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July 29, 1991

**MEMORANDUM**

GLEN CANYON ENVIRONMENTAL  
STUDIES OFFICE

**TO:** Dave Wegner, GCES Project Manager  
Bob Williams, Bureau of Reclamation COTR

AUG 9 1991

RECEIVED  
FLAGSTAFF, AZ

**FROM:** Rich Valdez and Bill Masslich

**SUBJECT:** Radio Telemetry Surgical Implant Procedures

**BACKGROUND**

As requested by Dave Wegner on July 24, 1991, we have conducted a preliminary evaluation of surgical procedures being used by BIO/WEST on humpback chub in the Grand Canyon. A tabular summary is attached that identifies the number of fish radioimplanted (1) with midline incision, nonabsorbable sutures, and no needle guide, (2) midline incision, absorbable sutures, and no needle guide, and (3) midline incision, absorbable sutures, with needle guide. We have examined field notes and photographs of fish recaptured at varying periods following implant, and submit the following recommendations and rationale for future surgical procedures.

Seven of 42 (17%) humpback chub radiotagged from October, 1990, to July, 1991, have been recaptured; five by BIO/WEST and two by Arizona Game and Fish. Three of the seven fish (43%) showed initial signs of transmitter expulsion; open or partly-open incision and inflammation around the incision as described by Marty and Sumerfelt, 1986 (Trans. Amer. Fish. Soc. 115:577-589). Although detailed examinations of the fish were not possible to determine exact physiological and histological processes, the condition of tissues and sutures as well as the overall condition of the incision area are consistent with observations by Marty and Summerfelt. The remaining four fish showed varying degrees of healing as well as some inflammation and reddening around the incision and antennae exit, none of which was judged to be seriously detrimental to the fish. We are concerned, of course about the possibility of transmitter expulsion as it affects the fish and as it affects the quality of our data. Recent discussions with GCES and Helen Yard (in charge of surgical procedures for BIO/WEST) as well as a review of literature have brought to light a number of possible actions for evaluating current surgical procedures to identify and correct the problem.





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## FACTORS TO CONSIDER IN RADIOIMPLANT

Some fish may be more predisposed to transmitter expulsion than others from such factors as: (A) bacterial infection via surgical procedures or antenna exit, (B) incision location (midline vs. lateral), (C) transmitter size and weight, (D) transmitter coating, and (E) sex, i.e. gravid females may expel tags during egg development.

A. Bacterial Infection is indicated on at least one fish that died shortly after recapture in January 1991. The areas around the incision and antenna exit were inflamed with redness radiating outward indicating peritonitis. To attempt to prevent this invasion, surgical procedures have included sufficient sutures to insure closure of the incision, and starting in July, 1991, the antenna will be passed through the exit with the aid of a specially-designed sheathed needle designed by BIO/WEST. This technique will minimize the opportunity for bacterial invasion into the peritoneum.

B. Incision Location has received much attention during this evaluation. BIO/WEST has used midline incisions on all fish implanted during this project. Midline incisions are based on the idea that tissues associated with the linea alba are less vascularized, contain fewer nerves, have greater tissue strength and are not associated with large muscle masses. Midline incisions are used and recommended frequently by some researchers, although high expulsion rates have been documented for some species such as channel catfish. Lateral incisions were not tested relative to tag retention in any of the literature reviewed to date.

Lateral incisions are routinely used in the Upper Basin on Colorado squawfish, razorback sucker and humpback chub with good results. Based on observational data of radiotagged fish and a small number of recaptures, no expulsion has not been documented in these species using a lateral incision (Tyus 1988). It must be noted however, that all radiotransmitters were equipped with internal antennae.

C. Transmitter Size and Weight may be a factor in the apparent expulsions. We continue to implant radiotransmitters only when the weight of the transmitter does not exceed 2% of the fish body weight. We have been working closely with the engineers from Advanced Telemetry Systems (ATS) to produce a lighter transmitter with an internal antennae and the signal strength of at least an 11-gm external-antenna transmitter. We recently received two transmitters that each weigh 11.2 gm with internal antennae (7.5 cm long, 1.0 cm diameter). We propose testing these transmitters in parallel with the 11-gm transmitters (6.0 cm long, 1.2 cm diameter) during the August trip to see if it is feasible to use internal antennae transmitters with comparable signal strengths. The external antennae are causing local inflammation and reddening and possibly a path for invasion of the peritoneal cavity.



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- D. Transmitter Coating has not been found to be a factor in expulsion but has been suggested as a possibility. Some researchers coat the transmitters with bees wax to provide an inert coating. We feel that this is unnecessary, adds weight to the transmitters, and the rough surface of the parafin makes sterilization more difficult. Tag manufacturers and veterinarians are confident that the factory coating is a neutral substance that should not encourage rejection.
- E. Sex Of The Fish has been documented as a cause of expulsion that results from expansion of the abdomen during egg development. It is not known if this expansion is greatest at the linea alba or along lateral abdominal muscle groups.

### RECOMMENDATIONS

We feel that it is necessary to evaluate as many of these five factors as possible. We have taken corrective measures to minimize bacterial invasion by incorporating the sheathed needle technique into the antenna exit, and will continue to work with the tag manufacturers to develop an internal-antenna transmitter with sufficient signal strength. We will also continue to monitor evidence of expulsion with both males and females to determine if abdominal expansion is a factor. We feel at this time that the most important variable that needs to be evaluated is incision location (midline vs lateral), and therefore recommend the following:

1. Implant eight fish in September, two with midline incision and six with lateral incision (both groups with absorbable sutures and needle guide).
2. Implant eight fish in November, four with midline incision and four with lateral incision (both groups with absorbable sutures and needle guide).
3. The sixteen fish implanted in September and November combined with the four fish already implanted in July would give us ten fish with midline incisions and ten fish with lateral incisions (all with absorbable sutures and needle guide).
4. An extended effort would be made in November and January to capture as many of these fish as possible to evaluate healing and evidence of expulsion. These results would be in time to incorporate the evaluation into the 1991 Annual Report to be completed in February 1992.

Please comment on these recommendations so we may have enough time to order transmitters and prepare for the August, September and November trips.

cc: M. Yard, H. Yard

Table 1. Summary of BIO/WEST's radioimplant procedures on humpback chub in the Grand Canyon, October, 1990 - July, 1991.

PROCEDURE <sup>a</sup>	OCT	NOV	JAN	MAR	MAY	JUN	JUL	TOTALS
MNN	10(4)	7	7	7(2)	0	0	0	31
MAN	0	0	0	0	3	4	0	7
MAG	0	0	0	0	0	0	4	4
TOTALS	10	7	7	7	3	4	4	42

<sup>a</sup>MNN = midline incision, nonabsorbable sutures, no needle guide

MAN = midline incision, absorbable sutures, no needle guide

MAG = midline incision, absorbable sutures, with needle guide

<sup>b</sup>all radiotransmitters with external antennae, weighed 11 gm except as indicated in parentheses, i.e. 4 of 10 fish in October received 9 gm transmitters.