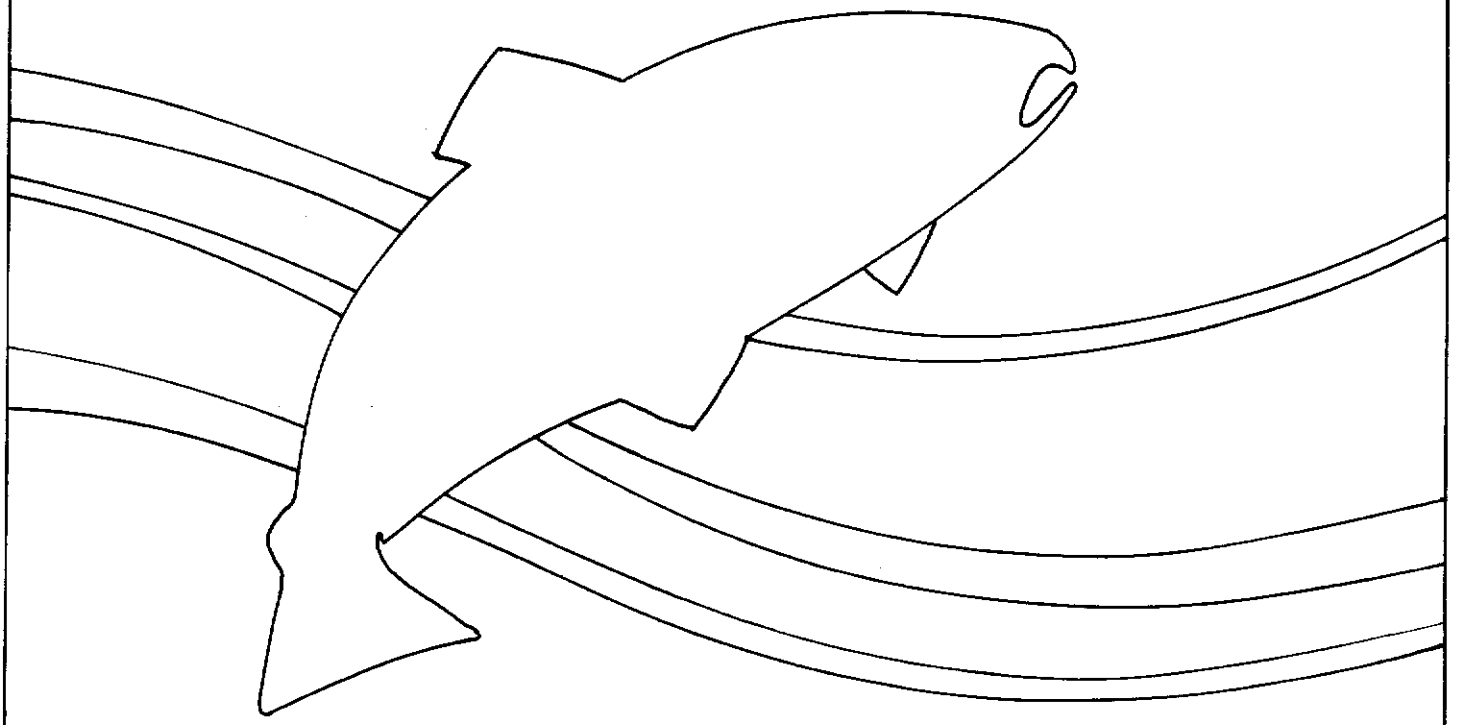
EVALUATION OF "HALF-LENGTH" BINARY CODED WIRE TAG APPLICATION IN JUVENILE CHUM SALMON

A Cooperative Study by:
U.S. FISH AND WILDLIFE SERVICE
PORT GAMBLE KLALLAM TRIBE
NORTHWEST MARINE TECHNOLOGY



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EVALUATION OF "HALF-LENGTH" BINARY CODED WIRE TAG APPLICATION IN JUVENILE CHUM SALMON

by

Jeffrey D. Opdycke and David P. Zajac

U.S. Fish and Wildlife Service
Fisheries Assistance Office
2625 Parkmont Lane, Bldg. A
Olympia, Washington 98502

ABSTRACT: Two consecutive brood years of chum salmon *(Oncorhynchus keta)* were tagged with 0.5 mm long binary coded wire tags (half-tags) and visually marked by removing the adipose fin on fish which were at a size of 0.8 g/fish. Tagging fish at this size required twice the time normally needed to tag fish larger than 1.8 g/fish (a size restriction inherent with use of the original - 1.0 mm long - binary coded wire tag). Tag loss 21 days after tagging was 34% in the 1977 brood and 1% in the 1978 brood. Tag-associated mortality was negligible in both broods.

The Jefferts-Bergman binary coded wire tag (Jefferts et al., 1963) has been used extensively in recent years for the specific identification of juvenile salmon and steelhead trout *(Salmo gairdnerii)*. The minute stainless steel tags (1.0 mm long and 0.1 mm in diameter), Figure 1, implanted in the snouts of fish, have proven to be an effective tool to assess rearing techniques and aid in harvest management. Fish can be tagged swiftly and accurately with little or no tag associated mortality, and tag loss generally does not exceed 10%. The original 1.0 mm long full length tag can only be used in fish larger than 1.8 g due to limitations imposed by the size of the tag relative to the optimum implantation area in the snout. Therefore, in order to use this particular type of identification on species routinely released smaller than 1.8 g/fish, such as chum salmon *(Oncorhynchus keta)*, the fish have to be reared to a larger release size.

To overcome the size limitations of the original 1.0 mm long coded wire tag (CWT), Drs. Keith and Elaine Jefferts of Northwest Marine Technology* devised a binary CWT made of the same diameter stainless steel wire but only half as long, naming it the "half-tag".

This study was designed to determine the feasibility of implanting half-tags in juvenile chum salmon at a size of 0.8 g/fish using the mass production system presently used routinely in full length coded wire tagging. Three parameters of performance were investigated: The percent of tag loss before and after release of the fish into saltwater; the efficiency of handling such small fish, i.e., the cost effectiveness of half-tagging compared with acceptable full length tagging of fish larger than 1.8 g/fish under similar conditions; and the effects of the tag and associated implantation procedures on fish health.

Rearing facilities for the fish used in the study were provided by the Port Gamble Klallam Tribe. Located on Port Gamble Bay, Washington (Figure 2), the facility combines fresh water ponds and raceways with floating net-pens close offshore for extended saltwater rearing. At this particular site, tag loss could be monitored through the change from fresh to saltwater and over and extended saltwater rearing period.

METHODS

A mobile tagging unit similar to others commonly operated by fisheries agencies on the west coast of the United States (Figure 3) was used for this evaluation so that the results of the study could be compared with data from full length tagging operations. The mobile tagging unit contains five sets of tagging equipment, fish holding tanks, a recirculating anesthetic system, and a water fish-transport system. Fresh water is constantly pumped through the holding and transporting systems to minimize temperature and oxygen stress.

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* The U.S. Fish & Wildlife Service makes no endorsements of commercial products.

Figure 1. - *Full length tags.*

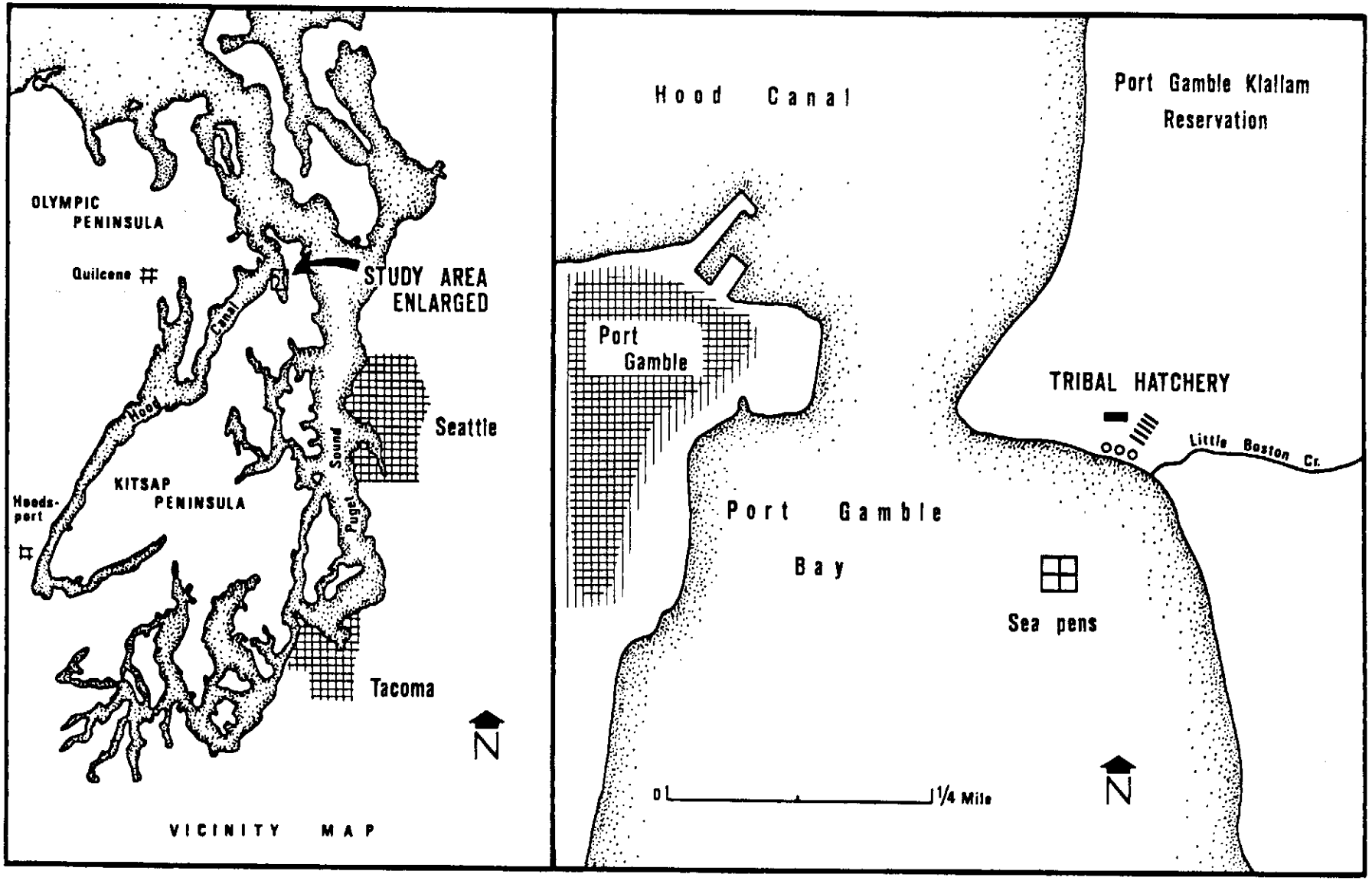

FIGURE 2. - *Location of chum tagging studies.*

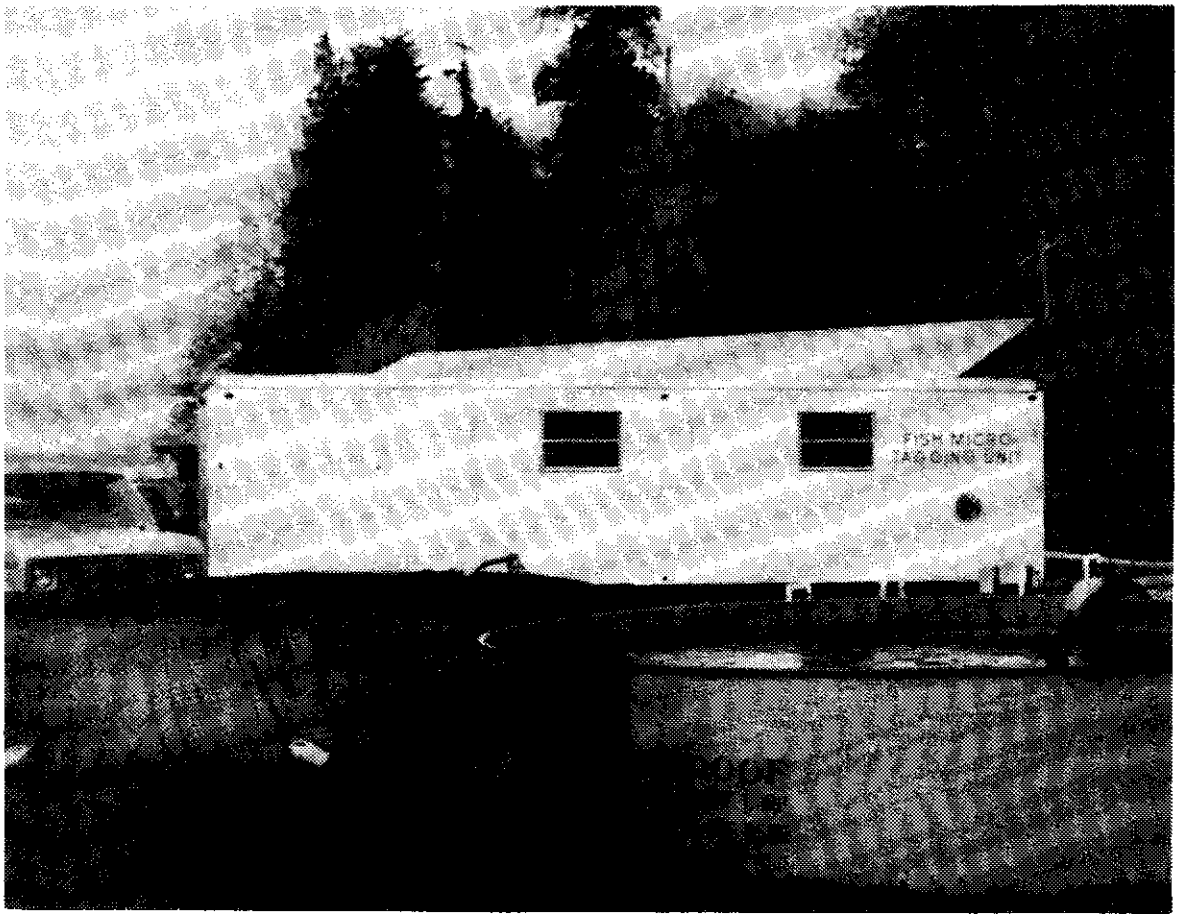

Figure 3. - *Mobile tagging unit operated by Fisheries Assistance Office, Olympia, at the Port Gamble Klallam Tribe rearing facility.*

Both tag injection and adipose fin removal were accomplished at each of three work stations utilized for this study. Fish were netted from the freshwater holding tank adjacent to each tagging station and immersed in an anesthetic bath of Tricaine Methanesulfonate (MS-222) diluted to a concentration of 100 mg/l. After the fish were anesthetized, their adipose fins were removed using surgical scissors. The fish were then placed in a freshwater bath, tagged before regaining consciousness (Figure 4), and passed via water transport through a quality control device (QCD). Inside the QCD, the tag within each fish was magnetized, and the fish passed through a magnetic field detector. If a magnetized tag was detected by the QCD, the fish was shunted to the hatchery raceway. If no tag was detected, it meant that the fish either possessed no tag at all or that it possessed a tag with no detectable magnetic field. In either case, the fish was rejected and shunted back to the tagging station for reprocessing.

The 1977 brood experiment, referred to as Study I, was performed in 1978. A total of 13,864 fish at 0.8 g/fish were tagged in this study. An inexperienced labor force was employed from the area, as is often the case in tagging operations of this type. Workers were oriented and trained during the first day of tagging. A vibriosis *(Vibrio anguillarum)* outbreak during the saltwater rearing period was anticipated, therefore the fish were vaccinated using an immersion method. The vaccination was performed the day after completion of the tagging operation.

Evaluation of the 1978 brood chum, referred to as Study II, was accomplished in 1979. A total of 20,311 fish were tagged at a size of 0.8 g/fish. Vaccination procedures were the same as in Study I; however, the vaccine was adminstered 3 days prior to the tagging operation. Labor was comprised of Fish and Wildife Service employees with prior experience in full-length coded wire tagging.

Head-molds (sculpted forms into which the heads of the fish are positioned during tag injection) are considered to be a very critical factor in keeping tag loss to a minimum. The same head-molds were used for both studies and were constructed using actual fish heads as forms. This is the same technique used in manufacturing head-molds used in full-length tagging operations (Tivel, 1978).

Sampling for tag loss began the day following completion of tagging in each study. The fish were allowed to recover from stress of tagging and anesthesia in fresh water until day 5. On day 5 they were transferred by barge to the saltwater net-pens offshore.

Figure 4. - *Chum salmon positioned for half-length coded wire tag injection. Fish weight is 0.8 g.*

On sampling days 1, 5, 7, 14, 21, and in the case of Study II, on additional days 28, 35, and 41, the fish were randomly sampled for tag loss using a uniform procedure. Between 1,000 and 2,000 fish were processed on each sampling day. Random sampling from the net-pen was assured by drawing the net to the surface to make all fish accessible to capture. All areas of the pen were sampled. The fish were anesthetized in MS-222 and tested individually through a magnetic field detector. If no magnetism was detected, the fish were passed through the field of a powerful magnet to remagnetize the tag in the event that the fish did possess a tag but one that had not been magnetized. The fish were again tested through the magnetic field detector. All fish failing this test were killed and the heads cut off and dissolved in a 50% solution of potassium hydroxide. A bar magnet was later passed through the slurry to remove any remaining tags.

RESULTS

Tag loss varied dramatically between Study I and Study II. Results of the post tagging test period are presented in Table 1. Tag loss value on day 14, Study I, was probably the result of poor detection procedure on that particular day rather than biased sampling, as very few fish were left in the pen at this point and random sampling was easily assured. As seen in Table 1, the number of tags requiring remagnetization during sampling also varied between studies. This was a considerable problem in Study I and occurred because the pipe conveying tagged fish through the ring magnet within the QCD was designed for larger fish. To effectively magnetize the tag, fish passing through the ring magnet must go through head or tail first, orienting the long axis of the tag perpendicular to the magnetic field. The very small fish used in this study were not restricted to perpendicular travel through the field because of the large relative size of the transfer pipe. Study II showed a substantially lower number of non-magnetized tags as a result of the installation of a smaller diameter transfer pipe from the tag injector through the QCD.

Tagging speed, by comparison with values normally experienced in full-length tagging, was slower for both Study I and Study II. Study I tagging speed averaged 241 fish tagged/injector hour while Study II averaged 459 fish tagged/injector hour. In comparison, average speed for full-length tagging is approximately 800 fish tagged/injector hour.

Tagging-associated mortility was negligible in both studies and fish health was not affected by the procedure or the tags themselves. The majority of the study fish ultimately died from vibriosis as an effect of the extended saltwater rearing environment.

DISCUSSION

These studies have indicated that the half-length CWT is a feasible marking tool from the standpoint of tag-induced mortality, speed of handling and processing, and the level of tag loss.

Tag injection and presence of the tag in fish for a long period of time had a negligible effect on pre-liberation survival. Normal raceway crowding and dip-netting procedures caused some mortality but no more than experienced when handling larger fish in a similar fashion.

The speed at which fish could be processed was, as expected, slower than tagging larger fish. This was strictly a human factor and not machine related. We found that a crew with prior training and experience performed faster than a crew trained on-the-spot with no prior experience. At best, half-tagging fish the size used in this evaluation will take approximately twice as long to accomplish as full-length tagging. Diligence and attention to detail must be stressed even more while half-tagging than during the full-length tagging process.

Tag loss values varied drastically between the two studies. This difference can be attributed to either the expertise of the tagging crew, time of the vaccination procedure relative to tagging, or a combination of the two. All other experimental parameters were the same in both studies.

Just as speed of handling is affected by tagging crew expertise, so is the accuracy of tag placement. Minor errors in fish positioning and injection timing can place the tag too near the skin surface. For example, the results of sampling on day 1 during Study I showed that the tags were indeed injected into the snout of all the fish but as time went on, tags were continuously shed as the wounds healed. These tag injection problems may be reduced by using an experienced, well- trained crew.

Vaccinating fish during Study I, the day after the completion of tagging, could have aggravated or directly contributed to the observed tag loss. Dipnetting large numbers of such small fish with fresh wounds from tag injection could have forced tags closer to the skin and accelerated tag shedding during the healing process.

RECOMMENDATIONS

1. If possible, use only experienced, diligent employees to perform half-tag implantation.

2. Do not crowd or dipnet freshly half-tagged fish. The fish should be allowed to recover sufficiently from the tagging process before transfer or release.

3. Check tag placement often during the day and watch the marking personnel carefully to reduce errors in the injection procedure.

4. Sample the tagged population periodically for at least 10 days. It is clear from the results of Study I that tag loss can continue over a long period of time. Establishing a trend over time can be very important in judging the accuracy of the number of tags in the population. If fish must be released before this time interval is reached, an expendable subsample of 1,000 - 2,000 tagged fish should be kept past this date in order to establish a more accurate tag loss figure.

5. Because tag loss can vary so widely when using half-tags on 0.8 g chum salmon, future experiments utilizing the tag should be designed to accept a substantial variation in this parameter.

Table 1. Half-tag loss in chum salmon tagged at a size of 0.8 g/fish during two study periods.

Sampling Day	Number of Fish Sampled	Tags Initially Detected	Tags Detected after Remagnetization	Tags Recovered by KOH Digestion	Total Tags Lost	Percent Tags Lost
			STUDY I - 1978			
1	1653	1389	264	0	0	0
5	1537	1220	95	6	216	14
7	1397	855	127	26	389	28
14	1352	925	191	1	235	17
21	1164	617	133	20	394	34
			STUDY II - 1979			
1	2056	2029	3	0	24	1
5	1964	1935	1	0	28	1
7	2049	2016	0	0	33	2
14	2084	2047	0	0	37	2
21	2022	1987	7	0	28	1
28	2046	2012	8	0	26	1
35	2015	1968	3	0	44	2
41	2061	2014	0	2	45	2

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