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DRILL SAMPLING DEVICE FOR FISH LIVERS*

I. CONSTRUCTIONAL DETAILS

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Since publication of the article "Preliminary Report on a Drill Sampling Device for Fish Livers[1]," constructional details have been modified to improve the operation of the sampler, and considerable experience in its use has demonstrated that the device is practical for commercial adaptation. Another report[2] gives instructions and precautions for more effective use of the sampler described here.

The sampler is designed specifically for use with livers in the standard five-gallon can employed on the Pacific Coast. Where the livers to be sampled are in containers of another size, appropriate modifications in the length and possibly other details of the sampler will have to be made. The design described here has given good results on fresh, unfrozen livers, and it will work well with soft-frozen livers. Sampling of hard-frozen livers, however, would require a more powerful motor.

The sampler (Figures 1 and 2) consists of five essential parts:

1. Drive unit.
2. Auger for removing cores.
3. Tube to enclose auger and direct cores into sample bottle.
4. Sample bottle to receive cores.
5. Guard to prevent auger from contacting bottom of liver can.

The drive unit is a standard model, $\frac{1}{4}$ inch, heavy duty, electric drill with a rated speed of 1750 R.P.M. This type drill is particularly well adapted for use with the sampler because there is a convenient handle by which the device may be manipulated. Also the hous-

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* This leaflet supersedes Sep. 84, a reprint from Fishery Market News, November 1944, pages 6-11.
1/ Sep. 66, a reprint from Fishery Market News, May 1944, pages 9-10.
2/ "Drill Sampling Device for Fish Livers," II. INSTRUCTIONS FOR USE. (This leaflet, page 4).

ing just above the chuck is cylindrical in form, and machined true so that the clamp of the sampler tube may be readily attached or removed. It is important to choose a drill of light weight with the maximum power available within the given size. A $\frac{1}{4}$ inch, heavy duty drill of the best quality will give better service and have a more advantageous power:weight ratio than will a cheaper drill.

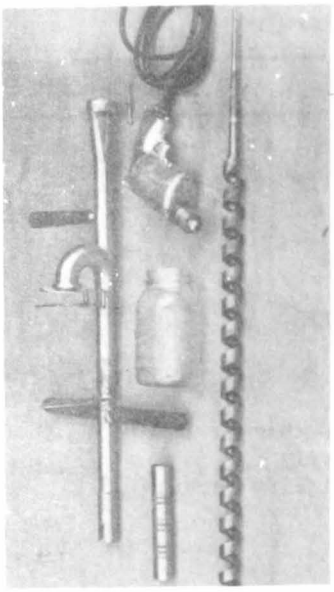

Figure 1
Fish liver sampler
unassembled.

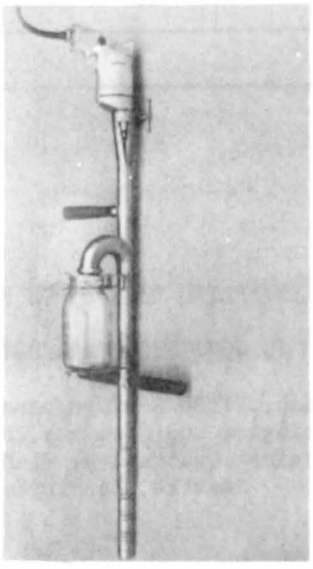

Figure 2
Fish liver sampler
assembled.

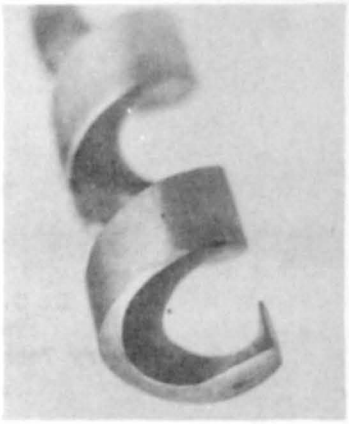

Figure 3
Tip of auger.

The auger employed is of the snip auger type, with single spiral and cutting edge, and without a screw. The auger is ground in such a way that the cutting edge projects well ahead of the heel (Figure 3). The shape of the tip of this cutting edge is of importance to the proper operation of the sampler. With the single spiral ship auger the heel normally recedes rapidly and little alteration will be necessary. On some augers, however, the edge is but little in advance of the heel, and the liver material is held away from the cutting edge. Grinding back the heel allows the liver material to rise ahead of the cutting edge, which should be honed as keen as possible, so that the liver fibers may readily be cut and will be less likely to wind around the auger.

The auger (shown in Figures 1, 3, and 4) is the 1-3/16-inch size with a spiral length of 24 inches. In order to facilitate insertion of the auger tip into the sampler tube, the clearance oversize portion at the tip--the only part of the auger that is 1-3/16 inches in diameter--is filed to conform to the 1-1/8-inch diameter of the spiral section. The shank of the auger is tapered gradually from the spiral to the point where the shank, $\frac{1}{4}$ inch in diameter, enters the wooden plug in the top of the sampler. The taper allows the liver fibers that may wrap around the shank to be forced upward beyond the discharge opening by the rising liver material without clogging the outlet. A four-inch space is available above the discharge opening to accommodate the accumulation of fibrous materials. Such an arrangement reduces the number of stoppages necessary to clear the auger during sampling. The material which evades the sample bottle, by being carried into this space at the top of the sampler tube, is less than one percent of the total material passing through the sampler and does not significantly bias the sample collected.

The tube used to house the auger is of 18-gauge mild steel stock tubing with an inside diameter of approximately 1-1/8 inches. Since it is important that there be no excessive clearance between the auger and the side wall, the tubing should be of such diameter that the auger will just slide within the tube. If there is any appreciable play, the liver material and oil will slip by the flights of the spiral and the elevation of the material will not be efficient. A close fit also eliminates vibration of the auger.

The lower end of the tube is provided with a detachable section to facilitate both the insertion and withdrawal of the auger and the removal of such liver fibers as may have fouled

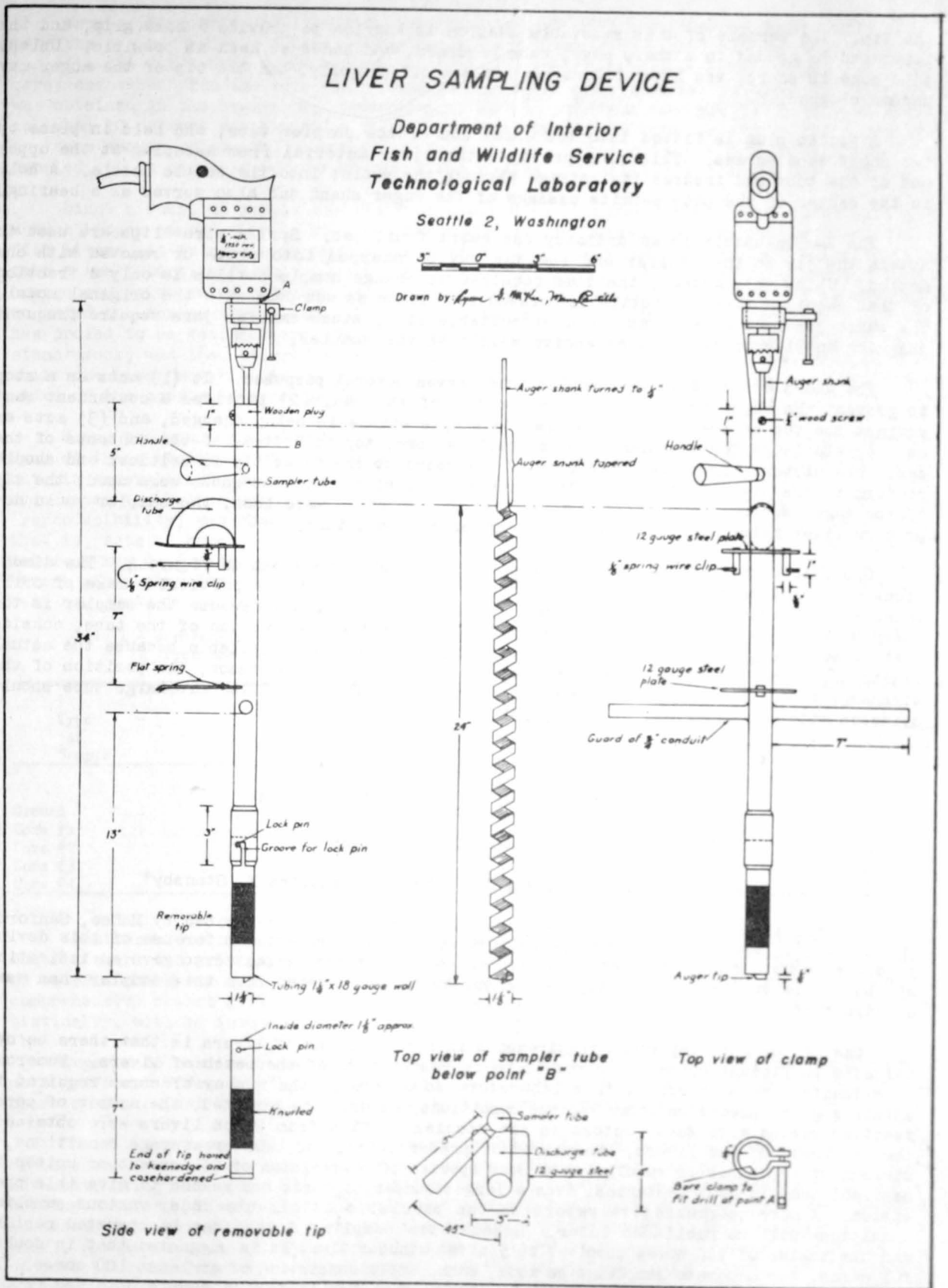

Figure 4 - Detailed drawing of liver sampler.

the tip. The surface of this removable section is knurled to provide a hand grip, and the lower end is ground to a sharp edge, case hardened, and honed as keen as possible. Unless this edge is sharp, the liver fibers are not cut off properly, and the tip of the auger may become clogged.

A wooden plug is fitted into the upper end of the sampler tube, and held in place by two short wood screws. This plug prevents the liver material from escaping at the upper end of the tube and insures its passage through the outlet into the sample bottle. A hole in the center of the plug permits passage of the auger shank and also serves as a bearing.

The sample bottle is an ordinary one quart fruit jar. Spring wire clips are used to attach the jar to the sampler and the jar may be snapped into place or removed with one motion. Using this method, the time required to change sample bottles is only a fraction of that required when the bottle is screwed into place as was done with the original model. The quart jar is suggested as the most suitable size, since smaller jars require frequent changing and larger jars add excessive weight to the sampler.

The guard attached to the sampler tube serves several purposes. It (1) acts as a stop to prevent the auger from striking the bottom of the can, (2) provides a convenient rest against the top of the liver can while the sample bottle is being changed, and (3) acts as an accurate gauge for procurement of a complete core, top to bottom, of the contents of the can. The distance from the lower edge of the guard to the auger tip is critical and should conform to the dimensions given. If a greater dimension than that shown were used, the tip of the auger would strike the bottom of the can and if it were less, the sampler would not procure liver material from near the bottom of the container.

Specific details of the several parts of the sampler are given in Figure 4. The dimensions of the clamp will vary, depending upon the housing of the particular make of drill selected. The handle on the upper part of the tube is essential because the sampler is too heavy to be operated by the use of one hand alone. In the construction of the tube, consideration must be given to the dimensions of the particular auger available because the actual length of the spiral varies from one auger to another. For this reason, the position of the discharge tube must conform to the auger being used. The top of the discharge tube should coincide with the upper end of the spiral.

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DRILL SAMPLING DEVICE FOR FISH LIVERS

II. INSTRUCTIONS FOR USE

F. Bruce Sanford, Glenn C. Bucher, and Maurice E. Stansby*

Constructional details of a fish liver sampler have been described by McKee, Sanford, and Bucher[1/]. The present report gives instructions and precautions for use of this device in order to obtain most accurate results, and some data are presented to give an indication of the precision (reproducibility) and accuracy to be expected from this sampler when used as directed.

One of the most important requirements in core sampling of livers is that there be obtained a sufficient number of cores to be representative of the batch of livers. Numerous experiments have been run at this laboratory to determine the number of cores required to attain a given precision under various conditions. As would be expected, the number of cores required varied with such factors as the species of fish from which livers were obtained, the freshness of the livers, the method of preservation, etc. Under average conditions, a minimum of 100 cores is required with most species if a precision of 95 percent or better is desired, and, in many instances, even a larger number of cores are needed to give this precision. A more comprehensive report on the precision attainable under various sampling conditions will be published later. Because the sampling device can be operated rapidly and the taking of 100 cores involves only a few minutes time, it is suggested that in doubtful cases, two separate samplings be made, each sample consisting of at least 100 cores. If satisfactory agreement is not obtained between such duplicates, a sample obtained from a larger number of cores should be taken.

* Chemists, Seattle Fishery Technological Laboratory. Acknowledgment is made to Manuel Cantillo, Fishery Fellowship Student, for assistance in procurement and analysis of a portion of the samples.

1/L. G. McKee, F. B. Sanford, and G. C. Bucher, "Drill Sampling Device for Fish Livers," I. CONSTRUCTIONAL DETAILS. (This leaflet, page 1).

When a small batch of livers is being sampled, it will sometimes be found difficult to take the desired number of cores. For example, if as many as nine cores are taken from one can with the 1-1/8-inch sampler, the livers lose their firmness so that when additional cores are taken from the same can, a smaller amount of liver material is taken per core than was obtained in the beginning. Accordingly, when 10 or fewer cans are to be sampled, (that is, when 10 or more cores must be taken from each can) precautions must be taken to see that the same amount of sample is removed from each can. When only one or two cans are to be sampled, it is probably better to grind the entire lot of livers using a meat grinder.

Since a quart of sample results from about 8 to 10 cores, 100 or more cores will give a much larger sample than is required for analytical purposes. In view of the high cost of fish livers, it is necessary to mix the cores until a homogeneous sample is obtained and then take a small portion (usually 1 or 2 pints) for analysis. In order to be certain that a homogeneous mixture is obtained before taking the final analytical sample, it is advisable to grind the cores before mixing. For this purpose, a small electrically-operated meat grinder has proved to be satisfactory. The cores are ground into a large vessel, such as a 12-gallon stone crock, and then stirred vigorously. The small aliquot sample for analysis is taken while the liver material is being stirred. This ensures that the final sample is representative of the composite cored material.

Using the technique described, a large number of batches of fish livers have been sampled. Many of these consisted of 100 or more cans. In most cases, the livers were in good condition, but, in several instances, cans having a considerable amount of free oil have been sampled. Even under the latter conditions, good precision and accuracy were obtained. Precision (reproducibility) was checked by comparing the results of analyses of duplicate samples, that is, sets of cores, from the same batch of livers. In a few instances, the degree of accuracy was determined by also analyzing a representative sample of the entire batch of livers after they had been ground, just prior to processing. Results from such an accuracy test are shown in Table 1.

Table 1 - Accuracy and Precision (reproducibility) when one core was taken for each sample from each of 100 5-gallon cans of soupfin shark (Galeorhinus zyopterus) livers by means of sampler with 1-1/8-inch auger

Type of Sample	Oil		Liver	Relative Deviation of Drill Sample from Ground Sample		
	Content	Vitamin A per gram	Vitamin A per lb.	Oil Content	Vitamin A Per gm. oil	Vitamin A Per lb. liver
	Percent	U.S.P. units	Millions of U.S.P. units	Percent	Percent	Percent
Ground	64.2	60,000	17.5	-	-	-
Core #1	66.4	57,100	17.3	3.4	4.8	1.1
Core #2	67.0	56,500	17.2	4.3	5.8	1.7
Core #3	65.5	60,800	18.1	2.0	1.3	3.4
Core #4	64.5	59,900	17.6	0.5	0.1	0.6

Considerable work has been done on the precision of the sampler involving many lots of soupfin shark and grayfish (dogfish) livers, as well as a limited amount of lingcod. Results on soupfin shark and grayfish are at least as precise as those indicated in Table 1. A comprehensive report giving details of other experiments, including full data treated statistically, will be issued shortly.

Experience has indicated that minor variations in the manipulation of the sampler have no significant effect on the accuracy and precision of the method. Thus, the individual operator can adjust his exact procedure to his own convenience.

The authors have found that it is most practical to obtain the entire sample in a more or less continuous operation, inserting and removing the sampler with a regular rhythmic movement, going from container to container without interruption, except to change the receiving bottles. The motor is usually not stopped until the whole lot has been sampled. In addition to being least tiring for the operator, this procedure yields cores of uniform size. (Otherwise, the amount of sample taken in each core varies inversely with the rate of inserting the sampler.) In ordinary operations with firm fresh livers, about 5 seconds is taken to obtain a single core. The weight of the sampler is more than sufficient to drive it into fresh or soft-frozen livers; therefore, the operator must hold back the device at all times.

In order to preclude the possibility of errors due to unethical practices such as "packing" or "stovepiping," the cores should be taken at a variety of locations and angles. Although the device is constructed to prevent piercing the bottom of the can, care must be taken to avoid running the sampler through the side.

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