

PALLID STURGEON PROPAGATION -2002

Garrison Dam NFH

Rob Holm

*US Fish and Wildlife Service
Garrison Dam NFH, Riverdale ND*

Background/Introduction

The Pallid Sturgeon Recovery Plan (1993) established guidance for collection of wild brood fish, propagation, research needs, and reintroduction of progeny to accomplish recovery goals. This hatchery's role in the recovery effort centers around the spawning and rearing of larval pallids. Pallid Sturgeon propagation at Garrison Dam NFH began in 1997. Successful spawning has occurred annually since 1998. April 2002 marked the first stocking of yearling pallids from this facility. Past successful propagation of pallids have been cut short of stocking due to viral concerns and all progeny in past years were destroyed. Findings of iridovirus positive pallid sturgeon at Miles City SFH have led to the acceptance of stocking fish exposed to the virus.

Objectives

Objectives for this year will be twofold; one will be renewed emphasis on augmentation in RPA's 2, 3 and 4, the second will focus on identifying the source of the Shovelnose Sturgeon Iridovirus (SSIV) in RPA #1.

All four hatcheries used in past pallid propagation will be utilized in 2002. We will attempt to collect three females and nine males for spawning at Garrison Dam NFH. In addition to spawning and rearing of the nine 2002 'confluence' family lots, the hatchery will have a compliment of eggs from the Upper Missouri River spawning and will be holding 2001 'Upper Missouri River progeny' for stocking RPA #2 later this summer if given clearance from Montana's Fish Health Committee. Pairing for family lots will be based on results from the Genetics Lab at UC Davis. We plan on producing (3) 1X3 matings using the twelve broodfish. If eggs are abundant we may make 1X4 crosses to ensure survival of at least three family lots per female. We will also do trials on number of eggs fertilized/cryopreserved straw of milt. If enough pallid eggs exist we will be using them. Milt cryopreserved from 2000, male A65 will be used. The same male is available on station to cryopreserved additional straws for future use.

Miles City SFH will be supplied with four adults, three males and a single female. In addition to spawning in June they will be culturing four family lots from 2001 to a tagable size prior to stocking in RPA #2 later in the summer. Eggs from the Miles City spawning will be held at both the Miles City hatchery and Gavins Point NFH.

Bozeman FTC will also be culturing 2001 progeny further for stocking RPA #1. Plans are to spawn riverside again on the CM Russel Refuge. Eggs from this spawning event will be held at

both the Bozeman hatchery and Garrison Dam NFH.

Work will continue on PCR confirmation tests and on locating SSIV positive adult sturgeon in the upper Missouri River above Fort Peck Reservoir. Research into the advancement of a PCR diagnostic test was to be accomplished at the University of California, Davis campus under the direction of Dr. Ron Hedrick. Additional samples of the 2001 year class fish that had been suspect for the virus were sent this Spring for use in the development and testing process.

Spring Stockings 2002

April 1 pit tagging began in the South 20 foot tank. A total of 1741 fish were tagged in two days (5.7 fish/minute with three crews). On April third the fish were loaded on Gavins Point's distribution truck and transported for stocking three locations on the Missouri River Nebraska/South Dakota boarder (St. Helena, Vermillion, Bellevue). The following week on April 9th fish from the North 20 foot tank (a mixture of the four confluence family lots plus culls too small to pit tag) were hauled to Blind Pony SFH in Missouri along with the remaining fish for stocking lower RPA #4 at Booneville, MO. Hauling temperature was 43°F and tagging temperature was 38°F. Tagging for the RPA #4 fish finished up on the 10th. It took two long days of pit tagging with three crews to tag 5,116 fish. On the 11th the fish were loaded on two trucks to make the trip south. Gavins Point truck hauled 221 pounds (3,564 fish) in four 200 gallon tanks and the Garrison truck hauled 108 pounds (1,552 fish) in a 175 gallon tank. The Gavins Point truck fish were offloaded onto a truck from Neosho NFH (3 compartment 250 gallon each) to complete their trip to Bellevue, Nebraska and Booneville, Mo. The fish stocked near Vermillion, SD completed the trip in 11 hours. They were hauled at 40°F. Oxygen was used - no Fresh-Flo's. Oxygen levels were difficult to control - Oxygen saturation was over 200%. The final Spring stocking went out on April 21st. RPA #3 received 70 fish each from 8 family lots (missing CIF X E09). A total of 560 fish were stocked along with 525 future brooders that were off loaded at Gavins Point NFH - representing all 9 family lots produced in 2001. The remaining 2001 fish at Garrison Dam NFH consisted of 345 each of the Upper Missouri River fish scheduled for stocking RPA #2. See Appendix 3. 2001 Pallid Stockings from Garrison Dam NFH

Spring Capture 2002

Methods and Results

Confluence Spawning

Through the efforts of the Montana Parks and Wildlife and US Fish and Wildlife personnel pallids were captured near the confluence for Spring spawning. Twenty-five fish were captured with all but five being recaptures. Three females and nine males were held at Garrison Dam NFH for spawning efforts. A single female and three males were transported to the Miles City SFH. The first week of collections folks from the USGS office in Columbia, Missouri were on

hand to collect blood samples and do scoping/ultrasound of all the captured sturgeon. The second week sexing was based on catheterization, history, and guesswork See Table 1.
Broodstock Data

Chronology of capture:

April 22 - Three boats fishing from 10:00 am through 7:00 pm. Nine fish collected, one gravid female and eight males. The fish (1F497F1801) was determined to be a female using ultrasound and confirmed with a sample of eggs taken by catheter. This fish had been collected in April 1995 and was determined to be gravid at that time. This fish along with three other males (1F482F3F2B, 7F7F065834, 115556461A) were transported to Miles City SFH. Five other males were collected, three sported transmitters (1F4A27214F, 1F4A111C6A, 7F7D3C5708). Two were recaptures (7F7D434B54, 1F4B225A1A). The 'male', A1A had previously been at the hatchery (2000) and collected in four of the past five years - a 'snaky' older looking fish. In 2000 it was injected but produced nothing, likely no longer capable of reproducing.

April 23 - Three boats fishing from 9:00 to 5:00. Six fish collected, one immature female, five males. There were three fish with transmitters, a male, tag #1F4A111C6A, had been collected the previous day, a second male #1F477B3A65 had expelled the transmitter, the third was tag # 1F4849755B. The male that expelled the transmitter had been at the hatchery and spawned on two other occasions in 1999 and 2000. Since no progeny had been stocked yet, it was taken to the hatchery. Third time is a charm. Two other males taken to the hatchery were #115544332A and one double tagged # 1F4A3E1445 / 1F4A2F3A2E. 'Male' # 32A was taken to Miles City last year and catheterized. No eggs were recovered and it was presumed to be an immature female. Ultrasound indicated it is a male. Both fish were recaptures. The fourth fish taken to the hatchery was misdiagnosed using ultrasound as a male. At the hatchery it was determined to be a female, # 115553544A, spawned at Garrison Dam NFH in 1999. Apparently the fish has immature eggs. It's weight is 10 pounds less that when captured 3 years earlier. No tears were noted in the Mullerian ducts from the catheterization in 1999. In defense of the ultrasound team, females with fully developed eggs were identified 100% and although the endoscope was unable to view through the thick wall of the Mullerian duct, it was able to confirm that there were no lasting holes in the duct due to previous catheterization procedures.

April 24 - Two fish collected, one a 'new' 37 pound female, # 4310187B69, the second a 53 pound male, #1F4772396F. The male had been collected in 1994, 1997, and 1999. In 1997 it was spawned at Garrison Dam NFH. No progeny have been released from this fish. Both fish were taken to Garrison Dam NFH for spawning.

April 25 - One 'new' 40 pound female pallid captured, tag # 115716093A. This fish had a rubber gasket from irrigation pipe stretched around it's head. The gasket had caused an ulcer and a indented ring around it's head and was a little on the lean side. The gasket was cut loose and the fish taken to the hatchery. Also collected was a mature female sturgeon of about 15 pounds. The fish was a suspect hybrid and was also taken to the hatchery (This fish grouped genetically with shovelnose sturgeon).

April 26 - One large male, a new fish, # 116167123A, was collected. The sturgeon had a rather large fish in it's gut that was confirmed with ultrasound. This fish was taken to the hatchery.

April 29 - Two fish were collected, one male, one female. The male # 7F7D434B54 was a recapture, the female # 116224546A, a 'new' fish. Both were taken to the hatchery.

April 30 - Three fish collected, two transmitted males (2202236E31, 115525534A) and a female # 1F5420727B. The female had been catheterized and biopsied in the Fall of 1997. No record of egg stage at that time-apparently an immature female but no confirmation. The Mullerian duct was also scoped- again, no tears were seen. Apparently the catheterization done in 1997 had completely healed. On May 1 the female was catheterized - mature eggs with a considerable amount of fat were removed.

May 1 - Two male recaptures were collected, one tag # 220F107A6F , the other double tagged #1F53312736 / 1F52167900. Both were taken to the hatchery. End of collections.

Seven of fifteen transmitted fish were collected, all males. A single transmitted female was located, #1F47715752, on several occasions. In spite of a considerable amount of effort, the fish was able to elude the trammel nets. It makes you wonder as to the effectiveness of the nets.

Also interesting to note: 5 of 25 fish collected were new fish, two females, three males.

June 3 - Eggs were taken from the three female candidates by catheter - Polarity index values indicated all three were ready with values ranging from 0.07 to 0.06. The catheter was also used to confirm the sex of male 1F53312736. Testes recovered from the fish had sperm cells that were activated by water.

June 4 - Female 115553544A, the fish spawned in 1999 was catheterized to confirm egg stage. As suspected this fish had immature white eggs. Interestingly, the fish also contained shriveled black eggs from an aborted 2001 spawning attempt. This fish apparently has a two year spawning cycle.

Table 1. Broodstock Data

PALLID STURGEON BROODSTOCK DATA 2002							
Tag Number	Site	Date	Sex	lbs.	Milt	Other Info	Capture Site
1F497F1801	MC	4/22/02	F			no surviving progeny	confluence
1F482F3F2B	MC	4/22/02	M			no milt produced	confluence
7F7F065834	MC	4/22/02	M		Y		confluence
115556461A	MC	4/22/02	M		Y	new fish	confluence
1F4A27214F	RELES	4/22/02	M			Transmitted - Butch, 2001	confluence
1F4A111C6A	RELES	4/22/02	M			Transmitted - Ben, 2001	confluence
7F7D3C5708	RELES	4/22/02	M			Transmitted - Bob, 2001	confluence
7F7D434B54	RELES	4/22/02	M			Recapture	confluence
1F4B225A1A	RELES	4/22/02	M			Recapture	confluence
115544332A	GAD	4/23/02	M	55	Y	deformed dorsal - died	confluence
1F4A3E1445	GAD	4/23/02	M	34	Y	1F4A2F3A2E, two tags	confluence
1F477B3A65	GAD	4/23/02	M	28	Y	Trans. lost- Aaron, 2000	confluence
115553544A	GAD	4/23/02	F	41		immature eggs - catheter	confluence
1F4849755B	RELES	4/23/02	M			Transmitted - Art, 2000	confluence
1F4772396F	GAD	4/24/02	M	53	Y	spawned in 1997 - died	confluence
4310187B69	GAD	4/24/02	F	37		new fish - died post spawn	confluence
115716093A	GAD	4/25/02	F	40		new fish, gasket around head	confluence
116167123A	GAD	4/26/02	M	50	Y	new fish	confluence
7F7D434B54	GAD	4/29/02	M	30	Y	fins torn in net	confluence
116224546A	GAD	4/29/02	F	60		new fish - 6/3 catheter eggs	confluence
1F5420727B	GAD	4/30/02	F	68		5/1 catheter eggs - died	confluence
2202236E31	RELES	4/30/02	M			Transmitted - Arnie, 2000	confluence
115525534A	RELES	4/30/02	M			Transmitted - Alex, 2000	confluence
1F53312736	GAD	5/01/02	M		N	1F52167900, catheter testes	confluence
220F107A6F	GAD	5/01/02	M	~50	Y		confluence
411D0E2C5F	CMR	6/04/02	M			Recapture - milt refrigerated	Upper Mo. R
7F7D461025	CMR	6/11/02	M	30	Y		Upper Mo. R.

PALLID STURGEON BROODSTOCK DATA 2002							
Tag Number	Site	Date	Sex	lbs.	Milt	Other Info	Capture Site
132319571A	CMR	6/11/02	F	48		died - poor survival of prog.	Upper Mo. R.

Upper Missouri River Spawning

Water flows into Fort Peck were considerably higher this year than the past few with flows peaking at about 18,000 CFS on the 14th of June. Water turbidity was extremely high and water temperatures were lower than in the past. The Montana crews were out the first week of June netting for adult brood fish. On June 4th the first fish, a male #411D0E2C5F, was captured. River flows had increased to 10,000 CFS at this time. This fish was a recapture from last year. Milt was collected and stored refrigerated until spawning. Adult shovelnose were also collected and held in a net cage for spawning and iridovirus sampling. June 11th a pair of pallids were collected, one male #7F7D461025, and one female #132319571A. Garrison Dam NFH personnel were notified and plans were made to travel to the site. Warm Springs FTC personnel were also along to provide spawning assistance and for cryopreservation.

Before departure the following morning, attempts were made to collect milt from the sturgeon held at the hatchery. Males collected in the Upper Missouri River were producing milt at this time and we wanted to determine if fish held at the hatchery under similar temperatures would produce milt without injections. After an unsuccessful attempt to retrieve milt we departed for Montana. We arrived at the camp at 6:00 pm after a 8 hour trip. The female was catheterized and ~75 eggs were recovered for the progesterone assay and polarity index. The polarity index looked favorable with a range of 0.07-0.09. At 8:00 pm we injected four pair of shovelnose sturgeon using LH-RH. The males were given full dosages, the females one tenth of the total. The following morning the female shovelnose were given the resolving dose at 9:00 am. The rest of the day was spent netting for pallids (10:30 am to 4:00 pm), two boats - no captures. At 9:00 pm the pair of pallids were injected, the male with LH-RH (full dose) and the female with Ovaprim at the 1/10th rate. Water temperature in the tank was 65°F.

June 14th we began spawning shovelnose at 7:45am with ovulation occurring in one of the four fish. At 8:00 the female pallid was given the resolving dose of Ovaprim. 180 mls of milt was taken from the male pallid, the milt looked coagulated. Both pallids are fairly lethargic. Water temperature is 62°F. After collecting the milt, the water pump was started and water temperature in the tank dropped to 58°F. At 10:15 am the second female shovelnose ovulated. Eggs were recovered from both ovulated fish but in small quantities (~250 to 1000 eggs). At noon another small collection from the two shovelnose. At 2:15 one of the two unovulated females was dead. The fish was cut open and ovaries removed and placed in extender (HBSS) progesterone solution to evaluate the possibility of the eggs ovulating in solution - no luck. The eggs were also preserved and bisected to determine the presence/absence of the nucleus (Both ovulated and unovulated eggs underwent nuclear breakdown). Water temperature in the tank is at 64° F and the pump was shut off after running two hours. At 3:15 milt was again aspirated from the pallid. This take looks much better and is confirmed under scope. Bill and Jaci cryopreserved 100 - 0.5 ml straws for the repository. Bill noted that the milt was acidic, something he had not seen previously. At 4:00 pm a small amount of eggs are palpated from the shovelnose. The abdomen is very flaccid and a catheter is inserted - eggs are flowing. The fish is pithed and an incision is made to recover eggs. The female had completely ovulated. The second female is pithed and cut. She too was fully ovulated but by palpation we were able to collect only a small

amount of eggs. This fish had many overripe eggs also free in the body cavity. The final shovelnose female is still unovulated. At 4:30pm, 7:30pm, midnight, 5:30am, 8:15am, 10:00am, 12:00 noon the female pallid is checked - no eggs. The fish should have ovulated around 8:00 am - a catheter was used to remove a sample of eggs at noon and milt was added. If the eggs recovered by catheter were ovulated, we should see cleavages in the eggs by 4:00 pm. At 2:00 pm still no eggs - the catheter tube was inserted and a few eggs expelled. At 4:00 we observed cleavage in a few of the eggs sampled earlier. We decided to remove the fish and recover eggs using the catheter. When the female was located (extremely silty water) in the tank she was dead - two hours after the last check. She was cut open to reveal the condition of the ovaries. The few eggs free in the body cavity were fertilized with milt from the two pallids. The ovaries were cut out, placed in a pan and milt was applied directly to the ovaries while 'combing' loose eggs from the mass. The eggs were incubated until 6:30, bagged and shipped to Bozeman. A small sample of the two crosses were bagged as a 'backup' and transported to Garrison Dam NFH. The male was released, the female wrapped and frozen at the Garrison hatchery. At the hatchery the eggs were incubated - survival was very low but we did have ~100 fry hatch on June 18th. By the 24th, the number of prolarvae alive was down to 30. No data was taken on total eggs collected. There was no survival on the pallid eggs incubated at the Bozeman Fish Technology Center and on the 18th the eggs were bagged and frozen.

Confluence Spawning at Garrison Dam NFH

June 17th catheter checks on the three females indicated that the polarity index of female 546A was acceptable for injection (the index was 0.1) and we had confirmation from the previous weeks progesterone assay that the fish was ready. The fish was injected the evening of the 17th and the resolving dose given the following morning. Ovaprim was used at the standard 0.5mg/kg rate. The fish was checked that evening at 11:30 (24 hours after initial injection) and again the following morning at 6:00. Periodic checks were made during the day. At 4:45 we catheterized the fish to check on the progression of ovulation. Eggs readily filled the catheter tube. Ovulation had apparently occurred but we were unable to express eggs by palpation. We collected eggs about hourly until midnight trying first to express them using palpation but then reverting to catheterization when palpation failed. We apparently timed the catheterization correctly, the first collection by catheter at 5:15 resulted in 93% fertilization - the best I've seen. We ended up collecting 1887 mls of eggs that evening and making 4 family lots. See Table 3. Spawning Results. In addition to the regular production lots, Bill Wayman of the Warm Springs Fish Technology Center used cryopreserved milt to fertilize two additional batches of eggs - one from cryopreserved milt from 2000 pit tag # 3A65 using (4) 0.5 ml straws, and the second from a 5 ml straw frozen last year with AKOS extender - pit tag # 1F4A27214F. Preliminary fertilization rates indicated 50.2% fertilization with the large 5 ml straw and only 6.2% with the smaller straws. See Table 2. Cryopreservation Data

Table 2. Cryopreservation Data

Cryopreservation Data (egg size 33.67/ml)								
Male tag #	Year	brood location	Straw size	% fert	mls of eggs	# of eggs used	fertile eggs	fry at 1 month
1F477B3A65	fresh	GAD	n/a	76.8	36	1212	931	N/A
1F477B3A65	2000	GAD	0.5 ml (4)	6.2	37	1246	77	14
1F4A27214F	2001	Miles City	5 ml (1)	50.2	147	4950	2485	953*

* 953 fish shipped to Gavins Point NFH 7/16/02 based on a total weight of 156 grams and a sample size of 99 fish/16.2 grams. - 636 eggs were preserved from the 4,950 used in the 5 ml straw trial to verify % fertilization data.

Table 3. Female # 116224546A - Spawning Results

FEMALE #116224546A						
TIME	DATE	MALE #	MLS EGGS	# EGGS @ 36.5/ML	Percent Fertilization	Estimated Hatch Number
4:45 p	6/19/02	116167123A	11	402	~80	321
5:03 p	6/19/02	116167123A	26	949	~80	759
5:15 p	6/19/02	220F107A6F	410	14965	93.1	13932
5:20 p	6/19/02	116167123A	140	5110	81.5	4165
7:10 p	6/19/02	7F7D461025	142	5183	40.0	2073
7:15 p	6/19/02	7F7D461025	144	5256	54.5	2865
8:19 p	6/19/02	1F477B3A65	139	5074	~80	4059
8:27 p	6/19/02	116167123A	174	6351	~80	5081
9:18 p	6/19/02	1F477B3A65	306	11169	~80	8935
11:38 p	6/20/02	7F7D461025	175	6388	73.8	4714
12:18 a	6/20/02	1F477B3A65	36	1212	76.8	931
12:18 a	6/20/02	1F477B3A65	37	1246	6.2	77
12:18 a	6/20/02	1F4A27214F	147	4949	50.2	2485
7:30 a	6/20/02	116167123A	40	1460	0.0	0
8:00 a	6/20/02	1F477B3A65	191	6972	1.0	30
9:50 a	6/20/02	220F107A6F	114	4161	0.0	7
TOTAL			2232	80882		50434

Sample counts were made at the egg stage ‘elongation of pronephros.’ A total of 1569 eggs were measured in a 250 ml graduated cylinder. The line of egg level with water was 43 mls giving an egg size of 36.5 eggs/ml. Egg size of the cryopreserved eggs was accomplished in a 5 ml syringe. The egg size was determined to be 33.67/ml. Eggs were incubated in 68° F water. Fry were hatched directly into 30 inch circular tanks. As hatching progressed the jars were moved to additional tanks to keep the number of fry in any single tank at a reasonable number (~3,500). Feed was fed out using Sweeney vibrating feeders 24/7 at 15 minute intervals. BioOregon’s #1 starter diet was used. On June 20th eggs from the family 546A X 7A6F were shipped to the Miles City SFH via personal plane. A total of 200 mls were sent (an estimated 10,000 eggs). Survival on eggs was excellent.

Female # 1F5420727B was injected with Ovaprim at 11:30p on the evening of June 19th. The progesterone assay for this fish was positive on June 16 (previous week was negative) - nuclear breakdown had occurred in all eggs. The PI was good with an average of 0.09. The following morning the fish was given the resolving dose (11:20). The morning following the resolving dose the fish's behavior was very odd. Typically the injection will cause the fish's activity to increase. They swim aggressively around the perimeter of the tank moving with the water flow. The only movement of this fish during the day was noted when handling when there was limited resistance. It appeared to be in 'shock.' Handling of the fish occurred on three occasions during the day to check for ovulation. At 3:45 a catheter was used to recover a couple dozen eggs. Half were fertilized the others preserved to check for nuclear breakdown. After 7 hours it was apparent that the eggs were not viable. At 11:30 pm the fish was observed on it's side with very slow ventilations. It was apparent the fish was nearly dead. The fish was cathetered to recover eggs. Some eggs were removed but they were covered with fat. The eggs appeared in good condition - either recently ovulated or unovulated. After the initial collections a sample of eggs were taken that looked flaccid. It was thought that the fish had ovulated at that point and likely had good ovulated eggs still inside. Once the fish had died, an incision was made to remove the eggs. The condition of the ovaries was extremely fat. It appeared the eggs were unovulated but every attempt was made to fertilize the eggs. Eggs were combed from the ovaries, fat was removed and the eggs were incubated. Eggs were incubated four days without signs of development.

The final female, #4310187B69 was injected at 9:00 pm on June 24th. The fish was injected with Domperidone and LH-RH. The males were also injected at this time, half with LH-RH, the other three with Ovaprim. Immediately following injecting with Ovaprim the male #1F4772396F turned 'pink.' I have never seen a response like this in any other fish. The following morning at 8:00 am the female received the resolving dose. Milt was collected from 4 of the six injected fish. The two that didn't produce had been injected last week with the same results. The milt had good color however the motility was low on all but one. See Appendix 1. Milt collections. Ovulation checks began on the evening of the 25th at 11:00 pm. The fish was palpated again at 6:00 am with no eggs seen. At 8:30 am she was checked the third time - no eggs. Palpation at 11:45am resulted in 4 eggs collected. At 1:30pm the fish was palpated again, this time no eggs were observed. A catheter was inserted to determine state of ovulation. The tube was filled with a slate gray fluid and flaccid eggs. The fish had apparently ovulated much earlier and we were unable to determine ovulation using the preferred palpation method. The catheter was inserted again, this time farther anterior into the abdominal cavity to determine if any viable eggs were present. A total of 200 mls of eggs were collected and fertilized with a single male (7F7D434B54). The condition of the eggs was poor and the process abandoned to prevent stressing the female further.

During this time, eggs from the Miles City SFH spawning were sent to the hatchery. Two family lots were sent via private plane (1F497F1801 X 7F7F065834 - 396 mls and 1F497F1801 X 115556461A - 298 mls). The eggs arrived at 11:30 am and were treated with 100 ppm Betadine

for 10 minutes upon arrival. Milt from one of the males (115544332A) held at Garrison Dam NFH was sent back to Miles City via plane to provide for production of a third family lot. On June 27 eggs from the third family produced (1F497F1801 X 115544332A - 100 mls) at Miles City were brought back via truck. No egg development was noted on the eggs received from Miles City and there was no survival at either hatchery from that female.

On June 28th the development of eggs taken from female pit tag #4310187B69 on the 25th was determined. As expected a sample relieved fertilization rates for this fish would be poor - 14.1% (from 283 eggs sampled, 40 were viable) . The egg stage at this time was characterized as 'elongation of the pronephros.' The total volume was 200 mls for an estimated 7,300 eggs. June 30th hatch began. A total of 1,300 fry hatched for an actual fertilization rate of 17.8%. Over the course of two weeks 95% of the hatched prolarvae died. As we have experienced in the past, poor quality eggs typically result in poor survival during the final stages of prolarvae development. We ended up with 63 surviving fingerlings at two months of age.

July 3rd two male adult pallids died, one in the morning, the other in the afternoon - nine days post injection. Both fish had negative reactions to the Ovaprim injections, the one turned pink immediately post injection, the other exhibited the typical porpoising response seen when under stress. The male 1F4772396F had was spawned here in 1997 and milt from this fish was cryopreserved this year. The other male, 115544332A had milt sent to Miles City but no progeny survived. Milt from this fish was also cryopreserved. Both fish were autopsied at the hatchery. Gonads were frozen as were livers and tissues from both fish and were sent to the Fish Technology Center. Internally and externally both fish looked good - the exception being some hemorrhaging in the gonads of male 332A (Male 332A was injected last year at Miles City but no milt was produced - males typically respond well to injections).

July 8th the fish health team was at Garrison Dam NFH collecting samples for virus testing. Five fish from each of four yearling family lots were lethally sampled. Fish from one family were under represented and were not sampled. In addition all but a single female pallid brood fish were sampled by fin clips.

On July 9th female 4310187B69 was found dead in the tank. The fish appeared to have recovered fine from the attempted spawn. The previous week she was expelling ovulated eggs in the tank and appeared to be fairly vigorous. While collecting fin samples the previous day from the other adult fish for virus testing she was much more lethargic. Because of this behavior she was not subjected to the stress of handling. The fish was autopsied to determine possible cause of death. An incision was made into the abdomen and a white fluid was present. The ovaries had fully ovulated and no ovulated eggs were present in the body cavity or ovaries. The ovaries contained white oocytes and appeared normal. The ovaries were removed as was the liver, frozen for shipment to Rick Barrows to assist in the development of sturgeon diets. The oviducts of this fish were dissected to determine if any inflammation or hemorrhaging had occurred during the catheterization process. Nothing was apparent, however it was noted and photographed that there appear to be pores in the inner lining of the Mullerian duct that may connect the duct with the kidney. The inner lining of the Mullerian duct is continuous with the outer lining of the kidney. I would assume that being the case, nitrogenous wastes which eliminated through the

kidney pass into the Mullerian duct. With the Mullerian duct ruptured by the catheter those wastes could and likely do enter the body cavity. The overall effect may not be as critical as you might think since the bulk of the urinary nitrogen passes out of freshwater fish through the gills as ammonia and at this point are not clear as to the overall toxicity of the waste product (K.F.Lager et al, 1977). Tests will be conducted on surplus shovelnose to evaluate the catheterization process. We also have evidence from fish used as broodstock that have been catheterized as early as 1977 that survival is in fact likely, but this process may have contributed to the death of the fish. I would also hypothesize that if the wastes that are eliminated into the body cavity contain bacteria, it would likely result in an inflammatory response and that wasn't evident in the fish. Equally as plausible, a major contributing factor in the death would have been the overall stress the spawning process and the unknown effects of the hormone injections. Kidney failure or overload may also be occurring. The kidney's function is to eliminate metabolic wastes and purify the blood. Hormones action controls filtration and reabsorption in the kidney. Our hormone injection may create an imbalance of the kidney's function. In the case of ovulated females whose eggs are not expelled, the decomposing eggs no doubt create a huge load on the liver as well. I'm sure there are many other possible explanations - at this point nothing is conclusive.

July 16th we finally arranged to move fish to Gavins Point NFH to provide the 'backup' to the fish spawned here. The fish size was determined to be ~3000/lb and a total of 20,950 fish were packaged at 1000/box and hauled to Yankton. The breakout of the shipment is as follows: 6,000 each for 2 family lots; 4,000 each for 2 family lots, and 950 of the final family. The 950 fish were estimated at 2774/pound and 156 grams were sent. Yankton received the entire compliment of this family since RPA #2 already has representatives stocked from both parents. This lot was a lot produced from last year's cryopreserved milt. In addition 30 half ml straws of cryopreserved milt was sent for each male spawned this Spring to add to their repository. After shipping, the fish retained at Garrison were spread out equally among available tanks to reduce the loading density.

July 23rd, The MRFWMAO was up to haul pallid broodstock to the river. Five of the nine fish were shipped with the remaining scheduled for next week. Screens in the 2002 progeny were switched out to the aluminum slots. Received news back from Bozeman FHC that the smaller female (4310187B69) that had died on the 9th was found to be positive for the iridovirus. This represents the first adult pallid diagnosed as positive for the virus that I am aware of. To date no positive virus findings on the 2001 progeny but sampling is only half done.

Table 4. Pallid Spawning Statistics

Female	Male	Location	# eggs @ 36.5/ml	hatch #	% hatch *	5 week mortality	5 week % survival	Shipped	Aug 1 Inventory	Dec 1 inventory	% survival 8/1-12/1	Comments
546A	3A65	Confluence	16243	13882	85%	1862	87%	6000	3200	2114	93%	
546A	123A	Confluence	12812	12876	100%	1560	88%	6000	3097	2115	99%	
546A	7A6F	Confluence	14965*	7455	97%	1052	86%	4000	2351	2070	98%	*7,300 toMCSFH
546A	1025	Con / Up MO	16827	8325	49%*	2882	65%	4000	1443	1402	98%	*Refrig milt
546A	214F	Confluence	4950	2485	50%	445	82%	953	-	0	-	Cryo -953 to GAP
546A	3A65	Confluence	1246	77	6%	63	18%	-	-	0	-	Cryopreserved
546A	3A65	Confluence	1212	931	77%	-	-	-	-	-	-	Cryo controls
7B69	4B54	Confluence	7300	1315	18%	1251	5%	0	64	63	98%	
571A	1025	Upper MO	?	87	0%	72	17%	0	15	15	100%	
571A	2C5F	Upper MO	?	0	0%	0	-	0	0	0	0%	
1801	461A	Miles City	10880	1	0%	1	0%	0	0	0	0%	
1801	5834	Miles City	14450	0	0%	0	-	0	0	0	0%	
1801	332A	Miles City	3650	0	0%	0	-	0	0	0	0%	
727B		Confluence	?	0	0%	0	-	0	0	0	0%	
Total				47434		9188		20953	10170	7779		

* Day old eggs not included in % hatch as there was no survival

Summer Stockings for RPA #2

Tagging operations for the RPA #2 stockings were done the afternoon of July 24th. Three crews of four were set up. Each fish was measured and injected with a pit tag into the base of the dorsal fin and green elastomer stripe into the rostrum. The process took about 5 hours for 1626 fish tagged (5.4 fish/minute). Water temperature at tagging was 67°F. No mortalities were noted. The following day the fish were loaded into the truck by stocking site, the heaviest tank had 62 pounds. Oxygen was used to maintain the DO level around 8 ppm. The fish were stocked at 5 locations as noted in Table 5.

Table 5. RPMA #2 Stockings - July 25th, 2002

2001 Progeny - Stocked July 25, 2002							
Broodstock		Stocking Locations - RPMA #2					
Female	Male	Sidney	Wolf Point	Fairview	Culbertson	Intake	Total
411D262C1F	1F4A4B5973	85	85	85	85	13	353
411D262C1F	411D0E2C5F	86	85	85	64	0	320
411D262C1F	41476A0462	85	85	85	85	84	424
411D262C1F	411DOB4E09	85	85	21	0	0	191
411D262C1F	17509415139	86	85	84	83	0	338
TOTALS		427	425	360	317	97	1626
WEIGHT(LBS)		62	54	45	41	11.2	213.2
LENGTH (IN)		10.1	9.7	9.6	9.7	9.4	9.8

The day following stocking an angler reported catching an elastomer tagged sturgeon. He had caught another tagged fish five days earlier at Intake as well (Miles City fish had been released on the 17th).

August 1 an inventory was performed on the 2002 year class and fish were moved from the 30 inch tanks to the 4 and 5 foot tanks. Another inventory was completed on August 23rd. Growth rates were compared between the two sampling times relative to density and family lot. Density ranged from 0.08 to 0.44 pounds per square foot (40-235 fish/tank) using 1 month old fish. There was no significant difference between the tanks in growth or mortality. Fish on August 1 were receiving 132 grams/day of Biodiet #3 Starter in the large tanks, 66 grams (100 mls)/ day in the smaller tanks. Feeding was in excess and regulated to provide food every 15 minutes. The building was kept dark except during tours and cleaning.

Table 6. August Inventory on 2002 Progeny

Female	Male	Location	August 1			August 23
			Number	Weight	Size (gram/fish)	Size (grams/fish)
116224546A	1F477B3A65	Garrison Dam	6020	4491.4	0.75	3.53
116224546A	116167123A	Garrison Dam	5316	4767.8	0.90	3.97
116224546A	220F107A6F	Garrison Dam	2403	1852.3	0.77	4.17
116224546A	7F7D461025	Garrison Dam	1443	1143.2	0.79	-
4310187B69	7F7D434B54	Garrison Dam	64	31.2	0.49	-
132319571A	7F7D461025	Upper Missouri	15	18.4	1.23	-
1F497F1801	115556461A	Miles City SFH	1	0.8	0.80	-
Total			15262	12305.1	0.81	11.67

August 12th, two-hundred ten pallids were sent to the Environmental Branch of the U.S. Army Corps of Engineers to determine how the juvenile sturgeon react to water flows. Terri Allen is conducting the research.

The fish were switched from a 1.0 mm Biodiet Grower to a Silver Cup #3 trout diet on August 18th. The transition was done in three days. The fish didn't appear to have much difficulty making the feed switch; however, the size may be a little large for the 'runts.' Mortality in August was from 0-2%. The bulk of the mortality was in two tanks that had some gill disease problems. An increase in water flow appeared to correct the problem.

Mid-August the Bismark FWMAO located a radio tagged female (1F47715752) from the 2000 spawning near the Highway 85 bridge. After a few net drifts we were fortunate to capture the fish. The fish was catheterized to determine egg stage. No eggs were recovered and only ovarian tissue was removed. It is my opinion that this fish had spawned this Spring and if that is the case, it is likely that both the pallid and shovelnose are capable of spawning every other year.

September 15th increased feed to 200 grams (300 mls) and on the 24th to 265 grams (400 mls) per day - Silver Cup #3 trout crumble. Growth is good but we are losing some fish to starvation - worst case is ~8% loss and the higher dropout rate is present in only one of the four half sibling family lots. The other three family groups have monthly mortality rates closer to the 1% level. It has been about a month since switching feed brands. It is likely that the emaciated fish are those that did not convert to the new diet. On the first of October fish were removed from the tanks to lower densities to 310 fish per 5 foot tank and 210 fish per 4 foot tank. That density equates to 19.7 and 16.7 fish/sqft respectively and should provide a density of 1 pound per square foot or less at stocking time. On October 4th and again on the 7th the excess fish were sampled to determine growth rates and disposed of. Progeny from the 546A X 3A65 family had a mean

length of 164 mm and a mean weight of 16.1 grams. Progeny from the 546A X 123A family had a mean length of 175 mm and a mean weight of 18.7 grams. The minimum size was 88 mm and maximum was 212 mm. The mean condition factor (K) for 200 fish sampled was $3,348 \times 10^{-6}$.

October 24th the Bozeman FHC crew was on site to take samples. A total of 60 lethal samples were taken, 15 from each of the four half sibling family lots. Received the final report on the 2001 progeny - no viral infections found. It was noted that 'low to moderate levels of inflammation were observed in all lethal samples' and epithelial tissue indicated melanization, degeneration, and necrosis. On a positive note, the fish had fatty livers rated from mild to moderate with no associated pathology and internal organs appeared healthy in contrast to last years findings when many were rated severe. The diet used through this July's sampling were the same as last year's.

November 7th a sample of 16 pallids was taken to evaluate size and growth. The mean length at this time was 194 mm and weight 26.4 grams. The size range was from 160 mm to 255 mm FL. The K value was $3,300 \times 10^{-6}$. The 2001 progeny sampled on November 29, 2001 averaged 24 grams each and were 194 mm FL. Last year's early April stocking had an average length of 200 mm and average weight of 30 grams. We are nearly there.

Side Notes

The shovelnose catheterization tests indicate that there is no apparent short term affect from the procedure in immature shovelnose. In several fish, the Mullerian duct was purposely ruptured into the kidney and still no mortality. Since we have documented survival in adult pallids that have undergone several catheterizations, I'm not convinced that the procedure poses a greater risk than an incision to determine egg stage and sex. In fact, I would still recommend catheterization as what I consider the less evasive of the two procedures.

The Ovaprim bottle used on the pallid sturgeon this Spring was injected into 50 shovelnose sturgeon to determine if there was a possible contamination problem or toxicity. To date none of the injected fish have shown any adverse effects. The shovelnose were all immature fish (11/2 years old).

On the two suspect hybrid sturgeon:

Pit tag #115676690A - genetics results lean toward calling this fish a pallid. The fish was captured in the confluence on 4/18/2000. At that time the catheterization check showed small yellow eggs. The fish was catheterized later that summer on September 27 and the eggs were 2.5 mm and black. The fish was overwintered in a hatchery pond. She should have spawned in the Spring of 2001. This May she was catheterized and had small yellow eggs with small 'raisined' black eggs. She will be ready to spawn in the Spring of 2003. The second suspect hybrid was captured on 4/25/02. This hybrid grouped with the rest of the shovelnose genetically. She had fully developed black eggs at the time of capture. The catheterization check on 10/01/02 revealed resorbing black eggs.

I had sent off pallids from 2001 that were OTC marked at seven weeks old to determine if the marks could be seen. Ron Brooks read the marks on both otolith and spine. He indicated the fish could be marked as week old fry. We are currently marking day old walleye fry with 98% success.

August 1 trawling by Pat Braaten and Dave Fuller indicated that there was a wide range of spawning events. They had collected sturgeon from 15-81 mm in length (a 15 mm fish is likely only a couple weeks post hatch). The three smallest fish (15,18 & 22 mm) were collected near the Hwy 85 bridge. In September were trawling between the Hwy 85 bridge and the Nohly bridge and collected sturgeon 17-25 mm in length. The fork length of fish at the hatchery during that time was 16-20 cm, ten times larger.

Prolarvae pallid behavior in 68° F water indicated the switch from random dispersal in the tank to benthic orientation with directional alignment between day 10 and 11. That behavior change also signals initiation of feeding although feed is introduced prior to that stage to stimulate the feeding response. The eggs hatch in four days at that temperature. From a hatchery perspective it is advantageous to increase the screen size immediately prior to the fish's behavior change and increase screen size as frequently as possible to facilitate excess feed and fecal removal and avoid contracting bacterial gill disease.

Corps of Engineers funding was used to purchase float valves necessary to control heated water spillage, a fifth wheel trailer for the adult pallid distribution unit, a replacement UV bulb, cryopreservation supplies and a backup milt storage dewar to be maintained at Warm Springs FTC, new screening materials for tanks, and a digital camera capable of photographing egg stage for determining polarity indices.

Table 7. 2002 Progeny Stockings - RPA 4

Female	Male	Mulberry, NE July 15, 2003		Mulberry, NE Oct 5, 2003		Bellevue, NE July 16, 2003		Booneville, MO July 15, 2003		Total Fish Stocked	
		Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
116224546A	1F477B3A65	500	64.2	78		500	70.2	245	36.9	1323	171.3
116224546A	116167123A	500	88.8	20		500	80.9	399	68.1	1419	237.8
116224546A	220F107A6F	566	89.0	19		556	89.6	470	75.0	1611	253.6
116224546A	7F7D461025	380	65.8	16		382	69.1	326	50.9	1104	185.8
TOTALS		1946	307.8	133	21.5	1938	309.8	1440	230.9	5457	870

Appendix 1. Milt Collections 2002

Milt Collections									
Pit Tag #	mls	Hormone	Inj Date	Inject Time	Take Date	Time	Motility	Characteristics	Milt Cryo
115544332A	265	Ovaprim	6/20	11:30 p	6/21	9:25 a	90	milky	Y
115544332A	195	Ovaprim	6/24	9:00 p	6/25	1:00 p	15	skim	N
1F4A3E1445	300	Ovaprim	6/24	9:00 p	6/25	1:00 p	80	skim	Y
1F477B3A65	210	Ovaprim	6/17	9:30 p	6/18	1:55 p	90	skim	N
1F477B3A65	350	Ovaprim	6/17	9:30 p	6/19	9:15a	90	1% milk	Y
1F4772396F	180	Ovaprim	6/24	9:00 p	6/25	1:00 p	35	skim	Y
115716093A	2	Ovaprim	6/20	11:30 p	6/21	9:25 a	na	clear	N
115716093A	1	Ovaprim	6/20	11:30 p	6/21	8:00 p	na	clear	N
115716093A	35	LH-RH	6/24	9:00 p	6/25	1:00 p	na	clear	N
116167123A	180	Ovaprim	6/17	9:30 p	6/18	1:55 p	90	clear	N
116167123A	260	Ovaprim	6/17	9:30 p	6/19	9:15a	75	skim	Y
7F7D434B54	235	Ovaprim	6/20	11:30 p	6/21	9:25 a	1	skim	N
7F7D434B54	180	Ovaprim	6/20	11:30 p	6/21	8:00 p	40	1% milk	N
7F7D434B54	200	LH-RH	6/24	9:00 p	6/25	1:00 p	40	milky	Y
1F53312736	25	Ovaprim	6/17	9:30 p	6/18	1:55 p	na	clear	N
1F53312736	40	Ovaprim	6/17	9:30 p	6/19	9:15a	na	clear	N
1F53312736	5	LH-RH	6/24	9:00 p	6/25	1:00 p	na	clear	N
220F107A6F	120	Ovaprim	6/17	9:30 p	6/18	1:55 p	90	clear	N
220F107A6F	350	Ovaprim	6/17	9:30 p	6/19	9:15a	85	skim	Y
7F7D461025	?	LH-RH	6/13	9:00 p	6/19	7:00p			Y

Appendix 2. Milt Repository

Pit Tag	Year	RPMA	Straw Size (ml)	~ #	# Goblets	Dewar #	Comments
4773	2000	2	0.5	5	1	4	
6E31	2000	2	0.5	5	1	4	
453A	2000	2	0.5	5	1	4	
4552	2000	2	0.5	5	1	4	
194B	2000	2	0.5	5	1	4	
3350	2000	2	0.5	5	1	4	
214F	2001	2	0.5	15	3	1	
1C6A	2001	2	0.5	10	2	1	
222A	2001	2	0.5	10	2	1	
5708	2001	2	0.5	10	2	1	
5708	2001	2	5	4	0	2	
1C6A	2001	2	5	4	0	2	
214F	2001	2	5	3	0	2	
222A	2001	2	5	3	0	2	
4E09(2265)	2001	1	0.5	5	1	3	MeOH
4E09(2265)	2001	1	5	3	0	3	MeOH
214F	2001	2	0.5	3	1	3	MeOH
214F	2001	2	5	1	0	3	MeOH
5139	2001	1	0.5	10	2	4	
0462	2001	1	0.5	10	2	4	
2C5F	2001	1	0.5	10	2	4	
4E09 (2265)	2001	1	0.5	10	2	4	
5973	2001	1	0.5	5	1	4	
4B54	2002	2	0.5	20	4	5	
3A65	2002	2	0.5	5	1	5	
1025	2002	1	0.5	20	4	6	
5834	2002	2	0.5	20	4	6	

Pit Tag	Year	RPMA	Straw Size (ml)	~ #	# Goblets	Dewar #	Comments
461A	2002	2	0.5	20	4	7	
3A65	2002	2	0.5	35	7	7	
396F	2002	2	0.5	20	4	8	
7A6F	2002	2	0.5	20	4	8	
123A	2002	2	0.5	20	4	9	
1445	2002	2	0.5	20	4	9	
332A	2002	2	0.5	20	4	10	

Appendix 3. 2001 Progeny Stockings

Broodstock		Stocking Locations							Total
Female	Male	Vermillion, SD	Bellevue, NE	Booneville, MO	RPMA # 2	RPMA # 3	Blind Pony SFH	Gavins Point NFH	Fish Stocked
411D262C1F	1F4A4B5973	28	21	20	353	70	56	50	598
411D262C1F	411D0E2C5F	557	555	558	320	70	56	50	2166
411D262C1F	41476A0462	601	580	560	424	70	221	50	2506
411D262C1F	411DOB4E09	0	0	0	191	0	0	105	296
411D262C1F	17509415139	67	51	52	338	70	14	50	642
Half Sibling Family Total		1253	1207	1190	1626	283	347	305	6211
220E345E09	1F4A111C6A	339	336	362	0	71	0	50	1158
220E345E09	1F4A27214F	256	250	256	0	70	0	50	882
Half Sibling Family Total		595	586	618	0	141	0	100	2040
7F7F06672B	7F7D3C5708	173	222	198	0	70	60	50	773
7F7F06672B	115631222A	133	118	180	0	70	68	50	619
Half Sibling Family Total		306	340	378	0	140	128	100	1392
Confluence Mix	Tank N20	0	0	0	0	0	1721	0	1721

Broodstock	Stocking Locations							Total
TOTALS	2154	2133	2186	1626	561	2196	505	11361

Appendix 4. Five Month Inventory - November 1, 2002

Tank #	-	-	Hatch number	Initial mortality	Prolarvae % survival	shipped culled	August 1 Inventory	Aug mort	Sept mort	Oct mort	Nov mort	Second culling #	Dec 1 Inventory	% mort Aug 1-Dec 1
T 51	546A	3A65				6000	350	3	4	0	0	33	310	2%
T 58	546A	3A65					350	23	12	0	0	270	45	-
T 59	546A	3A65					350	12	3	0	1	25	309	5%
T 67	546A	3A65					250	9	17	-	-	224	0	-
T 69	546A	3A65					250	2	0	0	0	38	210	1%
T 72	546A	3A65					350	1	3	0	0	36	310	1%
T 73	546A	3A65					350	2	17	0	0	21	310	6%
T 74	546A	3A65					350	4	3	1	0	33	309	3%
T 75	546A	3A65					350	4	10	0	0	26	310	4%
T 81	546A	3A65					250	2	22	-	0	226	0	-
LOT TOTAL			13882	1862	87%	2820	3200	62	91	1	1	932	2113	7%
T 52	546A	123A				6000	350	3	1	0	1	36	309	1%
T 53	546A	123A					350	3	1	0	0	36	310	1%
T 54	546A	123A					350	4	0	0	0	36	310	1%
T 70	546A	123A					250	2	0	0	0	38	210	1%
T 76	546A	123A					350	3	0	0	0	37	310	1%
T 77	546A	123A					350	1	1	0	0	38	310	1%
T 78	546A	123A					350	1	1	0	1	38	309	1%
T 79	546A	123A					247	8	0	0	0	194	45	-
T 80	546A	123A					250	0	1	-	0	249	0	-
T 83	546A	123A					250	0	0	-	0	250	0	-

Tank #			Hatch number	Initial mortality	Prolarvae % survival	shipped culled	August 1 Inventory	Aug mort	Sept mort	Oct mort	Nov mort	Second culling #	Dec 1 Inventory	% mort Aug 1-Dec 1
LOT TOTAL			12876	1560	88%	2219	3097	25	5	0	2	952	2113	1%
T 56	546A	7A6F				4000	350	1	3	0	0	36	310	1%
T 57	546A	7A6F					350	3	2	0	0	35	310	2%
T 60	546A	7A6F					350	0	1	0	0	39	310	0%
T 61	546A	7A6F					350	0	4	0	0	36	310	1%
T 62	546A	7A6F					350	1	3	0	0	36	310	1%
T 63	546A	7A6F					350	4	0	0	0	36	310	1%
T 68	546A	7A6F					251	6	13	0	0	22	210	8%
T 80	546A	7A6F								0	0	-45	45	0%
LOT TOTAL							7455	1052	86%	52	2351	15	26	0
T 50	546A	1025				4000	350	2	1	0	0	15	332	1%
T 55	546A	1025					193	2	0	0	0	0	191	1%
T 64	546A	1025					300	6	1	0	0	0	293	2%
T 65	546A	1025					300	9	0	0	0	0	291	3%
T 66	546A	1025					300	0	5	0	1	0	294	2%
LOT TOTAL							8325	2882	65%	0	1443	19	7	0
T 71	7B69	4B54				0	63	0	0	0	1	0	62	1%
LOT TOTAL			1315	1251	5%	0	63	0	0	0	1	0	62	1%
T 82	571A	1025				0	15	0	0	0	0	0	15	0%
LOT TOTAL			87	72	17%	0	15	0	0	0	0	0	15	0%
GRAND TOTAL			13882	1862	87%	5091	10169	121	129	1	5	2139	7774	0%

Appendix 5. Initial Inventory - August 1, 2002

Initial Tank	Transfer 7/16	To Tank on 8/1	-	-	Inventory Num on 8/1	Weight (grams)	Initial Hatch# 6/24	Ship # 7/16	5 week Mort	Tank Total 8/1/02	% surv to 8/1/02	Size Fish/ Gram
FT-24	FT 1	T 59	546A	3A65	350	226.4	0	0	15	586	98%	1.5
FT-24	FT 1	T 81	546A	3A65	236	152.7						
FT-25	FT 3	FT 1	546A	3A65	50	40.9	0	0	37	965	96%	1.3
FT-25	FT 3	FT 2	546A	3A65	50	41.2						
FT-25	FT 3	-	546A	3A65	165	147.7						
FT-25	FT 3	T 51	546A	3A65	350	257.2						
FT-25	FT 3	T 72	546A	3A65	350	276.9						
FT-25	FT 10	FT 9	546A	3A65	50	42.9						
FT-25	FT 10	-	546A	3A65	95	80.1						
FT-25	FT 10	T 81	546A	3A65	14	9.1						
FT-16	FT 13	FT 12	546A	3A65	50	36.1	0	0	6	717	99%	1.3
FT-16	FT 13	-	546A	3A65	389	312.0						
FT-16	FT 13	FT 14	546A	3A65	228	180.5						
FT-16	FT 13	FT 15	546A	3A65	50	36.3						
FT-25	FT 14	T 69	546A	3A65	250	192.5	0	0	10	600	98%	1.3
FT-25	FT 14	T 58	546A	3A65	350	275.8						
FT 16	-	-	546A	3A65	698	603.8	3373	1000	752	898	72%	1.2
FT 16	-	G 8	546A	3A65	200	164.3						
FT 18	-	T 75	546A	3A65	350	~269	1511	1000	147	364	90%	1.3
FT 18	-	T 67	546A	3A65	14	9.3						

Initial Tank	Transfer 7/16	To Tank on 8/1	-	-	Inventory Num on 8/1	Weight (grams)	Initial Hatch# 6/24	Ship # 7/16	5 week Mort	Tank Total 8/1/02	% surv to 8/1/02	Size Fish/ Gram
FT 21	-	T 74	546A	3A65	350	~269	1692	1000	142	550	92%	1.2
FT 21	-	T 67	546A	3A65	200	185.4						
FT 24	-	FT 27	546A	3A65	200	156.8	2864	1000	489	774	78%	2.1
FT 24	-	-	546A	3A65	224	186.8						
FT 24	-	T 73	546A	3A65	350	~269						
FT 25	-	-	546A	3A65	196	145.1	4442	1000	150	407	90%	1.3
FT 25	-	FT 26	546A	3A65	175	138.6						
FT 25	-	T 67	546A	3A65	36	26.7						
LOT TOTAL					6020	4732.1	13882	6000	1862	6020	87%	1.3
FT-19	FT 6	T 80	546A	123A	199	192.6	0	1000	28	199	98%	1.0
FT-17	FT 7	FT 4	546A	123A	50	40.9						
FT-17	FT 7	FT 6	546A	123A	50	43.5						
FT-17	FT 7	-	546A	123A	51	40.7						
FT-17	FT 7	FT 8	546A	123A	50	41.2						
FT-17	FT 7	T 52	546A	123A	350	286.6						
FT-17	FT 7	T 80	546A	123A	51	49.3						
FT-22	FT 8	T 53	546A	123A	350	285.3	0	1000	48	436	97%	1.2
FT-22	FT 8	T 79	546A	123A	86	71.4						
FT-23	FT 9	T 54	546A	123A	350	272.4	0	1000	67	426	96%	1.2
FT-23	FT 9	T 79	546A	123A	76	69.1						

Initial Tank	Transfer 7/16	To Tank on 8/1	-	-	Inventory Num on 8/1	Weight (grams)	Initial Hatch# 6/24	Ship # 7/16	5 week Mort	Tank Total 8/1/02	% surv to 8/1/02	Size Fish/ Gram
FT 17	-	-	546A	123A	182	179.1	3622	1000	361	582	81%	1.2
FT 17	-	FT 18	546A	123A	50	52.3						
FT 17	-	T 78	546A	123A	350	~269						
FT 19	-	-	546A	123A	40	37.3	3046	1000	179	640	90%	1.2
FT 19	-	T 77	546A	123A	350	~269						
FT 19	-	T 83	546A	123A	250	224.7						
FT 22	-	-	546A	123A	437	618.7	2546		225	837	79%	0.9
FT 22	-	T 76	546A	123A	350	~269						
FT 22	-	FT 21	546A	123A	50	56.5						
FT 23	-	-	546A	123A	385	349.2	3662		231	769	77%	1.1
FT 23	-	FT 28	546A	123A	384	349.2						
FT -23	FT 29	-	546A	123A	490	420.6	0		344	825	71%	1.2
FT-23	FT 29	T 70	546A	123A	250	205.7						
FT-23	FT 29	T 79	546A	123A	85	74.5						
LOT TOTAL					5316	4768	12876	6000	1560	5316	88%	1.1
FT 20	-	-	546A	7A6F	52	~43	2148	1000	296	852	86%	1.2
FT 20	-	T 60	546A	7A6F	350	290.9						
FT 20	-	T 61	546A	7A6F	350	~269						
FT 20	-	T 68	546A	7A6F	100	88.0						
FT 26	-	T 56	546A	7A6F	350	260.1	2845	1500	555	790	80%	1.3

Initial Tank	Transfer 7/16	To Tank on 8/1	-	-	Inventory Num on 8/1	Weight (grams)	Initial Hatch# 6/24	Ship # 7/16	5 week Mort	Tank Total 8/1/02	% surv to 8/1/02	Size Fish/ Gram
FT 26	-	T 62	546A	7A6F	350	~269						
FT 26	-	T 68	546A	7A6F	90	74.7						
FT 27	-	T 57	546A	7A6F	350	240.2	2462	1500	201	761	92%	1.4
FT 27	-	T 63	546A	7A6F	350	~269						
FT 27	-	T 68	546A	7A6F	61	48.4						
LOT TOTAL					2403	1852	7455	4000	1052	2403	86%	1.3
FT 15	FT 12	T 55	546A	1025	76	~59.5	0	0	76	376	83%	1.3
FT 15	FT 12	T 64	546A	1025	300	~231						
FT 15	-	T 50	546A	1025	204	180.2	2973	0	1950	571	23%	1.2
FT 15	-	T 55	546A	1025	67	~52.2						
FT 15	-	T 65	546A	1025	300	~231						
FT 28	-	T 50	546A	1025	146	119.8	2419	1500	423	496	83%	1.3
FT 28	-	T 55	546A	1025	50	~38.5						
FT 28	-	T 66	546A	1025	300	~231						
FT 29	-	out	546A	1025	2500	347.5	2933	2500	433	0	85%	0.0
LOT TOTAL					3943	1491	8325	4000	2882	1443	65%	1.3
FT 13	-	-	546A	214F	0	156	1398	953	445	0	68%	0.0
LOT TOTAL					0	156	1398	953	445	0	68%	0.0
	FT 11	FT 11	1801	461A	1	~0.8	1	0	0	1	100%	1.3
LOT TOTAL					1	0.8	1	0	0	1	100%	1.3

Initial Tank	Transfer 7/16	To Tank on 8/1	-	-	Inventory Num on 8/1	Weight (grams)	Initial Hatch# 6/24	Ship # 7/16	5 week Mort	Tank Total 8/1/02	% surv to 8/1/02	Size Fish/ Gram
	FT 2	T 71	7B69	4B54	9	3.7	920	0	911	9	1%	2.4
	FT 4	T 71	7B69	4B54	55	22.2	395	0	340	55	14%	2.5
LOT TOTAL					64	25.9	1315	0	1251	64	5%	2.5
	FT 30	T 82	571A	1025	15	18.4	87	0	72	15	17%	0.8
LOT TOTAL					15	18.4	87	0	72	15	17%	0.8
GRAND TOTAL					17762	13044	45339	20953	9124	15262	80%	1.2

Appendix 6. Pallid Augmentation in Recovery Priority Areas 1-3.

Pallid Augmentation in the Upper Basin

Year	Hatchery of origin Mating design Effective population(Ne)	Female Pit tag (last 3 digits)	Male Pit tag (last 3 digits)	RPA #1			RPA #2			RPA #3			Total stocked per family
				Number stocked	Cumulative		Number stocked	Cumulative		Number stocked	Cumulative		
					Effective population size (Ne)	Frequency of inbreeding (F/gen)		Effective population size (Ne)	Frequency of inbreeding (F/gen)		Effective population size (Ne)	Frequency of inbreeding (F/gen)	
1997	Gavins Point NFH 2 x 3* Ne = 4.8	E04	439	138	4.8	10.4 %	151	4.8	10.4 %	80	4.8	10.4 %	369
		E04	A07	138	2 X 3	10.4 %	155	2 X 3	10.4 %	80	2 X 3	10.4 %	373
		E04	83D	138			155			79			372
		354	439	138	163	76	377						
		354	A07	138	155	101	394						
1998	Garrison Dam NFH 1 X 2 Ne = 2.7	171	123	0	4.8	10.4 %	100	7.5	6.7 %	49	7.5	6.7 %	149
		171	031	0	2 X 3	100	3 X 5	49	3 X 5	149			
1999	Gavins Point NFH 1 X 2* Ne = 2.7	573	774	0	4.8	10.4 %	159	10.2	4.9 %	67	10.2	4.9%	159
		573	83D	0	2 X 3	159	4 X 7	50	4 X 7	159			
		573	62A	0	160	65	160						
2001	Miles City SFH (2) 1 X 2 Ne = 5.4	E09	C6A	0	4.8	10.4 %	366	12.9	3.9%	0	10.2	4.9%	366
		E09	14F	0	2 X 3	366	5 X 9	0	4 X 7	366			
		72B	708	0	4.8	10.4 %	247	15.5	3.2%	0	10.2	4.9%	247
		72B	22A	0	2 X 3	298	6 X 11	0	4 X 7	298			
2001	Bozeman FTC 1 X 5 Ne = 3.3	CIF	973	494	8.7	5.7 %	73	15.5	3.2 %	0	10.2	4.9%	567
		CIF	C5F	289	3 X 8	0	6 X 11	0	4 X 7	289			

Pallid Augmentation in the Upper Basin

Year	Hatchery of origin Mating design Effective population(Ne)	Female Pit tag (last 3 digits)	Male Pit tag (last 3 digits)	RPA #1		RPA #2		RPA #3		Total stocked per family			
				Number stocked	Cumulative		Number stocked	Cumulative			Number stocked	Cumulative	
					Effective population size (Ne)	Frequency of inbreeding (F/gen)		Effective population size (Ne)	Frequency of inbreeding (F/gen)			Effective population size (Ne)	Frequency of inbreeding (F/gen)
		CIF	462	553			0			0			553
		CIF	E09	176			0			0			176
		CIF	139	546			85			0			631
2001	Garrison Dam NFH	E09	C6A	0	8.7 3 X 8	5.7 %	0	15.5 6 X 11	3.2 %	70	12.9 5 X 9	3.9 %	70
		E09	14F	0			0			70			70
	(2) 1 X 2 Ne = 5.4	72B	708	0	8.7 3 X 8	5.7 %	0	15.5 6 X 11	3.2 %	70	15.5 6 X 11	3.2 %	70
		72B	22A	0			0			70			70
	1 X 5 Ne = 3.3	CIF	973	0	8.7 3 X 8	5.7 %	353	19.5 7 X 16	2.6 %	70	19.1 7 X 15	2.6 %	423
		CIF	C5F	0			320			70			390
		CIF	462	0			424			352			776
		CIF	E09	0			191			0			191
		CIF	139	0			338			70			408
2002	Garrison Dam NFH	546A	3A65	0	8.7 3 X 8	5.7 %	0	22.9 8 X 20	2.2 %	0	19.1 7 X 15	2.6 %	0
		546A	123A	0			0			0			0
	1 X 4 Ne = 3.2	546A	7A6F	0			0			0			0
		546A	1025	0			0			0			0
	1 X 1 Ne = 2.0	7B69	4B54	0			0			0			0
2002	Gavins Point	546A	3A65	0	8.7	5.7 %	653	22.9	2.2 %	120	22.5	2.2 %	773

Pallid Augmentation in the Upper Basin

Year	Hatchery of origin Mating design Effective population(Ne)	Female Pit tag (last 3 digits)	Male Pit tag (last 3 digits)	RPA #1			RPA #2			RPA #3			Total stocked per family
				Number stocked	Cumulative		Number stocked	Cumulative		Number stocked	Cumulative		
					Effective population size (Ne)	Frequency of inbreeding (F/gen)		Effective population size (Ne)	Frequency of inbreeding (F/gen)		Effective population size (Ne)	Frequency of inbreeding (F/gen)	
	NFH 1 X 5* Ne = 3.3	546A	123A	0	3 X 8		645	8 X 20		121	8 X 19		766
		546A	7A6F	0			0			120			120
		546A	1025	0			653			120			773
		546A	214F	0			0			120			120
2002	Miles City SFH	546A	7A6F	0			2173			0			2173
Total				2748	8.7	5.7 %	8642	22.9	2.2 %	2139	22.5	2.62%	13347

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