Upper Basin Pallid Sturgeon Survival Estimation Project

2015 Update

Report Updated by Jay Rotella
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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

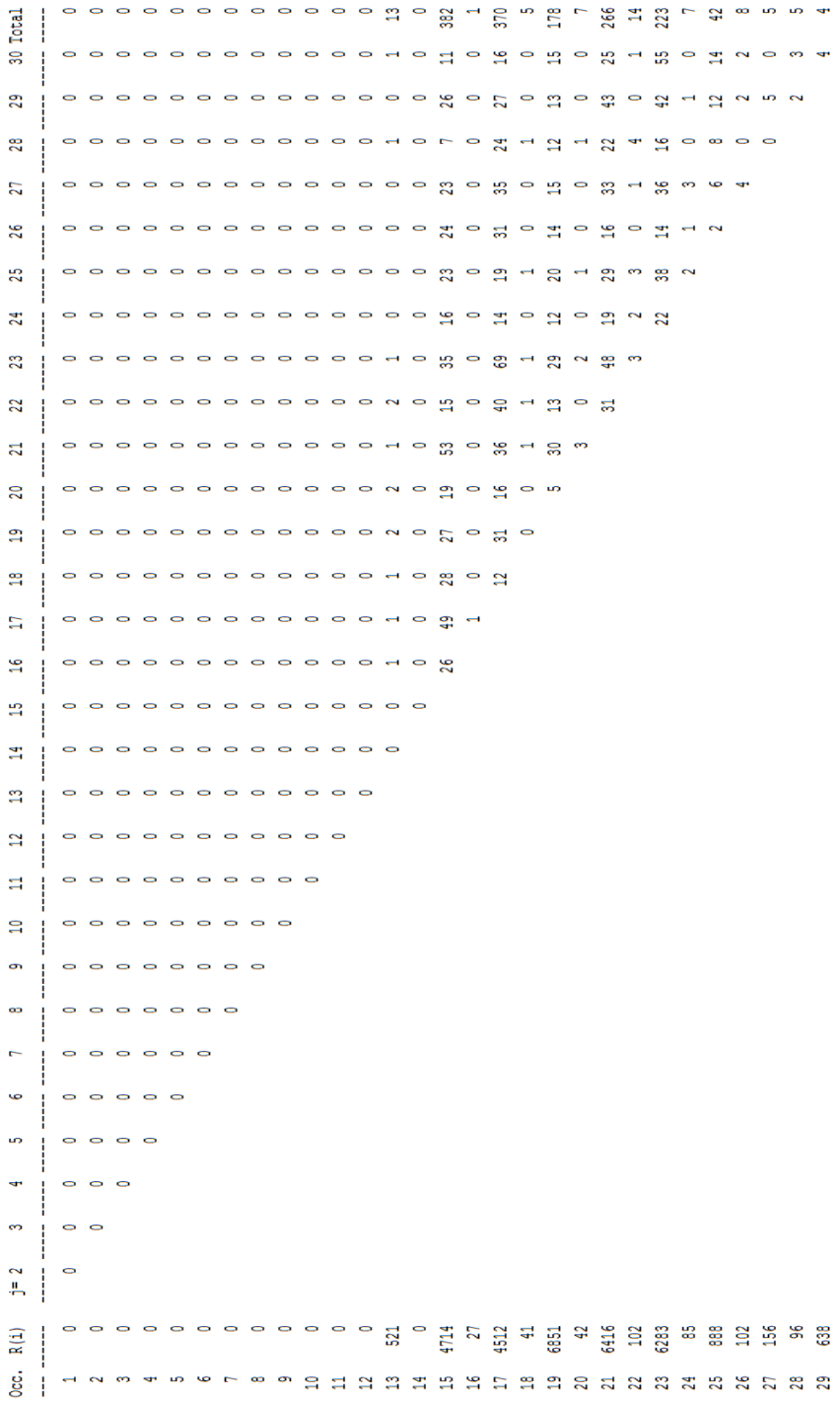
Dates and numbers for releases and recapture work on RPMA 1.

					Release Numbers for Each Fish Type				
Occ	Begin	End	Midpoint		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	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
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
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	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
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	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
11	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
13	521													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
15	4714															26	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	27																1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
17	4512																	12	31	16	36	40	69	14	19	31	35	24	27	16	370
18	41																		0	0	1	1	1	0	0	0	0	1	0	0	5
19	6851																			5	30	13	29	12	20	14	15	12	13	15	178
20	42																				3	0	2	0	1	0	0	1	0	0	7
21	6416																					31	48	19	29	16	33	22	43	25	266
22	102																						3	2	3	0	1	4	0	1	14
23	6283																							22	38	14	36	16	42	55	223
24	85																								2	1	3	0	1	0	7
25	888																									2	6	8	12	14	42
26	102																										4	0	2	2	8
27	156																											0	5	0	5
28	96																												2	3	5
29	638																													4	4

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)*

[1]The 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).

[2]The 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 x 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.

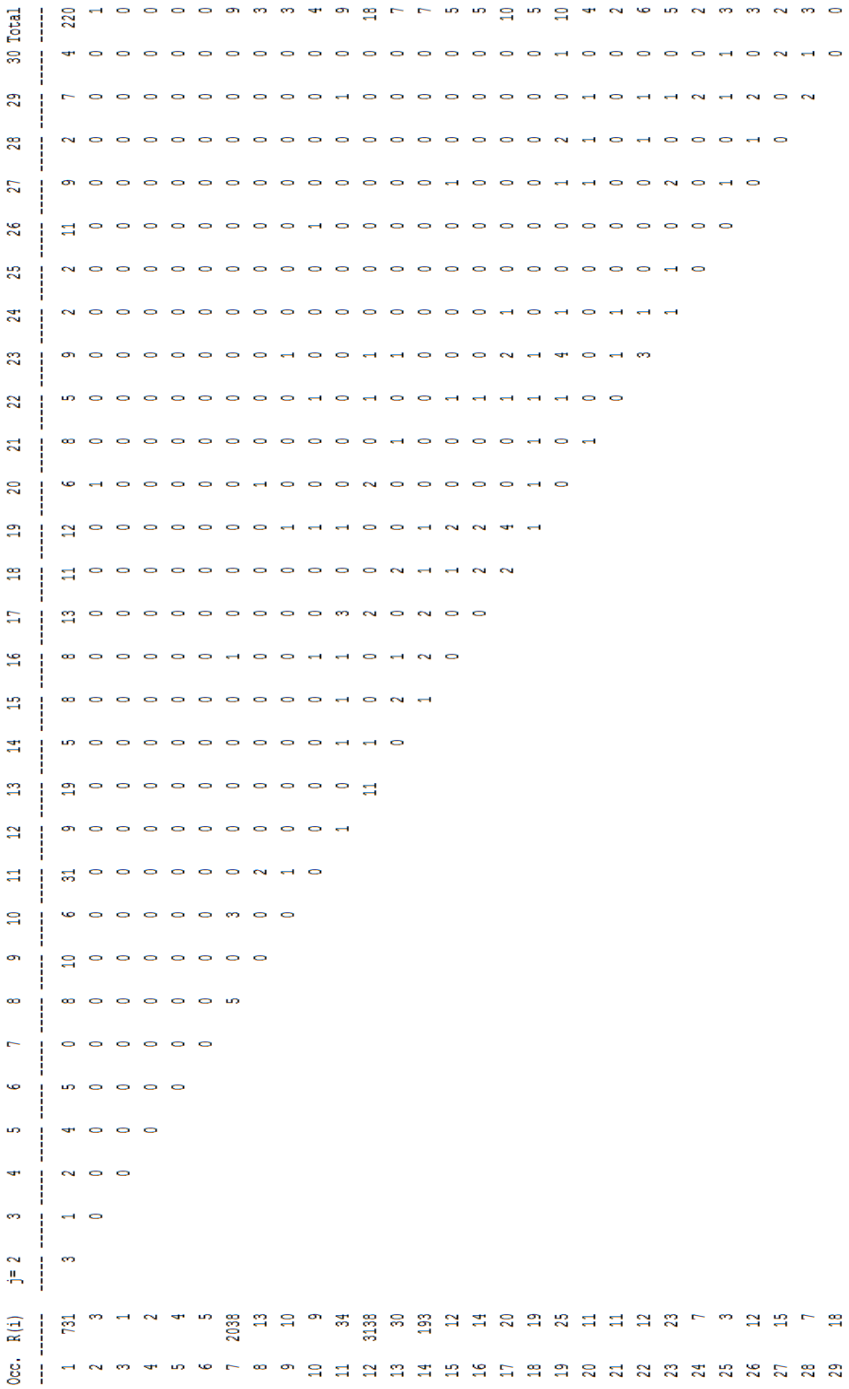
When the most recent estimates of the proportion surviving and the number surviving from each release cohort are assembled, one can review how many fish released as spring yearlings are estimated to still be alive. At the time of the last estimation date (09/10/2013), ~7,777 fish released as spring yearlings 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	3	1	2	4	5	0	8	10	6	31	9	19	5	8	8	13	11	12	6	8	5	9	2	2	11	9	2	7	4	220
2	3		0	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	0	0	1
3	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
4	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
5	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
6	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
7	2038							5	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
8	13								0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
9	10									0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
10	9										0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
11	34											1	0	1	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
12	3138												11	0	0	0	2	0	1	0	2	1	0	0	0	0	0	0	0	0	0
13	30													0	2	1	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0
14	193														1	2	2	1	2	0	0	1	0	0	0	0	0	0	0	0	0
15	12															0	0	1	2	0	0	0	1	0	0	0	0	0	0	0	0
16	14																0	2	2	0	0	1	0	0	0	0	0	0	0	0	0
17	20																	2	4	0	0	1	0	0	0	0	0	0	0	0	0
18	19																		1	1	1	1	0	0	0	0	0	0	0	0	0
19	25																			0	1	1	4	1	0	0	1	2	0	1	0
20	11																				1	0	0	1	0	0	1	1	1	0	0
21	11																					0	0	3	1	0	0	0	1	0	0
22	12																						0	1	1	0	0	0	1	0	0
23	7																							1	0	0	2	0	1	0	0
24	3																								0	0	0	0	2	0	0
25	12																									0	1	1	1	0	0
26	15																										0	0	2	0	0
27	7																											0	0	1	0
28	18																												2	1	0
29																															

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.

				Release Numbers for Each Fish Type							
Occ	Begin	End	Midpoint	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.*

		Release Numbers for Each Fish Type & River of Release								
		Fingerlings			Spring			Summer		
Occ	Midpoint		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	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
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	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						0	0	0	0	1	0	1	0	0	1	0	0	3	0	0	0	0	0	0	0	0	6
7	0							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	12519								1	0	10	3	25	6	0	27	8	0	29	7	52	4	20	16	6	4	218	
9	1									0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
10	0										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	7054											1	57	18	0	38	11	0	43	13	65	10	22	29	15	19	372	
12	4												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	41579													0	0	7	4	0	18	3	24	0	3	4	7	11	84	
14	24														0	1	0	0	0	0	1	0	0	0	0	0	2	
15	0															0	0	0	0	0	0	0	0	0	0	0	0	
16	59101																3	0	79	11	115	4	59	30	34	44	400	
17	26																	0	0	0	0	0	0	0	0	1	1	
18	0																		0	0	0	0	0	0	0	0	0	
19	41347																			3	167	5	62	82	35	45	403	
20	37																				1	0	0	0	0	0	1	
21	4480																					0	16	12	20	7	76	
22	23																						1	1	1	0	4	
23	183																							2	3	3	8	
24	176																								1	7	10	
25	138																									1	6	
26	102																										1	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*	*to*	*1,428*
7	FNG	05/09/11	09/12/11	10.8	15.0	0.49	0.07	990	*716*	*to*	*1,264*
7	FNG	09/12/11	05/08/12	15.0	22.9	0.39	0.07	790	*522*	*to*	*1,059*
7	FNG	05/08/12	09/06/12	22.9	27.0	0.37	0.07	742	*479*	*to*	*1,004*
7	FNG	09/06/12	05/05/13	27.0	35.0	0.33	0.06	675	*421*	*to*	*928*
7	FNG	05/05/13	09/20/13	35.0	39.6	0.32	0.06	655	*404*	*to*	*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 (09/208/2013). 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*	*to*	*3,216*
3: 4,733	FNG	09/20/13	87.7	7.3	0.31	0.06	1,456	*880*	*to*	*2,032*
4: 20,284	FNG	09/20/13	75.7	6.3	0.31	0.06	6,295	*3,824*	*to*	*8,766*
5: 27,427	FNG	09/20/13	63.7	5.3	0.27	0.06	7,387	*4,200*	*to*	*10,573*
6: 20,315	FNG	09/20/13	51.5	4.3	0.31	0.06	6,313	*3,839*	*to*	*8,788*
7: 2,022	FNG	09/20/13	39.6	3.3	0.32	0.06	655	*404*	*to*	*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*	*to*	*1,611*
2	FNG	04/29/06	07/13/06	9.9	12.4	0.24	0.04	962	*639*	*to*	*1,285*
2	FNG	07/13/06	09/27/06	12.4	15.0	0.19	0.03	780	*507*	*to*	*1,053*
2	FNG	09/27/06	05/02/07	15.0	22.2	0.12	0.02	473	*300*	*to*	*645*
2	FNG	05/02/07	09/22/07	22.2	27.0	0.10	0.02	388	*251*	*to*	*525*
2	FNG	09/22/07	04/30/08	27.0	34.4	0.08	0.01	313	*208*	*to*	*418*
2	FNG	04/30/08	07/22/08	34.4	37.1	0.07	0.01	298	*199*	*to*	*397*
2	FNG	07/22/08	09/16/08	37.1	39.0	0.07	0.01	291	*195*	*to*	*387*
2	FNG	09/16/08	05/08/09	39.0	46.8	0.07	0.01	264	*177*	*to*	*352*
2	FNG	05/08/09	07/22/09	46.8	49.3	0.06	0.01	260	*174*	*to*	*346*
2	FNG	07/22/09	09/15/09	49.3	51.1	0.06	0.01	257	*171*	*to*	*342*
2	FNG	09/15/09	05/04/10	51.1	58.8	0.06	0.01	247	*163*	*to*	*331*
2	FNG	05/04/10	09/08/10	58.8	63.0	0.06	0.01	244	*160*	*to*	*328*
2	FNG	09/08/10	05/09/11	63.0	71.1	0.06	0.01	240	*156*	*to*	*324*
2	FNG	05/09/11	09/12/11	71.2	75.4	0.06	0.01	239	*155*	*to*	*323*
2	FNG	09/12/11	05/08/12	75.4	83.3	0.06	0.01	237	*153*	*to*	*322*
2	FNG	05/08/12	09/06/12	83.3	87.4	0.06	0.01	237	*153*	*to*	*321*
2	FNG	09/06/12	05/05/13	87.4	95.4	0.06	0.01	236	*152*	*to*	*321*
2	FNG	05/05/13	09/20/13	95.4	100.0	0.06	0.01	236	*151*	*to*	*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)		
1	16,810	FNG	09/20/13	112.2	9.4				
2	12,519	FNG	09/20/13	100.0	8.3	2,471	1,405	*to*	3,537
3	7,042	FNG	09/20/13	87.7	7.3	1,652	1,014	*to*	2,290
4	41,496	FNG	09/20/13	75.7	6.3	8,127	5,082	*to*	11,173
5	59,027	FNG	09/20/13	63.7	5.3	9,039	5,260	*to*	12,817
6	41,175	FNG	09/20/13	51.5	4.3	8,124	5,093	*to*	11,156
7	4,055	FNG	09/20/13	39.6	3.3	848	536	*to*	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
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
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
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	822					0	0	0	0	0	1	0	1	0	0	3	0	0	0	0	0	0	1	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
7	874							0	0	0	1	0	0	0	0	0	0	0	3	0	4	0	0	1	2	0	12
8	0								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	6729									0	39	2	29	8	0	8	3	0	27	5	47	2	20	7	13	2	14	226
10	0										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	41											0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	3
12	4013												44	10	0	19	10	0	35	11	76	1	11	6	20	2	20	265
13	75													2	0	1	0	0	1	0	3	0	0	0	0	0	0	7
14	8065														0	40	15	0	41	5	58	2	10	5	6	4	13	199
15	0															0	0	0	0	0	0	0	0	0	0	0	0	0
16	71																0	0	4	0	0	0	0	0	0	0	0	4
17	4992																	0	81	5	60	7	27	9	20	10	9	228
18	0																		0	0	0	0	0	0	0	0	0	0
19	193																			0	11	0	5	0	1	0	0	17
20	10705																				227	12	90	41	57	24	29	480
21	487																					0	17	3	7	0	1	28
22	3348																						53	23	35	19	17	147
23	234																							2	1	1	3	7
24	97																								1	2	1	4
25	163																									1	11	12
26	832																										19	19

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*	*to*	*513*
1	SPR	09/23/05	04/29/06	14.4	21.7	0.72	0.04	407	*366*	*to*	*449*
1	SPR	04/29/06	07/13/06	21.7	24.2	0.68	0.04	384	*338*	*to*	*430*
1	SPR	07/13/06	09/27/06	24.2	26.7	0.64	0.04	362	*313*	*to*	*412*
1	SPR	09/27/06	05/02/07	26.7	34	0.55	0.05	309	*253*	*to*	*364*
1	SPR	05/02/07	09/22/07	34	38.7	0.50	0.05	280	*222*	*to*	*338*
1	SPR	09/22/07	04/30/08	38.7	46.1	0.43	0.05	243	*184*	*to*	*303*
1	SPR	04/30/08	07/22/08	46.1	48.9	0.41	0.05	232	*172*	*to*	*291*
1	SPR	07/22/08	09/16/08	48.9	50.7	0.40	0.05	225	*165*	*to*	*284*
1	SPR	09/16/08	05/08/09	50.7	58.5	0.35	0.05	197	*138*	*to*	*257*
1	SPR	05/08/09	07/22/09	58.5	61	0.34	0.05	190	*131*	*to*	*250*
1	SPR	07/22/09	09/15/09	61	62.9	0.33	0.05	185	*126*	*to*	*245*
1	SPR	09/15/09	05/04/10	62.9	70.6	0.30	0.05	166	*107*	*to*	*225*
1	SPR	05/04/10	09/08/10	70.6	74.8	0.28	0.05	157	*98*	*to*	*216*
1	SPR	09/08/10	05/09/11	74.8	82.9	0.25	0.05	142	*84*	*to*	*201*
1	SPR	05/09/11	09/12/11	82.9	87.1	0.24	0.05	136	*77*	*to*	*195*
1	SPR	09/12/11	05/08/12	87.1	95.1	0.22	0.05	125	*66*	*to*	*184*
1	SPR	05/08/12	09/06/12	95.1	99.1	0.21	0.05	120	*62*	*to*	*179*
1	SPR	09/06/12	05/05/13	99.1	107.1	0.20	0.05	112	*53*	*to*	*171*
1	SPR	05/05/13	09/20/13	107.1	111.7	0.19	0.05	108	*49*	*to*	*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)	*(0.68*	*to*	*0.78)*
09/21/04	04/30/05	7.4	14.9	22.3	0.946	(0.005)	0.48	(0.04)	*(0.41*	*to*	*0.55)*
04/30/05	09/23/05	4.9	22.3	27.2	0.950	(0.003)	0.38	(0.03)	*(0.31*	*to*	*0.44)*
09/23/05	04/29/06	7.3	27.2	34.4	0.953	(0.003)	0.27	(0.03)	*(0.21*	*to*	*0.32)*
04/29/06	07/13/06	2.5	34.4	36.9	0.957	(0.002)	0.24	(0.03)	*(0.19*	*to*	*0.29)*
07/13/06	09/27/06	2.5	36.9	39.5	0.958	(0.002)	0.21	(0.02)	*(0.17*	*to*	*0.26)*
09/27/06	05/02/07	7.2	39.5	46.7	0.959	(0.003)	0.16	(0.02)	*(0.12*	*to*	*0.20)*
05/02/07	09/22/07	4.8	46.7	51.5	0.963	(0.003)	0.13	(0.02)	*(0.10*	*to*	*0.16)*
09/22/07	04/30/08	7.4	51.5	58.8	0.965	(0.003)	0.10	(0.01)	*(0.08*	*to*	*0.13)*
04/30/08	07/22/08	2.8	58.8	61.6	0.968	(0.004)	0.09	(0.01)	*(0.07*	*to*	*0.12)*
07/22/08	09/16/08	1.9	61.6	63.5	0.969	(0.004)	0.09	(0.01)	*(0.06*	*to*	*0.11)*
09/16/08	05/08/09	7.8	63.5	71.3	0.970	(0.004)	0.07	(0.01)	*(0.05*	*to*	*0.09)*
05/08/09	07/22/09	2.5	71.3	73.8	0.972	(0.005)	0.06	(0.01)	*(0.04*	*to*	*0.08)*
07/22/09	09/15/09	1.8	73.8	75.6	0.973	(0.005)	0.06	(0.01)	*(0.04*	*to*	*0.08)*
09/15/09	05/04/10	7.7	75.6	83.3	0.974	(0.005)	0.05	(0.01)	*(0.03*	*to*	*0.07)*
05/04/10	09/08/10	4.2	83.3	87.5	0.976	(0.006)	0.04	(0.01)	*(0.03*	*to*	*0.06)*
09/08/10	05/09/11	8.1	87.5	95.6	0.977	(0.006)	0.04	(0.01)	*(0.02*	*to*	*0.05)*
05/09/11	09/12/11	4.2	95.6	99.8	0.979	(0.006)	0.03	(0.01)	*(0.02*	*to*	*0.05)*
09/12/11	05/08/12	8.0	99.8	107.8	0.980	(0.006)	0.03	(0.01)	*(0.01*	*to*	*0.05)*
05/08/12	09/06/12	4.0	107.8	111.8	0.982	(0.006)	0.03	(0.01)	*(0.01*	*to*	*0.04)*
09/06/12	05/05/13	8.0	111.8	119.9	0.983	(0.006)	0.02	(0.01)	*(0.01*	*to*	*0.04)*
05/05/13	09/20/13	4.6	119.9	124.5	0.985	(0.006)	0.02	(0.01)	*(0.01*	*to*	*0.04)*

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*	*to*	*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*	*to*	*35*
2: 309	SPR	09/20/13	111.7	9.3	0.03	0.01	9	*4*	*to*	*15*
3: 2,288	SPR	09/20/13	99.6	8.3	0.01	0	34	*12*	*to*	*56*
4: 1,995	SPR	09/20/13	87.3	7.3	0.05	0.01	98	*60*	*to*	*135*
5: 3,059	SPR	09/20/13	75.2	6.3	0.02	0	63	*35*	*to*	*91*
6: 3,141	SPR	09/20/13	62.7	5.2	0.03	0.01	99	*62*	*to*	*137*
7: 5,272	SPR	09/20/13	50.7	4.2	0.14	0.02	750	*570*	*to*	*931*
8: 1,663	SPR	09/20/13	38.4	3.2	0.23	0.03	385	*301*	*to*	*469*
9: 389	SPR	09/20/13	14.2	1.2	0.77	0.02	298	*281*	*to*	*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	3	0	3	1	0	2	0	1	2	0	3	0	0	4	12	8	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	1	1	0	1	18
3	3138			0	0	13	7	9	1	0	4	3	13	5	0	14	0	0	15	6	24	0	10	3	17	4	15	163
4	4058				0	20	0	18	2	0	6	0	10	0	0	8	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
6	1638						4	10	0	0	8	0	7	1	0	3	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	1	0	0	0	0	1
8	216								1	0	0	1	1	0	0	0	0	0	0	0	1	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
10	1369										32	0	9	3	0	5	2	0	4	1	9	0	0	2	2	1	1	71
11	52											0	2	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
13	44													1	0	4	0	0	2	0	2	0	0	0	0	0	0	9
14	12														0	0	0	0	1	0	0	0	0	0	0	0	0	1
15	3279															25	3	0	19	3	28	0	3	0	6	0	10	97
16	63																1	0	2	1	6	0	1	1	1	0	1	14
17	6																	0	0	0	0	0	0	0	0	0	0	0
18	3810																		0	6	38	1	12	12	0	2	3	74
19	64																			1	6	0	1	1	0	0	0	9
20	42																				4	0	0	1	0	0	0	5
21	2096																					0	19	6	7	3	11	46
22	3																						1	0	0	0	0	1
23	1042																							2	11	2	7	22
24	36																								0	0	1	1
25	66																									1	3	4
26	16																										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 ≥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	0.01	*600*	*to*	*662*
2	09/20/13	3 to 5	24,945	0.58	*16,092*	*to*	*33,801*
2	09/20/13	6 to 8	15,455	0.36	*9,318*	*to*	*21,592*
2	09/20/13	≥9	1,981	0.05	*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.

				Release Numbers for Each Fish Type									
Occ	Begin	End	Midpoint	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	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
4	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
6	1						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
8	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
10	2										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
12	603												8	1	0	2	3	6	2	4	5	3	3	41	41
13	10													0	1	1	0	0	0	0	0	0	0	2	2
14	1176														4	4	3	8	0	8	2	5	4	38	38
15	7															0	0	0	0	1	0	0	0	1	1
16	650																3	5	0	3	1	0	1	14	14
17	9																	0	0	0	0	0	1	1	1
18	870																		0	4	1	6	3	2	16
19	2																			0	0	0	0	0	0
20	621																				0	3	2	0	5
21	16																					0	1	0	1
22	17																						0	0	0
23	17																							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 ≤~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	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
4	606				1	1	3	1	4	3	3	7	3	4	11	9	0	8	0	9	4	1	13	2	87
5	1					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
7	514							0	5	0	1	8	3	7	5	9	0	6	0	5	0	0	3	1	53
8	1								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
10	6										0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
11	1009											0	5	6	5	9	3	18	5	9	6	2	11	4	83
12	16												0	0	0	1	0	2	0	0	0	0	0	0	3
13	19													1	2	0	0	2	0	0	1	0	1	0	6
14	22														1	2	0	1	0	1	0	1	1	0	6
15	28															1	1	4	0	2	1	1	1	0	8
16	50																1	7	0	2	1	1	1	0	13
17	6																	0	0	0	0	0	0	0	0
18	63																		0	2	0	0	2	2	6
19	6																			1	0	0	0	0	1
20	34																				1	0	0	1	2
21	18																					0	0	0	0
22	6																						1	0	1
23	43																							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	1	0	1	0	0	1	0	0	1	1	0	1	0	1	3	0	3	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	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
5	1					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
6	1						0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
7	1							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
9	1									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
11	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
13	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
15	1															0	1	0	1	0	1	1	0	0	0
16	1																0	0	0	0	0	0	0	0	0
17	0																	0	0	0	0	0	0	0	0
18	1																		0	0	0	0	0	0	0
19	0																			0	0	0	0	0	0
20	1																				0	0	0	0	0
21	2																					0	0	0	0
22	0																						0	0	0
23	0																							0	0
24	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	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	1	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	1	0	1	0	0
5	13					0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
6	7						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
8	3								0	0	1	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	1	0	0	0	1
10	0										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	4											0	0	0	0	1	0	0	0	0	0	0	0	0	1
12	2												0	0	0	0	0	0	0	0	0	0	0	0	0
13	4													0	1	0	0	0	0	0	0	0	0	0	1
14	2														0	0	0	1	0	0	0	0	0	0	1
15	7															3	0	1	0	0	0	0	1	1	6
16	13																1	0	1	0	0	0	2	0	4
17	3																	2	0	0	0	0	0	0	2
18	7																		0	3	0	0	0	0	3
19	1																			0	1	0	0	0	1
20	4																				0	0	0	0	0
21	4																					0	0	0	0
22	0																						0	0	0
23	7																							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		
3	09/03/13	1 to 2	0	0.00	0	*to*	0
3	09/03/13	3 to 5	530	0.27	369	*to*	690
3	09/03/13	6 to 8	756	0.38	521	*to*	992
3	09/03/13	≥9	700	0.35	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	0.01	*600*	*to*	*662*
2	09/20/13	3 to 5	24,945	0.58	*16,092*	*to*	*33,801*
2	09/20/13	6 to 8	15,455	0.36	*9,318*	*to*	*21,592*
2	09/20/13	≥9	1,981	0.05	*1,204*	*to*	*2,761*

RPMA	Date	Age in years	N Alive	% of total	(Sum of 95% CI elements for N		
3	09/03/13	1 to 2	0	0.00	*0*	*to*	*0*
3	09/03/13	3 to 5	530	0.27	*369*	*to*	*690*
3	09/03/13	6 to 8	756	0.38	*521*	*to*	*992*
3	09/03/13	≥9	700	0.35	*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 RPMAs 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 RPMAs 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.