival for the 6th release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort= 599 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Interval End)		
6	SPR	05/11/11	04/28/12	9.5	21.3	0.15	0.03	88	56	to	121
6	SPR	04/28/12	07/25/12	21.3	24.2	0.15	0.03	88	56	to	121
6	SPR	07/25/12	05/11/13	24.2	33.9	0.15	0.03	88	56	to	119
6	SPR	05/11/13	09/03/13	33.9	37.7	0.15	0.03	88	56	to	119

No information provided for 7th release cohort of spring yearlings (~9.6 months old at time of release) in RPMA 3 (cohort=82 fish) as they were released on the last occasion considered here.

Summary information for Spring Yearlings released in RPMA 3.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort released prior to September 2013 are assembled, one can review how many fish released as spring yearlings were estimated to still be alive as of the last date analyzed here. The point estimates indicate that 1,064 of these fish were still alive in RPMA 3 as of September 2013. Of these ~30% (~326) were \leq 4 years old, ~60% (~639) were between ~4 to 7 years old, and the remainder were 12 year olds from the 1st release cohort.

Estimates of surviving proportions and numbers for spring yearling releases in RPMA 3.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 563	SPR	09/03/13	144.0	12.0	0.18	0.03	99	68	to	130
2: 601	SPR	09/03/13	83.3	6.9	0.24	0.05	145	92	to	199
3: 1,171	SPR	09/03/13	70.9	5.9	0.25	0.05	290	184	to	396
4: 636	SPR	09/03/13	58.5	4.9	0.32	0.05	204	143	to	266
5: 840	SPR	09/03/13	46	3.8	0.28	0.04	238	170	to	305
6: 599	SPR	09/03/13	33.9	2.8	0.15	0.03	88	56	to	119

Results for Releases of Summer Yearlings in RPMA 3

Data on the number of summer yearlings released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 3,323 releases and re-releases of fish originally released as summer yearlings had been conducted, which resulted in 337 recaptures. The results presented below are based on the analyses of the data collected on those released and recaptured fish.

Occ., $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 Total	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	606	1	1	3	1	4	3	3	7	3	4	11	9	0	8	0	9	4	1	13	2	87	0	0
5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	514	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	874	3	1	1	8	4	4	19	2	15	1	5	4	1	9	3	80	0	0	0	0	0	0	0
10	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Estimates of survival for the 1st release cohort of summer yearlings (~14.2 months old at time of release) in RPMA 3. *Estimates for this release type did not change substantially from the previous report's estimates. Precision is better than in the previous report as sample sizes have increased.*

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)		
07/26/03	10/01/03	2.2	14.2	16.5	1.000	(0.000)	1.00	(0.00)	1.00	to	1.00
10/01/03	05/02/04	7.1	16.5	23.6	0.943	(0.010)	0.66	(0.05)	0.56	to	0.75
05/02/04	10/19/04	5.7	23.6	29.3	1.000	(0.000)	0.66	(0.05)	0.56	to	0.75
10/19/04	04/19/05	6.1	29.3	35.3	0.950	(0.005)	0.48	(0.04)	0.40	to	0.56
04/19/05	10/04/05	5.6	35.3	40.9	1.000	(0.000)	0.48	(0.04)	0.40	to	0.56
10/04/05	04/23/06	6.7	40.9	47.6	0.968	(0.006)	0.38	(0.03)	0.32	to	0.45
04/23/06	10/04/06	5.5	47.6	53.1	1.000	(0.000)	0.38	(0.03)	0.32	to	0.45
10/04/06	04/20/07	6.6	53.1	59.7	0.976	(0.007)	0.33	(0.03)	0.26	to	0.39
04/20/07	09/23/07	5.2	59.7	64.9	1.000	(0.000)	0.33	(0.03)	0.26	to	0.39
09/23/07	04/26/08	7.2	64.9	72.1	0.989	(0.005)	0.30	(0.04)	0.23	to	0.38
04/26/08	09/30/08	5.2	72.1	77.3	1.000	(0.000)	0.30	(0.04)	0.23	to	0.38
09/30/08	05/03/09	7.2	77.3	84.5	0.992	(0.005)	0.29	(0.04)	0.20	to	0.37
05/03/09	08/11/09	3.3	84.5	87.8	1.000	(0.000)	0.29	(0.04)	0.20	to	0.37
08/11/09	05/13/10	9.2	87.8	97.0	0.998	(0.001)	0.28	(0.04)	0.20	to	0.37
05/13/10	08/12/10	3.0	97.0	100.0	1.000	(0.000)	0.28	(0.04)	0.20	to	0.37
08/12/10	05/11/11	9.1	100.0	109.1	0.999	(0.001)	0.28	(0.05)	0.19	to	0.37
05/11/11	04/28/12	11.8	109.1	120.9	1.000	(0.000)	0.28	(0.05)	0.19	to	0.37
04/28/12	07/25/12	2.9	120.9	123.8	1.000	(0.000)	0.28	(0.05)	0.19	to	0.37
07/25/12	05/11/13	9.7	123.8	133.5	1.000	(0.000)	0.28	(0.05)	0.19	to	0.37
05/11/13	09/03/13	3.8	133.5	137.3	1.000	(0.000)	0.28	(0.05)	0.19	to	0.37

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
0.78	9.4	0.66	0.05
1.76	21.1	0.73	0.16
2.78	33.4	0.79	0.15
3.79	45.5	0.87	0.14
4.82	57.9	0.91	0.18
6.13	73.6	0.97	0.20
6.90	82.80	0.97	0.21

Estimates of survival for the 1st release cohort of summer yearlings (~14.2 months old at time of release) in RPMA 3 (cohort=607 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	SUM	07/26/03	10/01/03	14.2	16.5	1.00	0.00	606	605	to	606
1	SUM	10/01/03	05/02/04	16.5	23.6	0.66	0.05	398	341	to	456
1	SUM	05/02/04	10/19/04	23.6	29.3	0.66	0.05	398	340	to	455
1	SUM	10/19/04	04/19/05	29.3	35.3	0.48	0.04	291	240	to	342
1	SUM	04/19/05	10/04/05	35.3	40.9	0.48	0.04	291	240	to	342
1	SUM	10/04/05	04/23/06	40.9	47.6	0.38	0.03	233	192	to	274
1	SUM	04/23/06	10/04/06	47.6	53.1	0.38	0.03	233	192	to	274
1	SUM	10/04/06	04/20/07	53.1	59.7	0.33	0.03	199	159	to	239
1	SUM	04/20/07	09/23/07	59.7	64.9	0.33	0.03	199	159	to	239
1	SUM	09/23/07	04/26/08	64.9	72.1	0.30	0.04	183	139	to	227
1	SUM	04/26/08	09/30/08	72.1	77.3	0.30	0.04	183	139	to	227
1	SUM	09/30/08	05/03/09	77.3	84.5	0.29	0.04	174	124	to	223
1	SUM	05/03/09	08/11/09	84.5	87.8	0.29	0.04	174	124	to	223
1	SUM	08/11/09	05/13/10	87.8	97.0	0.28	0.04	171	119	to	223
1	SUM	05/13/10	08/12/10	97.0	100.0	0.28	0.04	171	119	to	223
1	SUM	08/12/10	05/11/11	100.0	109.1	0.28	0.05	170	116	to	223
1	SUM	05/11/11	04/28/12	109.1	120.9	0.28	0.05	169	115	to	223
1	SUM	04/28/12	07/25/12	120.9	123.8	0.28	0.05	169	115	to	223
1	SUM	07/25/12	05/11/13	123.8	133.5	0.28	0.05	169	113	to	224
1	SUM	05/11/13	09/03/13	133.5	137.3	0.28	0.05	169	113	to	224

Estimates of survival for the 2nd release cohort of summer yearlings (~14.2 months old at time of release) in RPMA 3 (cohort= 511 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	SUM	10/19/04	04/19/05	14.2	20.3	0.60	0.06	309	248	to	370
2	SUM	04/19/05	10/04/05	20.3	25.9	0.60	0.06	309	248	to	369
2	SUM	10/04/05	04/23/06	25.9	32.6	0.42	0.05	216	162	to	270
2	SUM	04/23/06	10/04/06	32.6	38.1	0.42	0.05	216	162	to	270
2	SUM	10/04/06	04/20/07	38.1	44.7	0.33	0.04	167	126	to	208
2	SUM	04/20/07	09/23/07	44.7	49.9	0.33	0.04	167	126	to	208
2	SUM	09/23/07	04/26/08	49.9	57.1	0.29	0.03	146	112	to	180
2	SUM	04/26/08	09/30/08	57.1	62.3	0.29	0.03	146	112	to	180
2	SUM	09/30/08	05/03/09	62.3	69.5	0.26	0.03	133	102	to	165
2	SUM	05/03/09	08/11/09	69.5	72.8	0.26	0.03	133	102	to	165
2	SUM	08/11/09	05/13/10	72.8	82.0	0.26	0.03	130	99	to	162
2	SUM	05/13/10	08/12/10	82.0	85.0	0.26	0.03	130	99	to	162
2	SUM	08/12/10	05/11/11	85.0	94.1	0.25	0.03	128	97	to	160
2	SUM	05/11/11	04/28/12	94.1	105.8	0.25	0.03	128	96	to	160
2	SUM	04/28/12	07/25/12	105.8	108.8	0.25	0.03	128	96	to	160
2	SUM	07/25/12	05/11/13	108.8	118.4	0.25	0.03	127	95	to	159
2	SUM	05/11/13	09/03/13	118.4	122.3	0.25	0.03	127	95	to	159

Estimates of survival for the 3rd release cohort of summer yearlings (~14.2 months old at time of release) in RPMA 3 (cohort= 865 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
3	SUM	10/04/05	04/23/06	14.2	20.9	0.60	0.06	515	412	to	618
3	SUM	04/23/06	10/04/06	20.9	26.4	0.59	0.06	514	411	to	617
3	SUM	10/04/06	04/20/07	26.4	33.0	0.41	0.05	355	264	to	445
3	SUM	04/20/07	09/23/07	33.0	38.2	0.41	0.05	354	264	to	445
3	SUM	09/23/07	04/26/08	38.2	45.4	0.34	0.04	291	220	to	362
3	SUM	04/26/08	09/30/08	45.4	50.6	0.34	0.04	291	220	to	362
3	SUM	09/30/08	05/03/09	50.6	57.8	0.30	0.03	255	197	to	314
3	SUM	05/03/09	08/11/09	57.8	61.1	0.30	0.03	255	197	to	314
3	SUM	08/11/09	05/13/10	61.1	70.3	0.29	0.03	247	191	to	303
3	SUM	05/13/10	08/12/10	70.3	73.3	0.29	0.03	247	191	to	303
3	SUM	08/12/10	05/11/11	73.3	82.4	0.28	0.03	242	186	to	297
3	SUM	05/11/11	04/28/12	82.4	94.2	0.28	0.03	240	184	to	295
3	SUM	04/28/12	07/25/12	94.2	97.1	0.28	0.03	240	184	to	295
3	SUM	07/25/12	05/11/13	97.1	106.8	0.27	0.03	238	182	to	293
3	SUM	05/11/13	09/03/13	106.8	110.6	0.27	0.03	238	182	to	293

Estimates of survival for the 4th release cohort of summer yearlings (~14.2 months old at time of release) in RPMA 3 (cohort= 1,005 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
4	SUM	10/04/06	04/20/07	14.2	20.8	0.58	0.06	581	457	to	705
4	SUM	04/20/07	09/23/07	20.8	26.0	0.58	0.06	581	457	to	704
4	SUM	09/23/07	04/26/08	26.0	33.2	0.43	0.06	434	325	to	543
4	SUM	04/26/08	09/30/08	33.2	38.5	0.43	0.06	434	325	to	543
4	SUM	09/30/08	05/03/09	38.5	45.6	0.36	0.04	357	271	to	443
4	SUM	05/03/09	08/11/09	45.6	49.0	0.36	0.04	357	271	to	443
4	SUM	08/11/09	05/13/10	49.0	58.1	0.34	0.04	340	259	to	420
4	SUM	05/13/10	08/12/10	58.1	61.2	0.34	0.04	340	259	to	420
4	SUM	08/12/10	05/11/11	61.2	70.2	0.33	0.04	329	252	to	406
4	SUM	05/11/11	04/28/12	70.2	82.0	0.32	0.04	325	248	to	402
4	SUM	04/28/12	07/25/12	82.0	84.9	0.32	0.04	325	248	to	402
4	SUM	07/25/12	05/11/13	84.9	94.6	0.32	0.04	321	245	to	397
4	SUM	05/11/13	09/03/13	94.6	98.4	0.32	0.04	321	245	to	397

Summary information for Summer Yearlings released in RPMA 3.

When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as summer yearlings are estimated to still be alive. The point estimates indicate that 855 of these fish were still alive in RPMA 3 as of the last date analyzed here. All were ≥ 8.2 years old, and ~20% (~296) were ≥ 10 years old.

Estimates of surviving proportions and numbers for summer yearling releases in RPMA 3.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 606	SUM	09/03/13	137.3	11.4	0.28	0.05	169	113	to	224
2: 511	SUM	09/03/13	122.3	10.2	0.25	0.03	127	95	to	159
3: 865	SUM	09/03/13	110.6	9.2	0.27	0.03	238	182	to	293
4: 1,005	SUM	09/03/13	98.4	8.20	0.32	0.04	321	245	to	397

Results for Releases of Two-Year Olds in RPMA 3

Data on the number of two-year-olds released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 119 releases and re-releases of fish of this this release type had been achieved, which resulted in 16 recaptures. The results presented below are based on the analyses of the data collected on those released and recaptured fish.

Occ. $R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 Total
1	103	0	0	0	1	1	0	1	0	0	1	0	0	1	1	0	1	0	1	2	0	0	11
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Estimates of survival for the 1st (& only) release cohort of two-year olds (~27.7 months old at time of release) in RPMA 3. *Estimates of the proportion still alive remain low for this release type. However, the point estimates are a bit higher in this report than in the previous one for the more recent years, and the estimates of precision are somewhat improved. The estimates continue to be based on modest numbers of recaptures from the original release of 103 fish.*

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)		
07/29/00	04/24/02	21.1	27.7	48.9	0.966	(0.012)	0.48	(0.13)	0.23	to	0.72
04/24/02	04/23/03	12.1	48.9	61	0.989	(0.004)	0.42	(0.13)	0.17	to	0.67
04/23/03	07/26/03	3.1	61	64.1	1.000	(0.000)	0.42	(0.13)	0.17	to	0.67
07/26/03	10/01/03	2.2	64.1	66.4	1.000	(0.000)	0.42	(0.13)	0.17	to	0.67
10/01/03	05/02/04	7.1	66.3	73.5	0.922	(0.012)	0.23	(0.07)	0.09	to	0.38
05/02/04	10/19/04	5.7	73.5	79.2	1.000	(0.000)	0.23	(0.07)	0.09	to	0.38
10/19/04	04/19/05	6.1	79.2	85.2	0.928	(0.012)	0.15	(0.04)	0.06	to	0.23
04/19/05	10/04/05	5.6	85.2	90.8	1.000	(0.000)	0.15	(0.04)	0.06	to	0.23
10/04/05	04/23/06	6.7	90.8	97.5	0.951	(0.009)	0.11	(0.03)	0.05	to	0.16
04/23/06	10/04/06	5.5	97.5	103	1.000	(0.000)	0.11	(0.03)	0.05	to	0.16
10/04/06	04/20/07	6.6	103	109.6	0.962	(0.009)	0.08	(0.02)	0.04	to	0.12
04/20/07	09/23/07	5.2	109.6	114.8	1.000	(0.000)	0.08	(0.02)	0.04	to	0.12
09/23/07	04/26/08	7.2	114.8	122	0.981	(0.006)	0.07	(0.02)	0.04	to	0.10
04/26/08	09/30/08	5.2	122	127.2	1.000	(0.000)	0.07	(0.02)	0.04	to	0.10
09/30/08	05/03/09	7.2	127.2	134.4	0.986	(0.006)	0.06	(0.01)	0.04	to	0.09
05/03/09	08/11/09	3.3	134.4	137.7	1.000	(0.000)	0.06	(0.01)	0.04	to	0.09
08/11/09	05/13/10	9.2	137.7	146.9	0.997	(0.002)	0.06	(0.01)	0.04	to	0.09
05/13/10	08/12/10	3	146.9	149.9	1.000	(0.000)	0.06	(0.01)	0.04	to	0.09
08/12/10	05/11/11	9.1	149.9	159	0.998	(0.002)	0.06	(0.01)	0.04	to	0.09
05/11/11	04/28/12	11.8	159	170.8	0.999	(0.001)	0.06	(0.01)	0.03	to	0.09
04/28/12	07/25/12	2.9	170.8	173.7	1.000	(0.000)	0.06	(0.01)	0.03	to	0.09
07/25/12	05/11/13	9.7	173.7	183.4	0.999	(0.001)	0.06	(0.01)	0.03	to	0.09
05/11/13	09/03/13	3.8	183.4	187.2	1.000	(0.000)	0.06	(0.01)	0.03	to	0.09

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. NOTE: The first interval here was 21.2 months and so much longer than a year. This was used as it was the first actual interval; an annual rate is reported in the footnotes of the table. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.77	21.2	0.48*	0.13
3.03	36.4	0.88	0.47
3.82	45.8	0.55	0.79
4.79	57.5	0.65	0.62
5.82	69.8	0.73	0.52
6.83	81.9	0.73	0.51
7.86	94.3	0.88	0.43
8.89	106.7	0.86	0.39

*0.48 raised to 1/1.77 yields an estimated annual rate of 0.66 during the 1st interval.

Estimates of survival for the 1st release cohort of two-year olds (~27.7 months old at time of release) in RPMA 3 (cohort= 103 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	Two	07/29/00	04/24/02	27.7	48.9	0.48	0.13	49	24	to	75
1	Two	04/24/02	04/23/03	48.9	61.0	0.42	0.13	43	17	to	69
1	Two	04/23/03	07/26/03	61.0	64.1	0.42	0.13	43	17	to	69
1	Two	07/26/03	10/01/03	64.1	66.4	0.42	0.13	43	17	to	69
1	Two	10/01/03	05/02/04	66.3	73.5	0.23	0.07	24	9	to	39
1	Two	05/02/04	10/19/04	73.5	79.2	0.23	0.07	24	9	to	39
1	Two	10/19/04	04/19/05	79.2	85.2	0.15	0.04	15	6	to	24
1	Two	04/19/05	10/04/05	85.2	90.8	0.15	0.04	15	6	to	24
1	Two	10/04/05	04/23/06	90.8	97.5	0.11	0.03	11	5	to	17
1	Two	04/23/06	10/04/06	97.5	103.0	0.11	0.03	11	5	to	17
1	Two	10/04/06	04/20/07	103.0	109.6	0.08	0.02	8	4	to	13
1	Two	04/20/07	09/23/07	109.6	114.8	0.08	0.02	8	4	to	13
1	Two	09/23/07	04/26/08	114.8	122.0	0.07	0.02	7	4	to	11
1	Two	04/26/08	09/30/08	122.0	127.2	0.07	0.02	7	4	to	11
1	Two	09/30/08	05/03/09	127.2	134.4	0.06	0.01	7	4	to	10
1	Two	05/03/09	08/11/09	134.4	137.7	0.06	0.01	7	4	to	10
1	Two	08/11/09	05/13/10	137.7	146.9	0.06	0.01	6	4	to	9
1	Two	05/13/10	08/12/10	146.9	149.9	0.06	0.01	6	4	to	9
1	Two	08/12/10	05/11/11	149.9	159.0	0.06	0.01	6	4	to	9
1	Two	05/11/11	04/28/12	159.0	170.8	0.06	0.01	6	4	to	9
1	Two	04/28/12	07/25/12	170.8	173.7	0.06	0.01	6	4	to	9
1	Two	07/25/12	05/11/13	173.7	183.4	0.06	0.01	6	4	to	9
1	Two	05/11/13	09/03/13	183.4	187.2	0.06	0.01	6	4	to	9

Summary information for fish released as Two-Year Olds in RPMA 3.

Based on the most recent estimates of the proportion surviving and the number surviving from the single release cohort, 6 fish were estimated to still be alive in RPMA 3 as of 09/03/2013. These fish were ~15.6 years old at that time.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 103	Two	09/03/13	187.2	15.6	0.06	0.01	6	4	to	9

Results for Releases of Three-Year Olds in RPMA 3

Data on the number of three-year-olds released on each occasion ($R(i)$) along with information on when they were 1st subsequently recaptured (on occasion j) is provided in the table below. At the time of the analyses presented here, 741 releases and re-releases of fish in this release type had been achieved, which resulted in 89 recaptures. The results presented below are based on the analyses of the data collected on those released and recaptured fish.

Occ.	$R(i)$	$j=2$	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 Total	
1	462	0	3	0	8	5	0	1	2	0	2	2	4	2	5	6	2	3	0	1	1	0	2	0	49
2	190	2	0	0	5	2	1	1	0	0	1	0	0	0	1	2	0	0	0	0	0	0	0	0	15
3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	13	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	3
6	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
15	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	1	1	6
16	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2	0	4
17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
18	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
20	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Estimates of survival for the 1st release cohort of three-year olds (~36.3 months old at time of release) in RPMA 3. *Estimates of the proportion still alive for this release type drop faster in the first several years post-release than they did in the previous report. After 2007, however, the rates are now higher than previous estimates and the rate levels out at a higher value. Estimates are more precise or of similar precision to those in the most recent report. The estimates continue to be based on modest numbers of recaptures as can be seen in the table of recapture information on the previous page.*

Start Date	End Date	Months	Age at int. start (mos.)	Age at int end (mos.)	Monthly Survival	(SE)	Ppn. Still Alive	(SE)	(95% CI for Cum. Ppn. Surviving)	
07/29/00	04/24/02	21.1	36.3	57.4	0.973	(0.009)	0.56	(0.10)	0.36	to 0.76
04/24/02	04/23/03	12.1	57.4	69.5	0.991	(0.004)	0.50	(0.11)	0.29	to 0.72
04/23/03	07/26/03	3.1	69.5	72.7	1.000	(0.000)	0.50	(0.11)	0.28	to 0.72
07/26/03	10/01/03	2.2	72.7	74.9	1.000	(0.000)	0.50	(0.11)	0.28	to 0.72
10/01/03	05/02/04	7.1	74.9	82	0.938	(0.008)	0.32	(0.06)	0.19	to 0.44
05/02/04	10/19/04	5.7	82	87.7	1.000	(0.000)	0.32	(0.06)	0.19	to 0.44
10/19/04	04/19/05	6.1	87.7	93.8	0.943	(0.010)	0.22	(0.04)	0.15	to 0.3
04/19/05	10/04/05	5.6	93.8	99.4	1.000	(0.000)	0.22	(0.04)	0.15	to 0.3
10/04/05	04/23/06	6.7	99.4	106.1	0.961	(0.008)	0.17	(0.03)	0.12	to 0.22
04/23/06	10/04/06	5.5	106.1	111.5	1.000	(0.000)	0.17	(0.03)	0.12	to 0.22
10/04/06	04/20/07	6.6	111.5	118.1	0.970	(0.009)	0.14	(0.02)	0.1	to 0.18
04/20/07	09/23/07	5.2	118.1	123.3	1.000	(0.000)	0.14	(0.02)	0.1	to 0.18
09/23/07	04/26/08	7.2	123.3	130.5	0.985	(0.006)	0.12	(0.02)	0.08	to 0.17
04/26/08	09/30/08	5.2	130.5	135.8	1.000	(0.000)	0.12	(0.02)	0.08	to 0.17
09/30/08	05/03/09	7.2	135.8	142.9	0.989	(0.005)	0.12	(0.02)	0.07	to 0.16
05/03/09	08/11/09	3.3	142.9	146.3	1.000	(0.000)	0.12	(0.02)	0.07	to 0.16
08/11/09	05/13/10	9.2	146.3	155.4	0.998	(0.002)	0.11	(0.02)	0.07	to 0.16
05/13/10	08/12/10	3	155.4	158.5	1.000	(0.000)	0.11	(0.02)	0.07	to 0.16
08/12/10	05/11/11	9.1	158.5	167.5	0.998	(0.001)	0.11	(0.02)	0.07	to 0.16
05/11/11	04/28/12	11.8	167.5	179.3	1.000	(0.000)	0.11	(0.02)	0.06	to 0.16
04/28/12	07/25/12	2.9	179.3	182.2	1.000	(0.000)	0.11	(0.02)	0.06	to 0.16
07/25/12	05/11/13	9.7	182.2	191.9	0.999	(0.001)	0.11	(0.02)	0.06	to 0.16
05/11/13	09/03/13	3.8	191.9	195.7	1.000	(0.000)	0.11	(0.02)	0.06	to 0.16

Survival rates for approximately 1-year intervals post-release. *Intervals were based on observed intervals above and chosen based on which were closest to 1-year intervals post-release. NOTE: The first interval here was 21.1 months and so much longer than a year. This was used as it was the first actual interval; an annual rate is reported in the footnotes of the table. Interval survival rates represent the probability of surviving from one point in time to the next. After last interval reported, estimated annual survival was ~1.0 based on model's predictions and so are not reported. NOTE: Standard errors reported in the table treat survival rates in table above as being independent and may be conservative.*

Years Since Release	Months Since Release	Interval Survival Rate	SE
1.76	21.1	0.56	0.10
3.03	36.4	0.89	0.32
3.81	45.7	0.64	0.45
5.26	63.1	0.69	0.38
5.82	69.8	0.77	0.33
6.82	81.8	0.82	0.28
8.29	99.5	0.86	0.26
9.93	119.1	0.92	0.27

*0.56 raised to 1/1.76 yields an estimated annual rate of 0.72 for the 1st interval.

Estimates of survival for the 1st release cohort of three-year olds (~36.3 months old at time of release) in RPMA 3 (cohort= 460 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
1	Three	07/29/00	04/24/02	36.3	57.4	0.56	0.1	259	164	to	353
1	Three	04/24/02	04/23/03	57.4	69.5	0.50	0.11	233	132	to	334
1	Three	04/23/03	07/26/03	69.5	72.7	0.50	0.11	233	132	to	334
1	Three	07/26/03	10/01/03	72.7	74.9	0.50	0.11	233	131	to	334
1	Three	10/01/03	05/02/04	74.9	82.0	0.32	0.06	147	90	to	205
1	Three	05/02/04	10/19/04	82.0	87.7	0.32	0.06	147	89	to	205
1	Three	10/19/04	04/19/05	87.7	93.8	0.22	0.04	103	69	to	137
1	Three	04/19/05	10/04/05	93.8	99.4	0.22	0.04	103	68	to	137
1	Three	10/04/05	04/23/06	99.4	106.1	0.17	0.03	79	55	to	102
1	Three	04/23/06	10/04/06	106.1	111.5	0.17	0.03	79	55	to	102
1	Three	10/04/06	04/20/07	111.5	118.1	0.14	0.02	64	45	to	84
1	Three	04/20/07	09/23/07	118.1	123.3	0.14	0.02	64	45	to	84
1	Three	09/23/07	04/26/08	123.3	130.5	0.12	0.02	58	38	to	77
1	Three	04/26/08	09/30/08	130.5	135.8	0.12	0.02	58	38	to	77
1	Three	09/30/08	05/03/09	135.8	142.9	0.12	0.02	53	33	to	74
1	Three	05/03/09	08/11/09	142.9	146.3	0.12	0.02	53	33	to	74
1	Three	08/11/09	05/13/10	146.3	155.4	0.11	0.02	52	31	to	73
1	Three	05/13/10	08/12/10	155.4	158.5	0.11	0.02	52	31	to	73
1	Three	08/12/10	05/11/11	158.5	167.5	0.11	0.02	52	30	to	73
1	Three	05/11/11	04/28/12	167.5	179.3	0.11	0.02	51	30	to	73
1	Three	04/28/12	07/25/12	179.3	182.2	0.11	0.02	51	30	to	73
1	Three	07/25/12	05/11/13	182.2	191.9	0.11	0.02	51	29	to	73
1	Three	05/11/13	09/03/13	191.9	195.7	0.11	0.02	51	29	to	73

Estimates of survival for the 2nd release cohort of three-year olds (~36.3 months old at time of release) in RPMA 3 (cohort= 190 fish).

Release	Type	Start Date	End Date	Age at int. start (mos.)	Age at int end (mos.)	Ppn. Still Alive	(SE)	N at Interval End	(95% CI for N at Inteval End)		
2	Three	04/24/02	04/23/03	36.3	48.4	0.83	0.06	157	133	to	181
2	Three	04/23/03	07/26/03	48.4	51.5	0.83	0.06	157	133	to	181
2	Three	07/26/03	10/01/03	51.5	53.8	0.82	0.07	157	132	to	181
2	Three	10/01/03	05/02/04	53.8	60.9	0.36	0.07	69	43	to	96
2	Three	05/02/04	10/19/04	60.9	66.6	0.36	0.07	69	43	to	95
2	Three	10/19/04	04/19/05	66.6	72.6	0.19	0.06	36	15	to	58
2	Three	04/19/05	10/04/05	72.6	78.2	0.19	0.06	36	15	to	58
2	Three	10/04/05	04/23/06	78.2	84.9	0.12	0.04	22	7	to	38
2	Three	04/23/06	10/04/06	84.9	90.4	0.12	0.04	22	7	to	38
2	Three	10/04/06	04/20/07	90.4	97.0	0.08	0.03	16	4	to	27
2	Three	04/20/07	09/23/07	97.0	102.2	0.08	0.03	16	4	to	27
2	Three	09/23/07	04/26/08	102.2	109.4	0.07	0.03	13	3	to	22
2	Three	04/26/08	09/30/08	109.4	114.6	0.07	0.03	13	3	to	22
2	Three	09/30/08	05/03/09	114.6	121.8	0.06	0.02	11	3	to	19
2	Three	05/03/09	08/11/09	121.8	125.1	0.06	0.02	11	3	to	19
2	Three	08/11/09	05/13/10	125.1	134.3	0.06	0.02	11	3	to	18
2	Three	05/13/10	08/12/10	134.3	137.3	0.06	0.02	11	3	to	18
2	Three	08/12/10	05/11/11	137.3	146.4	0.05	0.02	10	3	to	18
2	Three	05/11/11	04/28/12	146.4	158.2	0.05	0.02	10	3	to	17
2	Three	04/28/12	07/25/12	158.2	161.1	0.05	0.02	10	3	to	17
2	Three	07/25/12	05/11/13	161.1	170.8	0.05	0.02	10	3	to	17
2	Three	05/11/13	09/03/13	170.8	174.6	0.05	0.02	10	3	to	17

Summary information for fish released as Three-Year Olds in RPMA 3.

Based on the most recent estimates of the proportion surviving and the number surviving from the 2 release cohorts for this group, 61 fish were estimated to still be alive in RPMA 3 as of 09/03/2013. Of these, all were ~15-16 years old at that time.

Release	Type	Date	Age in months	Age in years	Ppn. Still Alive	(SE)	N Alive	(95% CI for N Alive)		
1: 462	Three	09/03/13	195.7	16.3	0.11	0.02	51	29	to	73
2: 190	Three	09/03/13	174.6	14.6	0.05	0.02	10	3	to	17

Summary of number alive as of 09/13/2013 across all releases of fish in RPMA 3.

Since the last report, the numbers are greater in total and in the oldest age class. Numbers in the youngest two age classes are lower than they were previously, and numbers in the 6-9 year old class are similar to those reported previously.

Release	Type	Date	Age in years	N Alive	(95% CI for N Alive)		
6: 599	SPR	09/03/13	2.8	88	56	to	119
5: 840	SPR	09/03/13	3.8	238	170	to	305
4: 636	SPR	09/03/13	4.9	204	143	to	266
3: 1,171	SPR	09/03/13	5.9	290	184	to	396
2: 601	SPR	09/03/13	6.9	145	92	to	199
4: 1,004	SUM	09/03/13	8.2	321	245	to	397
3: 865	SUM	09/03/13	9.2	238	182	to	293
2: 511	SUM	09/03/13	10.2	127	95	to	159
1: 606	SUM	09/03/13	11.4	169	113	to	224
1: 563	SPR	09/03/13	12.0	99	68	to	130
2: 190	Three	09/03/13	14.6	10	3	to	17
1: 103	Two	09/03/13	15.6	6	4	to	9
1: 462	Three	09/03/13	16.3	51	29	to	73

**The Release column represents (a) the release cohort for the specific type of release and (b) the number of individuals in that release cohort.*

When summarized by age class, the estimates indicate that ~1,986 of the fish that were released from hatcheries in recent years in RPMA 3 were still alive there in September of 2013. Of these fish, no fish were <2.8 years old (other than the cohort that was just released and which is not included here). In addition ~27% (or 530 fish) were ~3- to 5-years old, ~38% (or 756) were ~6- to 8-years old, and ~35% (or 462) were more than ≥ 9 -years old.

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N Alive)		
3	09/03/13	1 to 2	0	0.00	0	to	0
3	09/03/13	3 to 5	530	26.69	369	to	690
3	09/03/13	6 to 8	756	38.07	521	to	992
3	09/03/13	≥ 9	700	35.25	494	to	905

Summary of Estimated Numbers across all RPMAs

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N Alive)		
1	09/10/13	1 to 2	457	5.8	438	to	465
1	09/10/13	3 to 5	4,209	53.0	3,373	to	5,045
1	09/10/13	6 to 8	3,017	38.0	2,258	to	3,778
1	09/10/13	≥9	252	3.2	162	to	342

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N Alive)		
2	09/20/13	~1	631	1.47	600	to	662
2	09/20/13	3 to 5	24,945	58.00	16,092	to	33,801
2	09/20/13	6 to 8	15,455	35.93	9,318	to	21,592
2	09/20/13	≥9	1,981	4.61	1,204	to	2,761

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N Alive)		
3	09/03/13	1 to 2	0	0.00	0	to	0
3	09/03/13	3 to 5	530	26.69	369	to	690
3	09/03/13	6 to 8	756	38.07	521	to	992
3	09/03/13	≥9	700	35.25	494	to	905

Conclusion

Addition of data from recent trapping occasions and years has added data for each RPMA and all stocking categories. Improvements in estimates and especially in precision are in keeping with where data improvements were greatest (i.e., not all release types on all RPMA's had the same percentage improvement in recaptures, and those that had the greatest improvements experienced the most substantial changes in precision).

The results reported here provide updated estimates of actual proportions and total numbers projected to have been alive in September 2013 based on actual release cohorts. The estimates provide more specific estimates for fish released in RPMA 2 as they provide estimates broken down by river of release. Based on the estimates provided here, it appears that substantial numbers of fish were still alive in the RPMA's in later summer 2013. The precision of estimates is improving and can be expected to continue to improve with continued sampling.

Despite data improvements, it remains important to try to continue to (1) improve capture probabilities for more age classes of fish, and (2) consider other covariates that might help explain any sources of heterogeneity in survival and capture probabilities, and (3) to consider other approaches for assessing the results.

Other approaches might include strategic use of radio telemetry to evaluate whether rates estimated here are similar to those obtained from radio-marked fish in various age classes of key interest. Alternatively, one might consider other methods of estimating population size although doing so across such large river stretches will likely be challenging. In fact, recent attempts to estimate abundance on short stretches seem workable but scaling up over entire RPMA's will likely be extremely expensive and/or assumption laden. If so, then the work here might be the most reasonable way to assess numbers at large in the system.