

**ARIZONA GAME AND FISH DEPARTMENT
INTEROFFICE MEMO**

TO: Ted McKinney, Wildlife Specialist III
Bill Persons, Research Program Supervisor

FROM: Dave Speas, Wildlife Specialist II

SUBJECT: Evaluation of Floy Tagging Experiment

DATE: November 22, 1999

Introduction and Objectives

This report summarizes results of a pilot collaborative study between Arizona Game and Fish Department (AGFD) and professional fly fishing guides in the Lee's Ferry tailwater. Objectives were to:

1. Assess feasibility and quality of mark/recapture data collection by professional fishing guides and participation of anglers in recording recapture observations.
2. Gain information on how frequently trout are captured by angling in the Lee's Ferry reach and insight into how vulnerability to angling relates to adult trout mortality.

Methods

Graduate students from the Fisheries Centre, University of British Columbia visited the Lee's Ferry tailwater on 11/5/98 and instructed two volunteer fishing guides from Marble Canyon Guides (MC) and Lee's Ferry Anglers Guide Service and Fly Shop (LFA) on the proper technique of fish tag insertion. Floy anchor tags (25 mm total length; Floy Tag Mfg. Co., Inc.) were inserted in the dorsal musculature between dorsal fin bones at roughly 45° to the vertical axis of the fish and twisted slightly to ensure the tag caught between bones. Guides rapidly learned the tagging technique and then were each provided with 500 Floy tags numbered sequentially from 0001 to 0500 and 0501 to 1000, a tagging gun, and a data notebook. Guides tagged fish caught by their clients and recorded recaptures over a period of approximately 9 months 1 week (11/5/98 through 8/17/99), recording dates, locations, tag numbers, mark/recapture designations, and additional (volunteered) data such as length and, categorically, fish condition (not presented herein). I acquired data on a semimonthly basis and stored it electronically at the AGFD research office in Page.

Sampling locations were wadable cobble bars that commonly receive fishing pressure from guided anglers. Since competition for such areas can be severe, we selected seven areas (river miles [RM] -14.8 right [R], -13.1 R, -12.6 R, -12.6 R, -9.8 center [C], -9.3 R, and -8.6 R) to ensure that guides would be able to access at least one sampling location on a daily basis.

All staff members of MC and LFA were provided with data notebooks and encouraged to report recaptures encountered on guided fishing trips. Additionally, AGFD encouraged the general angling public to report recaptures by placing information posters at the boat dock (Lee's Ferry, Glen Canyon National Recreation Area), Marble Canyon Lodge and Lee's Ferry Anglers Fly Shop, publishing an article on the project in *Arizona Wildlife Views* (March/April 1999), and circulating advisories on the internet.

Results and Discussion

Participation, Public Relations and Data Acquisition and Quality

Guides who volunteered to tag fish showed much enthusiasm for the project throughout the study period and reported all recaptures they encountered, and their associates at MC and LFA made observations as well. Staff at LFA reported recaptures on a scoreboard in their fly shop. However, it is doubtful that all recaptures were reported. Despite attempts to encourage participation by the general public, at best only 5% of recaptures were reported by unguided anglers, and their degree of participation is unknown. Moreover, guides not affiliated with MC or LFA rarely reported recaptures and one such guide stated that he had felt "excluded" from the study because AGFD had been working primarily with MC and LFA. For the forgoing reasons, only data reported by affiliates of MC and LFA are presented below.

The guides never reported an instance where the process of tagging interfered with their client's angling experience. The guides fully understood what types of data needed to be collected and did so. Guides recorded data legibly and often in great detail, although data books became wrinkled and faded due to frequent exposure to water.

Among recaptures, two tag numbers were apparently misread, and removed from the database. About 9% of the recaptures were reported by telephone, and in each instance the fish tag number was reported, but frequently locations were not. No recaptures were reported by e-mail. Five percent of fish recaptures were reported without tag numbers, usually due to anglers' lack of information on the project.

Five instances of Floy tags causing potential damage to fish (becoming fouled by algae, causing sores) were reported. General remarks from the guides indicated that tags caused little direct damage to recaptured fish. However, as benthic vegetation proliferated during the summer months, accretion of algal fronds often obscured the tags. At the end of the study, one guide suggested that tags could easily be overlooked if fish were not inspected closely.

The level of enthusiasm and interest evident on the part of guides who tagged fish indicates that the project was a very positive experience for those directly involved. The extent to which other guides and anglers participated in the study, however, is unknown. As a result, it is likely that recapture frequencies were underestimated. If future project objectives entail estimates of mortality, lack of recapture observations would pose serious limitations on accuracy of estimates. Mortality estimates may be derived through stock assessment, perhaps by extrapolation of observations standardized by angling effort. Alternatively, more aggressive

educative efforts could be made to encourage anglers not directly affiliated with the study to report recaptured fish. Increased information and education would require additional funding, planning, publicity and evaluation.

In the present study, chain of custody of data was not very convenient and in some cases did not facilitate accuracy. In future studies, field data should be gathered and stored electronically on a monthly basis. I suggest that guides be provided with monthly data booklets that can be mailed in their entirety, or that they mail data photocopies to AGFD at the close of each month. Additional care also should be taken in recording of tag numbers of recaptured fish.

Overall, I feel the study was very successful from the standpoint of sampling logistics, field data collection and public relations. Tagging fish and collecting data reportedly posed no inconveniences to the guides, good quality data was collected, and in general a positive working relationship between AGFD and professional fishing guides was established. These results definitely favor future collaborations with professional fishing guides. Expansion of efforts to maximize participation (i.e., reporting recaptures) on the part of the general angling public needs to be evaluated relative to available funds and labor, and in relation to quantitative alternatives (estimation of parameters from subsamples gathered by participating fishing guides).

Recapture data

Guides marked 726 fish and reported 55 recaptures during the study period. They marked fish on a total of 90 fishing days. Data pooled over dates and locations indicated that most fish were captured only once, although individual fish were captured as many as four times (Figure 1). Time elapsed between captures ranged from 3-181 days, and averaged 45 days (SE=6; table 1, Figure 2). On two separate occasions, marked fish were reportedly captured on the same day (not included in analysis).

Most fish were tagged at RM -14.8 R, -12.6 R, -9.3 R and -8.6R (Figure 3), and numbers of recaptures were correspondingly highest at these areas. Fish were tagged at an average rate of 115/month (SE=13) through April of 1999, after which rates declined (Figure 4). Two fish (0.3% of sample) were found dead three and ten days after being tagged, but neither showed evidence of damage from tag insertion.

Seven fish were recaptured from 0.5 to 5.5 miles from their initial tagging locations (Table 1), and four of these fish had moved downstream. Distance moved appeared to be greatest in the upstream direction (2.2-5.5 miles upstream, 0.5-1.1 miles downstream). One fish (not included in analysis) was reportedly recaptured 9.6 miles downstream from its initial tagging location.

Cumulative numbers of recaptured fish varied significantly with cumulative numbers of marked fish (linear regression, forced zero intercept; $R^2=0.98$, $P<0.0001$; Figure 5).

The data set procured in this study, while preliminary, does provide information on the rate at which individual fish are captured over time and percent of multiple recaptures. Because fish were captured by recreational anglers using fly fishing gear, variability in angler effort and

skill levels is probably representative of most fly fishing activities in the tailwater, although capture and recapture frequencies among spin-fishing anglers is unknown.

Estimates of multiple recaptures (Figure 1) are probably low due to incomplete reporting of recaptures. More accurate estimates may be obtained by standardizing capture observations by effort and extrapolating by an estimate of total angler effort. Unfortunately, accurate estimates of effort are unavailable in this study, and are certainly recommended for future studies. Estimates of mean days at liberty seem plausible, but again their accuracy depends on how thoroughly recaptures were reported.

If data are accurate, we may hypothesize that the majority of angler-related mortality in the Lee's Ferry tailwater is associated primarily with single captures as opposed to multiple recaptures, as incidence of the latter appear to be low. However, if probabilities of mortality increase with each successive recapture, mortality due to multiple recaptures may be significant in relation to total mortality.

Low levels of unaccountable variability in the relationship between numbers of recaptured fish with numbers of marked fish (Figure 5) demonstrates that marked fish can be recovered in a predictable fashion. This result suggests that collection of mark/recapture data by professional fishing guides may be a powerful tool in estimating key population parameters. Hypotheses regarding population size, survival and mortality rates may be tested in future studies providing additional information is gathered. Such additional information includes (but may not be limited to) estimates of daily angling effort, total number of fish (both marked and unmarked) captured per day, and perhaps accurate length measurements.

In general, all objectives were met except for quantitative evaluation of recreational capture and mortality. Mortality estimates will not be possible until total numbers of fish captured are recorded.

Recommendations

1. Continue mark/recapture study among current sampling locations, but begin recording angling effort (hours per angler) and total numbers of fish (mark and unmarked) captured per day.
2. Develop more convenient way to transfer data from the field to the AGFD office in Page on a monthly basis.
3. Emphasize to guides the importance of correctly reading tag numbers.
4. Provide guides with waterproof data sheets in the future.
5. Consider limiting Floy tag studies to seasons when benthic algal production is lowest (fall-spring) to avoid accretion of algae on the tags.
6. Evaluate efforts to increase participation of anglers and guides in reporting recaptured fish in relation to cost, effort and quantitative alternatives to estimate recaptures from subsampling.
7. Continue to develop fly-caught mark/recapture projects as long-term monitoring tools.
8. Evaluate additional funding needed to continue project.

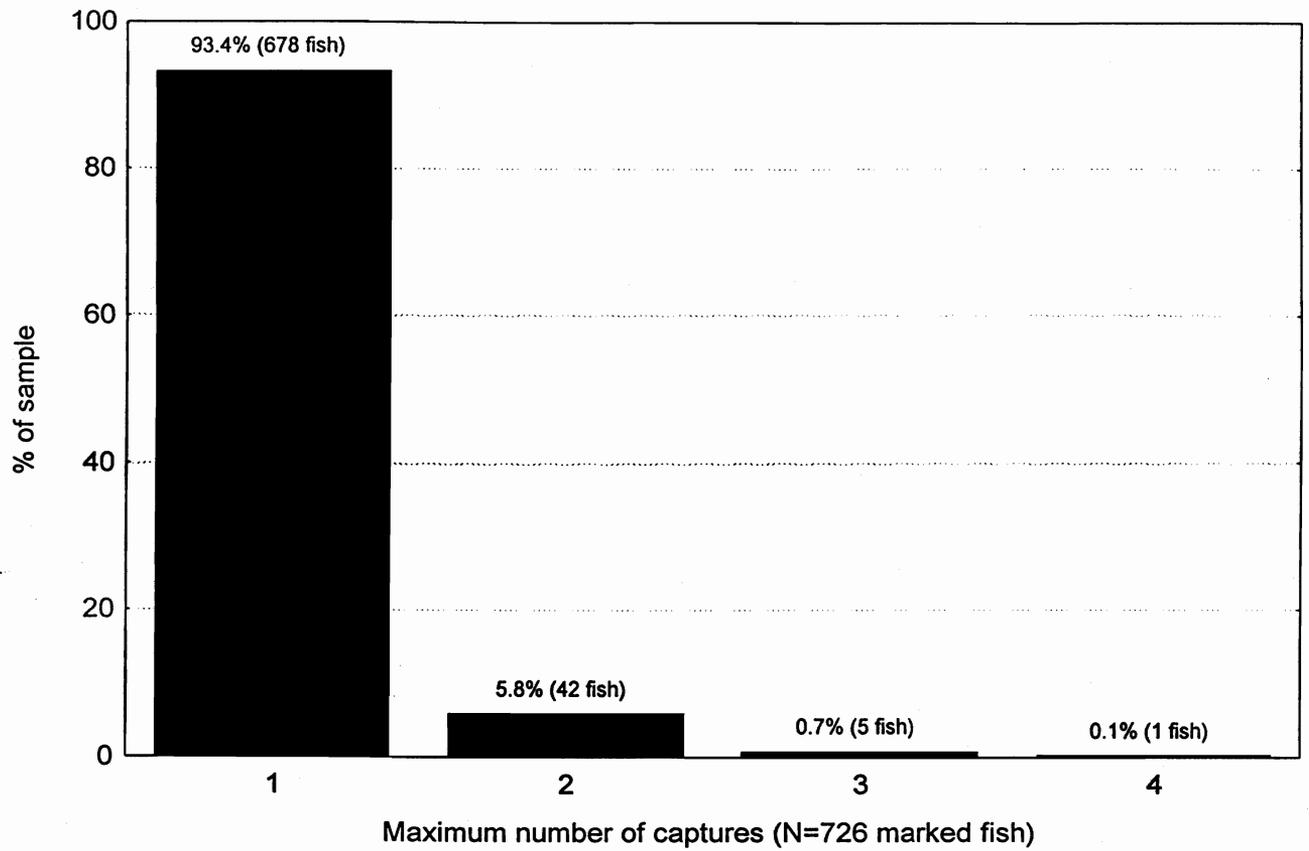


Figure 1. Percentages of rainbow trout captured on multiple occasions in the Lee's Ferry tailwater, 11/98-8/99. Values on x-axis are categorical.

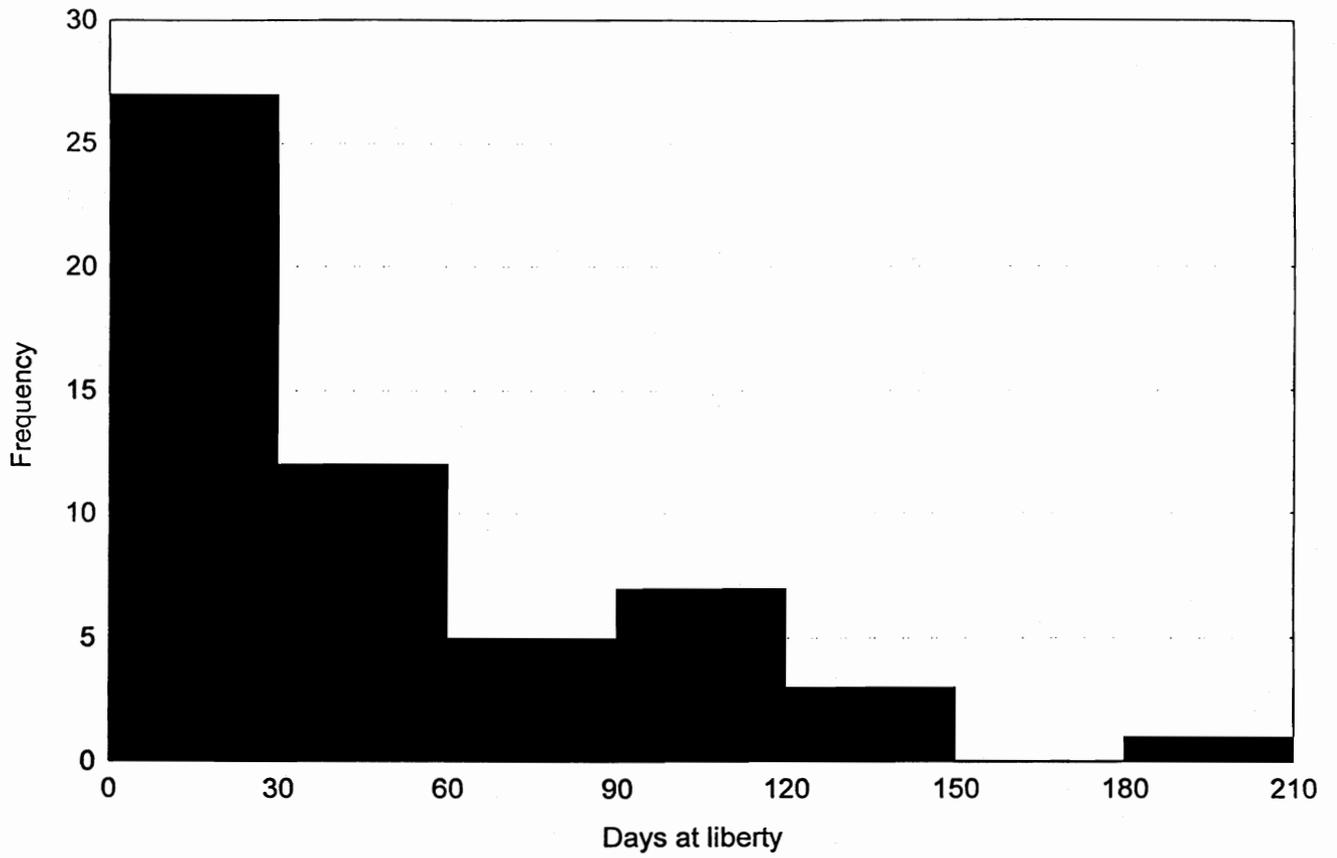


Figure 2. Histogram of time elapsed between mark and recapture of rainbow trout in the Lee's Ferry tailwater, 11/98-8/99 (N=55 recaptures).

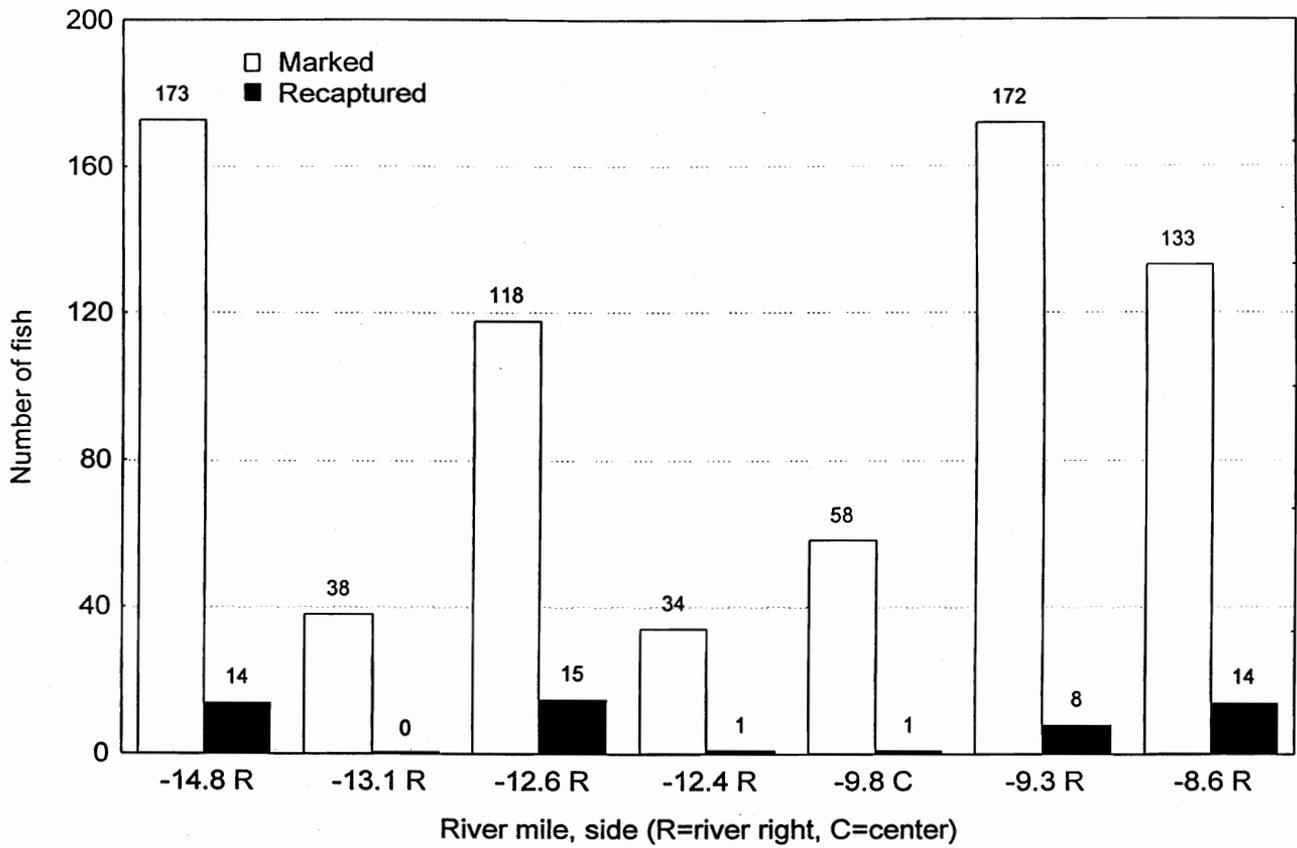


Figure 3. Numbers of marked and recaptured rainbow trout by sampling location in the Lee's Ferry tailwater, 11/98-8/99.

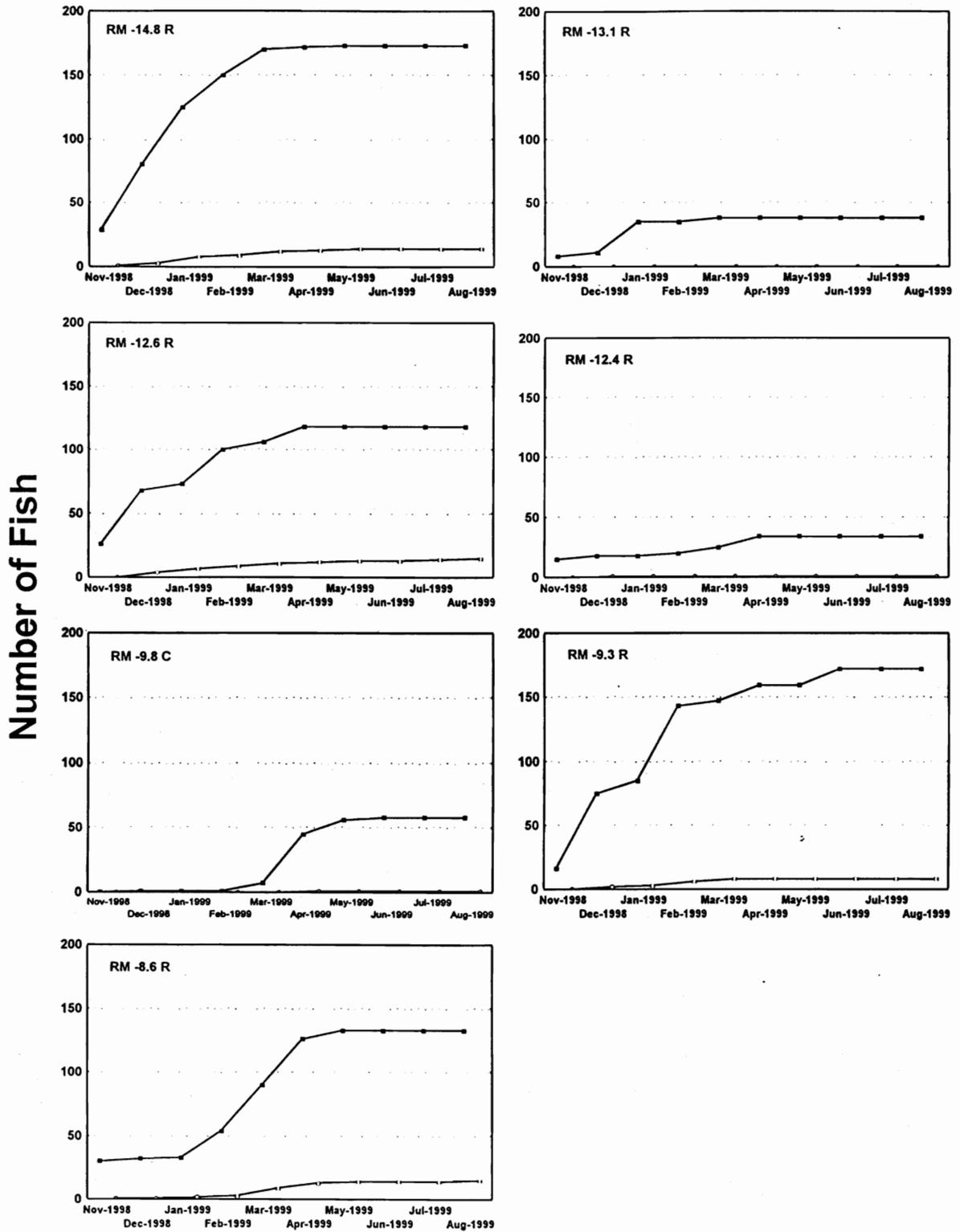


Figure 4. Spatial-temporal breakdown of marked and recaptured rainbow trout in the Lee's Ferry tailwater, 11/98-8/99 (closed symbols = marked, open symbols = recaptured).

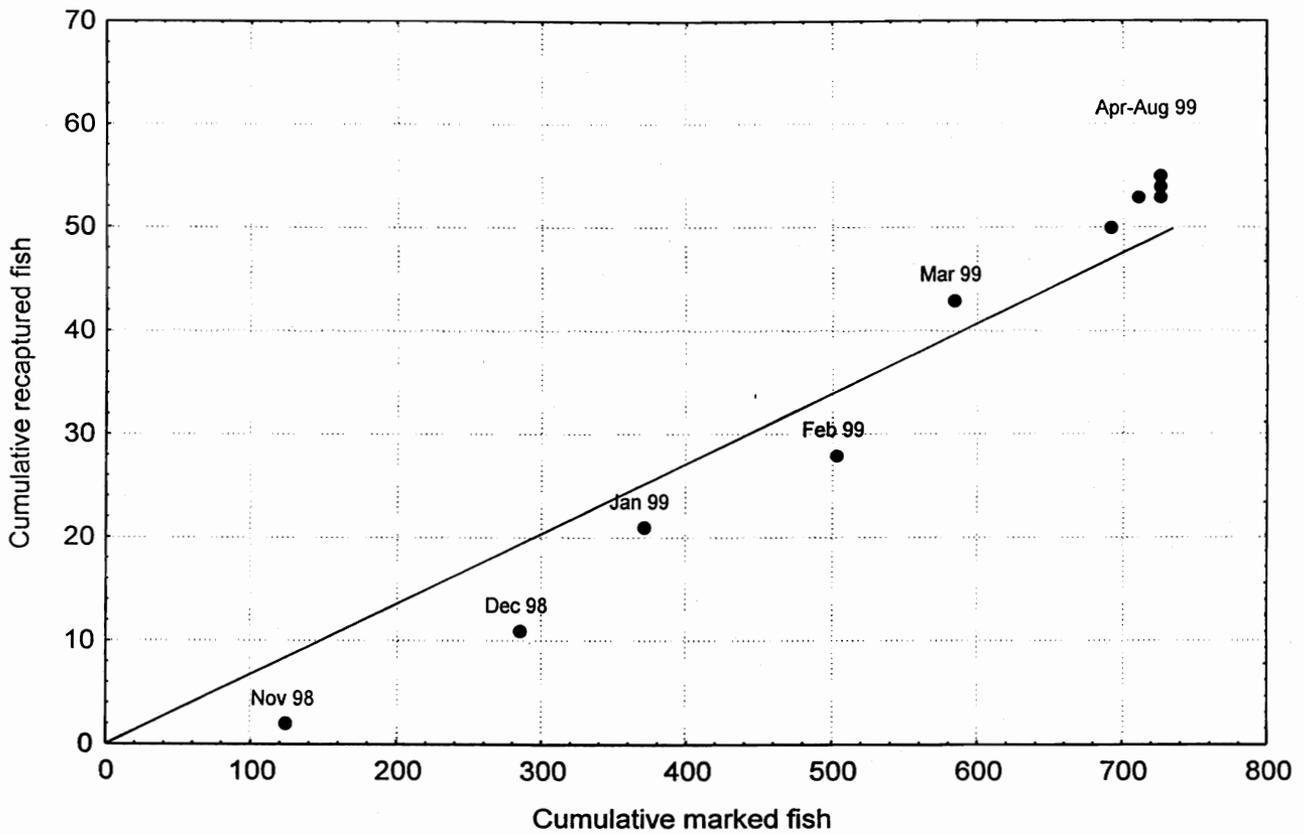


Figure 5. Relationship of cumulative recaptured trout to cumulative marked trout, Lee's Ferry tailwater, 11/98-8/99.

Table 1. Recapture dates, locations, net movement and days at liberty of individual fish, Lee's Ferry Floy tag experiment, Colorado River, AZ 1998-99.

Fish number	Date marked	River mile marked	Date recaptured	River mile recaptured	Net movement (miles)	Days at liberty
42	11/5/98	-12.6 R	12/28/98	-12.6 R	0	54
44	11/5/98	-12.6 R	12/5/98	-12.6 R	0	31
69	2/18/99	-8.6 R	3/10/99	-8.6 R	0	20
74	2/18/99	-8.6 R	4/1/99	-8.6 R	0	42
74	2/18/99	-8.6 R	4/21/99	-8.6 R	0	20
106	11/5/98	-12.6 R	1/5/99	-12.6 R	0	181
111	11/5/98	-12.6 R	3/12/99	-12.6 R	0	128
111	11/5/98	-12.6 R	4/13/99	-12.6 R	0	32
111	11/5/98	-12.6 R	8/16/99	-12.6 R	0	125
126	11/13/98	-12.4 R	3/17/99	-11.5 L	-0.9	124
133	11/14/98	-8.6 R	11/21/98	-8.6 R	0	7
142	11/20/98	-14.8 R	11/30/98	-14.8 R	0	10
148	11/20/98	-14.8 R	1/4/99	-14.8 R	0	45
155	11/21/98	-8.6 R	1/7/99	-8.6 R	0	47
162	11/22/98	-12.4 R	12/10/98	-12.4 R	0	18
170	11/23/98	-8.6 R	2/27/99	-8.6 R	0	96
172	11/23/98	-9.3 R	12/30/98	-9.3 R	0	37
173	11/23/98	-9.3 R	2/24/99	-9.3 R	0	93
179	2/28/99	-8.6 R	3/12/99	-8.6 R	0	12
182	2/26/99	-8.6 R	3/29/99	-8.6 R	0	31
184	2/26/99	-8.6 R	3/13/99	-8.6 R	0	15
208	11/29/98	-14.8 R	12/8/98	-14.8 R	0	9
208	11/29/98	-14.8 R	3/29/99	-14.8 R	0	111
269	12/14/98	-12.6 R	2/23/99	-12.6 R	0	71
271	12/14/98	-12.6 R	2/2/99	-12.6 R	0	50
272	12/14/98	-12.6 R	12/31/98	-12.6 R	0	17
272	12/14/98	-12.6 R	1/3/99	-14.8 R	2.2	3
274	12/14/98	-12.6 R	1/5/99	-12.6 R	0	22
276	12/23/98	-14.8 R	1/9/99	-14.8 R	0	17
282	12/25/98	-9.3 R	2/4/99	-9.3 R	0	41
339	1/1/99	-13.1 R	1/22/99	-12.6 R	-0.5	21
405	4/5/99	-8.6 R	5/3/99	-8.6 R	0	28
413	3/26/99	-14.8 R	4/25/99	-14.8 R	0	29
428	2/3/99	-9.3 R	3/29/99	-8.6 R	-0.7	54
428	2/3/99	-9.3 R	4/5/99	-8.6 R	0	7
448	2/1/99	-14.8 R	2/4/99	-14.8 R	0	3
460	12/29/98	-9.3 R	3/15/99	-9.3 R	0	76
461	12/29/98	-9.3 R	1/18/99	-14.8 R	5.5	20
463	12/29/98	-9.3 R	1/18/99	-9.3 R	0	20

Table 1, continued

Fish number	Date marked	River mile marked	Date recaptured	River mile recaptured	Net movement (miles)	Days at liberty
473	12/27/98	-9.3 R	12/30/99	-9.3 R	0	3
474	12/27/98	-9.3 R	3/11/99	-9.3 R	0	74
495	2/5/99	-14.8 R	3/12/99	-14.8 R	0	35
508	11/14/98	-9.3 R	2/27/99	-9.3 R	0	105
577	12/4/98	-12.6 R	12/28/98	-12.6 R	0	24
577	12/4/98	-12.6 R	3/26/99	-12.6 R	0	91
599	12/15/98	-14.8 R	12/21/98	-14.8 R	0	6
611	1/4/99	-14.8 R	1/10/99	-14.8 R	0	6
650	1/25/99	-14.8 R	5/5/99	-14.8 R	0	100
664	1/25/99	-12.6 R	3/28/99	-11.5	-1.1	62
667	1/28/99	-14.8 R	3/30/99	-14.8 R	0	61
718	3/15/99	-8.6 R	3/29/99	-8.6 R	0	14
739	3/28/99	-8.6 R	4/5/99	-8.6 R	0	8
988	4/10/99	-9.8 C	4/27/99	-9.8 C	0	17
995	4/6/99	-9.8 C	7/10/99	-12.6 R	2.8	95
998	4/6/99	-12.6 R	5/2/99	-12.6 R	0	26



GAME & FISH DEPARTMENT

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November 22, 1999

Dr. Barry Gold
Acting Center Chief
Grand Canyon Monitoring and Research Center
2255 N. Gemini Dr., Rm. 341
Flagstaff, AZ 86001

RE: Interim Reports – Snorkel survey
Evaluation of floy tagging experiment

Dear Dr. Gold, *Barry*

Enclosed are two interim reports, submitted in partial fulfillment of our Cooperative Agreement 1425-98-FC-22690. The reports present results of experimental snorkel surveys, and a cooperative venture with the guiding community to Floy tag trout in the Lee's Ferry tailwater. The snorkel survey work was specified in our Cooperative Agreement, and should provide useful information in preparation for the Protocol Evaluation of the Lees Ferry fishery. The Floy tagging experiment with the guides was not specified in our Agreement, but was developed with the advice and assistance of the conceptual model and stock assessment modelers. We feel that with some modification it may hold potential as an additional data collection tool for further development of stock assessment models.

I have also E-mailed these documents as specified in our Cooperative Agreement. If you have any questions concerning these reports, please contact me at (602) 789-3375

Sincerely,

Bill Persons
Research Program Supervisor
bpersons@gf.state.az.us

BP:bp

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Enclosures (2)

Received
Flagstaff, AZ