



Utilization of the mountain whitefish *Coregonus Williamsoni* in Montana
by John J Gaffney

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for a degree of
Master of Science in Fish and Wildlife Management
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Abstract:

The mountain whitefish (*Coregonus williamsoni*) is one of the most abundant cold water game fish in Montana. It is associated with several species of trout in the three major drainages: Columbia, Missouri and Saskatchewan. Although it is gamey and has palatable flesh, it has been little utilized by fishermen. The most intensive fishery on this species occurs in the winter when trout fishing is prohibited. A study was conducted from July 1952-to March 1954 to obtain information on distribution, abundance, effective methods of capture and methods of utilization including preparation, cooking and smoking. Illustrations are included to supplement descriptions of techniques.

This whitefish is found in most of the cold waters that drain the western half of the state. It is most abundant in the larger rivers and lower portions of primary tributaries but also occurs less commonly in secondary "tributaries and "headwater streams. A fly rod was useful for taking whitefish during the summer but a cane pole was more satisfactory during the winter. Whitefish are taken on live bait during all seasons and on artificial flies during the summer. Effective live baits were Plecoptera nymphs, maggots, earthworms and grasshoppers. Artificial flies tied on small hooks were most effective. The color or pattern of the fly was found to be of minor importance. Experiments were conducted to test the palatability of whitefish as compared to trout. The white-fish were rated favorably but trout were rated higher in some categories. Three types of units were found to be satisfactory for smoking whitefish and smoking methods are given. The information obtained in this study will be made available to the fishing public in order to encourage greater utilization of this game fish.

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IN MONTANA

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ABSTRACT

The mountain whitefish (Coregonus williamsoni) is one of the most abundant cold water game fish in Montana. It is associated with several species of trout in the three major drainages: Columbia, Missouri and Saskatchewan. Although it is gamey and has palatable flesh, it has been little utilized by fishermen. The most intensive fishery on this species occurs in the winter when trout fishing is prohibited. A study was conducted from July 1952 to March 1954 to obtain information on distribution, abundance, effective methods of capture and methods of utilization including preparation, cooking and smoking. Illustrations are included to supplement descriptions of techniques.

This whitefish is found in most of the cold waters that drain the western half of the state. It is most abundant in the larger rivers and lower portions of primary tributaries but also occurs less commonly in secondary tributaries and headwater streams. A fly rod was useful for taking whitefish during the summer but a cane pole was more satisfactory during the winter. Whitefish are taken on live bait during all seasons and on artificial flies during the summer. Effective live baits were Plecoptera nymphs, maggots, earthworms and grasshoppers. Artificial flies tied on small hooks were most effective. The color or pattern of the fly was found to be of minor importance. Experiments were conducted to test the palatability of whitefish as compared to trout. The whitefish were rated favorably but trout were rated higher in some categories. Three types of units were found to be satisfactory for smoking whitefish and smoking methods are given. The information obtained in this study will be made available to the fishing public in order to encourage greater utilization of this game fish.

INTRODUCTION

The range of the mountain whitefish (Coregonus williamsoni) includes the cold water streams and lakes on both sides of the Continental Divide from Alaska southward to the headwaters of the Colorado River. In Montana this whitefish is native in all three major drainages: Columbia, Missouri and Saskatchewan. Other game fish native in these waters are the cutthroat trout (Salmo clarkii) in all drainages, the American grayling (Thymallus signifer) in the headwaters of the Missouri drainage and the dolly varden (Salvelinus malma) in the Columbia drainage. Introductions of rainbow trout (Salmo gairdneri), brown trout (Salmo trutta) and eastern brook trout (Salvelinus fontinalis) have been made in most cold waters. Kokanee (Oncorhynchus nerka kennerlyi), lake trout (Cristivomer namaycush) and lake whitefish (Coregonus clupeaformis) have also been introduced into a few lakes containing mountain whitefish and other native species. Competition from these exotics, fishing pressure and conditions resulting from agricultural and industrial developments have greatly reduced the distribution and abundance of the cutthroat trout, dolly varden and American grayling. The mountain whitefish has been successful in coping with these changes and is probably the most abundant cold water game fish in Montana at the present time.

Although the mountain whitefish is gamey and has palatable flesh, it has been little utilized by most Montana fishermen who are primarily interested in trout. Inadequate utilization of this whitefish has also been reported in California (Dill and Shapavalov, 1939), in Utah (Sigler,

1951) and in Wyoming (Simon, 1946 and Eiserman, 1951). There is a growing interest in the mountain whitefish as a game and food fish in Montana (Brown, 1952). This is evidenced by a steady increase in the number of fishermen participating in the winter fishery. Winter fishing is primarily for mountain whitefish since regulations prohibit trout fishing except in a few streams where a daily limit may include one trout.

Because trout are still abundant enough to furnish good fishing, the mountain whitefish is often returned to the water or otherwise discarded. The inadequate harvest of this species has given it an advantage in competition with trout. Laakso (1951) reported some food competition between mountain whitefish and trout.

The present study was undertaken to encourage greater utilization of this fish by providing fishermen with information on: distribution and abundance, effective methods of capture and methods of preparation including skinning, filleting, smoking and cooking. In addition, an experiment was conducted testing the palatability of mountain whitefish as compared to trout.

Most Montana fishermen can readily identify the mountain whitefish but some do not recognize this fish. It is closely related to the trout but it is not likely to be confused with this group. It is usually misidentified as an American grayling (Thymallus signifer) or the common sucker (Catostomus sp.). It may also be confused with the lake whitefish (Coregonus clupeaformis), Columbia river chub (Mylocheilus caurinus) or the squawfish (Ptychocheilus oregonensis). The mountain whitefish can be

distinguished by the following characteristics: adipose fin, dorsal fin - 11 to 14 rays, a single fold of skin in the nostril, upper jaw projecting beyond the lower, the maxillary not reaching beyond a vertical line drawn from the anterior margin of the eye (Fig. 1).

Acknowledgements

The author expresses appreciation to the Sport Fishing Institute for financial assistance provided through a Research Fellowship. Sincere thanks are also extended to Dr. C. J. D. Brown who suggested and directed the study and assisted in preparation of the manuscript. Mrs. Helen L. Mayfield of the Agricultural Experiment Station Home Economics Department generously contributed much time in the supervision of palatability tests and in the development of methods of preparing mountain whitefish for table use. Thanks are also due Mr. Vernon E. Craig of the Montana Fish and Game Department for preparation of illustrations. Much information was provided by fishermen, custom smoke house operators, bait dealers and state fish and game personnel. Their cooperation is greatly appreciated.

DISTRIBUTION AND ABUNDANCE

Information on the distribution and abundance of mountain whitefish in Montana was obtained from fisheries biologists, game wardens and fishermen. This fish is found in most of the cold water streams and lakes that drain the western half of the state. It is most abundant in the larger rivers and the lower portions of primary tributaries but is found less commonly in many of the secondary tributaries and headwater

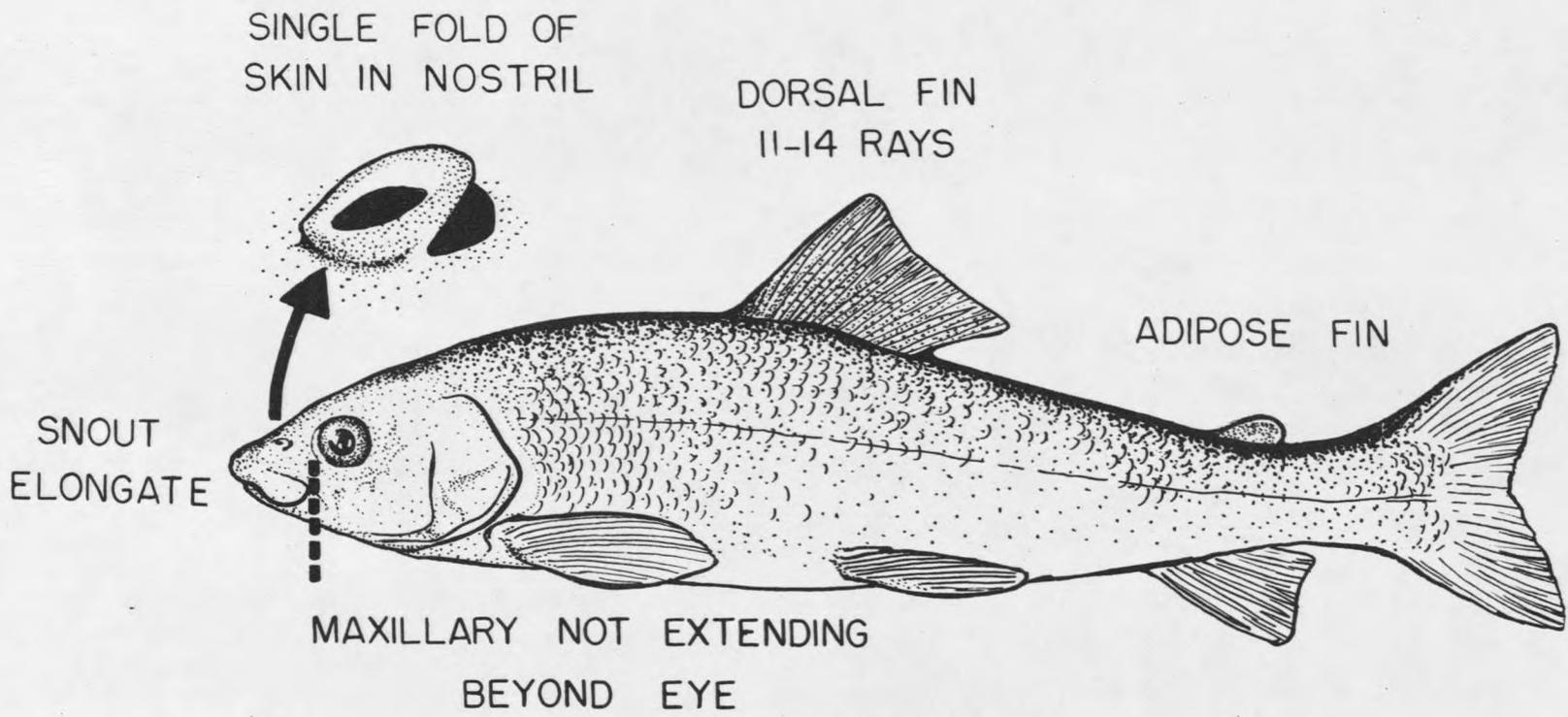


FIG. I CHARACTERISTICS OF THE MOUNTAIN WHITEFISH

streams. The distribution and abundance of this fish in the various waters of Montana is shown in Figure 2.

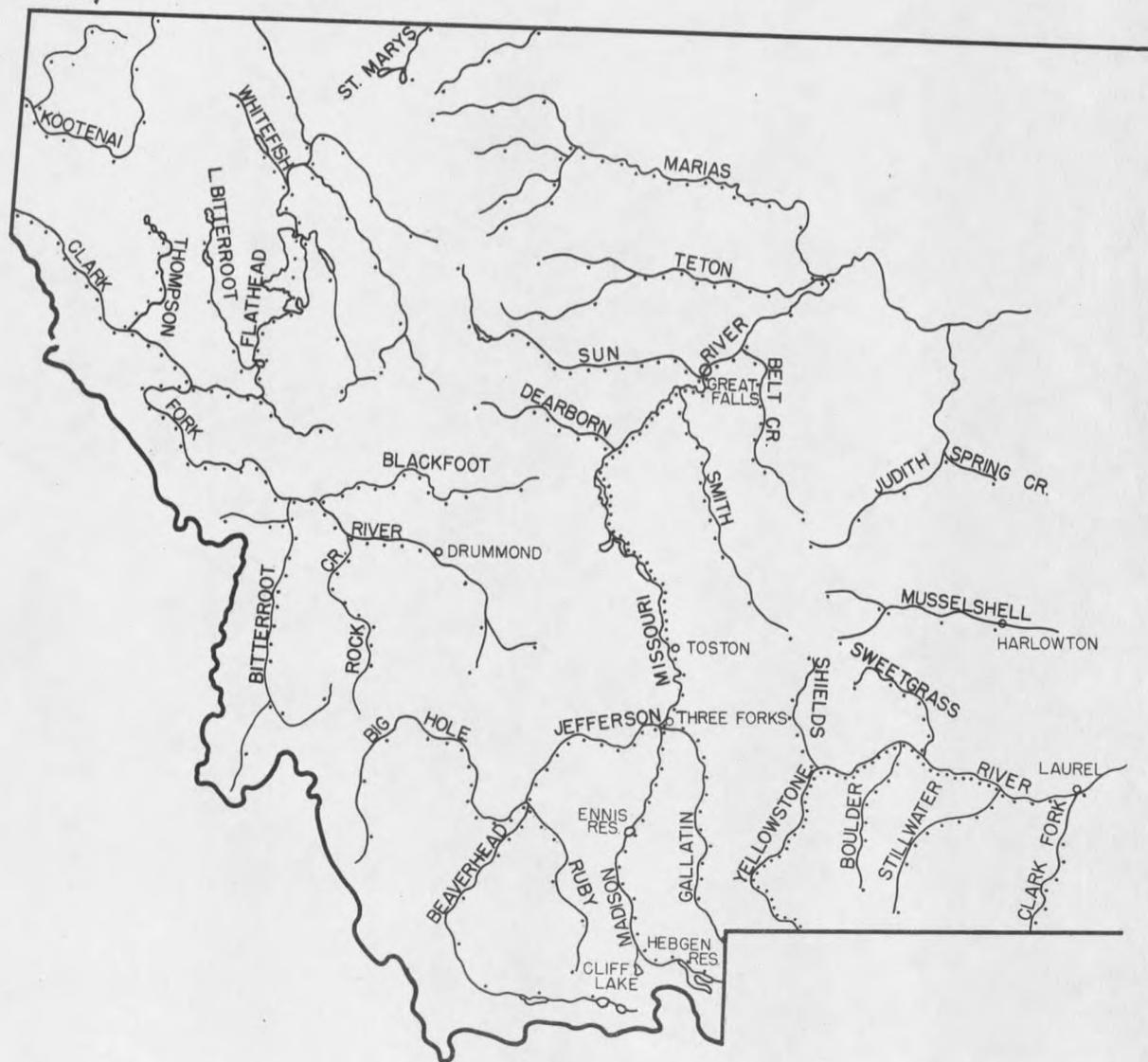
Missouri Drainage

The mountain whitefish is common in the Missouri River between Three Forks and Toston, abundant between Toston and Great Falls and has been reported as far downstream as the mouth of the Marias River. It is common in the Missouri River reservoirs above Great Falls and is also found in many tributaries of the Missouri.

The Yellowstone River is well known for the mountain whitefish it produces between Gardiner and Columbus. The 1950 creel census shows an average catch of about four fish per hour in this area. This whitefish is taken as far downstream as Laurel and occurs in the following tributaries: Clark Fork, Stillwater, Sweetgrass, Boulder and Shields. It is little utilized in these streams except the Clark Fork.

Creel census records show that whitefish are taken from the Musselshell River above Harlowton and from the Judith River above the Spring Creek tributary.

This fish is common in other Missouri River tributaries as follows: Marias River, Teton River, Belt Creek, Sun River, Smith River and Dearborn River but is little utilized in these streams. It is also common in the Gallatin River and its two main branches. Considerable numbers are present in the Madison River and its reservoirs. Mountain whitefish were introduced into Cliff Lake and have become very numerous. Abundant populations are present in the Jefferson River and the fish is common in the



LEGEND

- ABUNDANT.....
- COMMON.....
- FEW.....

FIG. 2. DISTRIBUTION AND ABUNDANCE OF MOUNTAIN WHITEFISH IN MONTANA

Big Hole, Ruby and Beaverhead tributaries.

Saskatchewan Drainage

The St. Mary's River also contains mountain whitefish but only about 20 miles of the stream occurs within the state. Fishing pressure is very light on this stream.

Columbia Drainage

The Kootenai River and its tributaries support moderate populations of whitefish but fishing pressure is negligible. This fish is common in the Clark Fork River above Drummond and abundant from there to the Idaho-Montana border. It is also found in all primary tributaries. It is common in the Thompson River and Thompson Lakes but is little utilized in these waters. It is present throughout the Flathead drainage but is most common in the Flathead River and Flathead Lake. The whitefish is abundant in the Bitterroot River and the Blackfoot River and is common in Rock Creek. These three streams receive most of the whitefishing pressure in that area.

METHODS OF CAPTURE

Information on effective methods of catching mountain whitefish was obtained by interviewing 414 fishermen. A total of 276 interviews were made during the winter while fishermen were engaged in whitefishing. Only three fishermen, of more than 100 interviewed, were actually attempting to catch this species during the summer. Mountain whitefish were taken by several of the trout fishermen interviewed but were usually

returned or otherwise discarded.

More than 300 hours were spent experimenting with various methods of taking whitefish by angling. The tackle and techniques employed were patterned after those used by successful fishermen. The following tackle and techniques are recommended because they were found to be most effective. However, the writer does not wish to imply that other methods are not successful.

Recommended Whitefish Tackle

A fly rod or spinning rod is satisfactory for stream fishing when the air temperature is above freezing but at lower temperatures ice forms in the guides and casting becomes difficult. At such times sectional or one-piece cane poles are more satisfactory. These are available in lengths up to about 20 feet. Ordinarily the pole selected should be the maximum length that can be conveniently handled. This permits the fisherman to reach better fishing areas without wading into deep water. Sectional poles are lighter and more limber than the one-piece poles and have the advantage of being easily transported.

The cane pole is equipped with a series of guides one-half inch or larger in diameter (Fig. 3). These guides do not fill with ice. If large guides cannot be purchased they can be made from any light weight stiff wire. An inexpensive single action reel taped to the base of the pole provides for the storage of line. A wooden bracket (Fig. 4) is a satisfactory substitute for the reel.

Nylon leader material is the most satisfactory line for winter use.

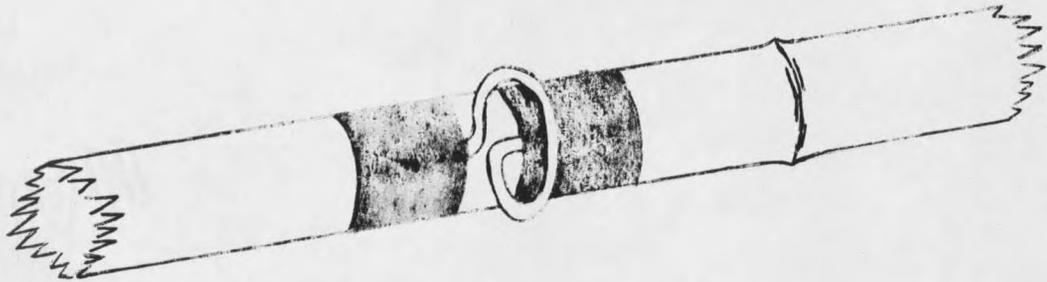


Fig. 3. Large guide used on cane pole.

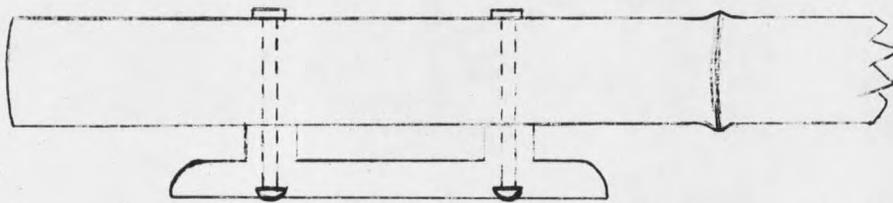


Fig. 4. Line-storage bracket on cane pole.

It does not absorb water like braided line and therefore does not "ice-up" so easily. It is often necessary to lift whitefish over the edge of shelf ice so the line should have a minimum breaking strength of about eight pounds. The use of nylon monofilament line eliminates the need for a leader.

Number 10 or 12 short-shanked hooks are most effective. Whitefish are occasionally taken on larger hooks and rarely on spoons or plugs but many strikes will be missed if large hooks are employed. A hook is tied to the end of the line and a number five or seven split-shot sinker is clamped on the line approximately six inches above the hook. If a second hook is used it is attached to a dropper loop 6 to 12 inches above the sinker.

A small cork or plastic float (one inch or less in diameter) is attached to the line above the other tackle. By regulating the position of the float the hooks can be kept close to the stream bottom without snagging on rocks and debris. Whitefish often strike so gently that it is not noticed, especially if there is some slack in the line. A small sensitive float will aid in recognizing these light strikes.

Fishing through the ice requires somewhat different equipment. A long cane pole is obviously unsatisfactory. Any short stiff rod or stick will serve the purpose but a fly rod tippet mounted in a wooden handle will furnish the most sport. Extra line is stored on a reel or wooden bracket secured to the handle. The line and tackle used on these rods is the same as that recommended for cane poles. A portable shack may be used for shelter where fishing is confined to lakes. A shack can be left

on the ice throughout the season and can easily be moved to desired fishing sites.

Whitefish Baits

Several kinds of bait are effective in taking whitefish. The type of bait used will depend upon availability and personal preference. Live baits are employed throughout the year but the type varies seasonally. Artificial flies are effective during the summer but are not recommended for winter use. The size of the bait is important since the whitefish has a small mouth.

Live bait: Immature aquatic insects are among the most effective whitefish baits known. These organisms are common in riffle areas of most cold clear streams where they cling to the underside of rocks. They can be secured throughout the year but are most numerous and of suitable size for bait in the winter and early spring. Many of these insects emerge during the late spring and summer and consequently will be less abundant following that period. They are most easily collected from rubble-strewn riffles covered by 6 to 18 inches of water.

A collecting device, made by nailing a section of window screen to two wooden handles, is held against the stream bottom at right angles to the current and rocks are overturned upstream (Fig. 6). Organisms are dislodged by the current and washed downstream into the screen.

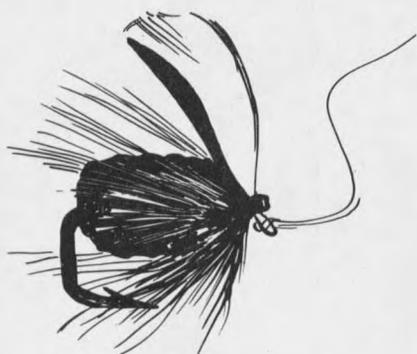
Plecoptera or stonefly nymphs (Fig. 5), locally called hellgramites or scratchers, are the most preferred. These vary from mottled tan to dark brown or black in color and range up to two inches in length. The



MAGGOT



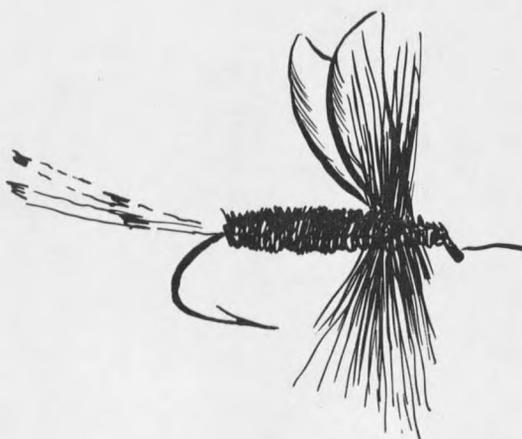
WHITEFISH HOOK



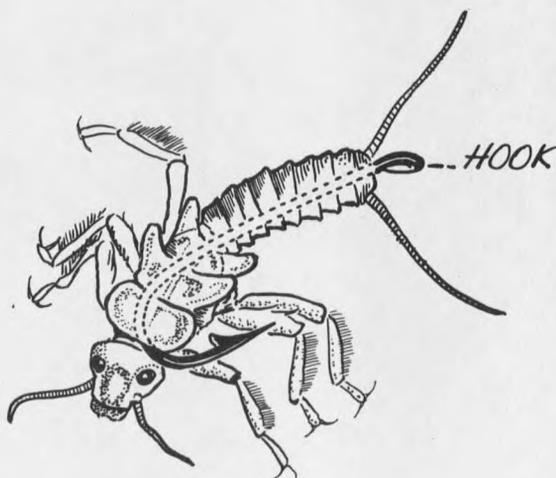
WET FLY



ARTIFICIAL NYMPH



DRY FLY



PLECOPTERA NYMPH

FIG. 5. BAIT AND FLIES



Fig. 6. Fishermen collecting bait.

lighter colored species of one inch or less in length are the most desirable bait.

Figure 5 shows a satisfactory method of placing the hook. The hook is inserted through the abdomen and thorax with the point projecting at the base of the head. This method insures a minimum loss of bait.

Maggots (Fig. 5) are not a natural food of the whitefish but are an effective bait. They are used extensively during the winter, especially in areas where stonefly nymphs are not easily secured. A supply of maggots can be cultured and stored for use during the winter season. Meat scraps in an exposed area will attract adult blowflies which lay their eggs on the meat. After a few days the meat is placed on a wire rack which is suspended over a shallow tray. Before the larvae are ready

to pupate they drop into the tray. These are placed in sand or sawdust and stored at a temperature of 35 to 45 degrees Fahrenheit. This will inhibit metamorphosis. Maggots can also be collected from the soil near slaughter houses, rendering plants or similar areas where a large amount of decaying organic material is present.

Maggots are offered for sale by a number of bait dealers during the winter season. The price is about 50 cents per can (100 to 200 maggots). It is estimated that more than four million maggots are sold annually in Montana. This figure is based on information received from 18 dealers who sell from about 100 to more than 5000 cans each year. Dealers obtain maggots from local sources and from wholesale bait firms. Maggots are generally available from October through February in most localities.

Earthworms are effective whitefish bait during the spring runoff period. Nightcrawlers are too large to be taken readily by whitefish but can be used if they are cut into sections.

Whitefish may be taken on live grasshoppers during the late summer. The smaller sizes will be taken most readily. The hook should be threaded through the abdomen and thorax to reduce the loss of bait.

Artificial flies: During the summer mountain whitefish are taken on a variety of imitation nymphs and wet and dry flies (Fig. 5). Flies of various shades of tan, grey, brown and green are most effective but whitefish may be taken on flies of any color or pattern. The size of the hook is of more importance than the color or pattern of the fly. Flies tied on hooks larger than number 10 are not recommended since many strikes

will be missed.

"Whitefish hooks" (Fig. 5) are frequently used during the winter season. These are small snelled hooks with chenille, plastic or other material wrapped around the shank leaving the entire bend of the hook bare. Short hackle is sometimes used on these lures. A maggot is threaded on the bare part of the hook.

Fishing Methods

A typical whitefish riffle is shown in Figure 7. The rapidly moving water flowing over the riffle proper is indicated by the "white-capped" water in the background. Schools of whitefish are found throughout the year in the area where the fast water blends into the slowly moving water along the shore. They are also found in pools below the riffles.

Bait fishing: The method most effective consists of casting into the lower end of the riffle and allowing the bait to drift along the edge of the fast water to the head of the pool. The bobber or float is adjusted so that the baited hooks drift close to the stream bottom. When a whitefish strikes, it should be allowed to pull the float beneath the surface of the water before the hook is set.

When floating ice is present, whitefish can be taken near the stream edge or under the shelf ice. When fishing through the ice on quiet backwaters and lakes a float will suspend the bait near the bottom and the line should be alternately raised and lowered to keep the bait in motion.

Fly fishing: Mountain whitefish frequently rise to surface insects during the summer and can be taken on dry flies. The fly is cast upstream and



Fig. 7. Typical whitefish riffle.

allowed to drift into the area where fish are rising. Fishermen commonly mistake these rising whitefish for trout and attempt to take them on large flies or lures. Whitefish may also be taken on wet flies or imitation nymphs during the summer. Wet flies are effectively fished at various depths in the riffle area and in the pool proper while nymphs are very effective when fished near the bottom at the foot of a riffle.

PALATABILITY

Although the mountain whitefish is a good food fish, its eating qualities are regarded lightly by many fishermen. The reasons for this lack of appreciation are not apparent but personal bias and methods of cooking are undoubtedly involved. The lake whitefish, a closely related

species, has long been an important commercial food fish in the Great Lakes.

An experiment was conducted by the Agricultural Experiment Station Home Economics Department to determine the palatability of the mountain whitefish. Six unbiased judges (three men and three women) were selected to serve as a panel for this experiment which was designed to make comparisons between mountain whitefish and trout. Four of the judges had previous experience in judging foods.

A total of 45 fish (22 whitefish and 23 trout) were used in this experiment. These were collected from the Madison River during the period of February 15, 1953 to April 18, 1953. The whitefish varied from 9.6 to 14.3 inches in total length while the trout were 8.6 to 15.2 inches. All fish were eviscerated, scaled, washed and frozen soon after capture and were kept frozen from two to eight days before being cooked and served to the panel. The number of fish served at a session varied from 9 to 12. Fish prepared for each session were assigned code numbers in such a manner that judges would not associate any certain numbers with either group of fish. Each fish was cut into three sections of approximately equal length. These sections were seasoned and pan-fried for 25 to 30 minutes in heavy iron skillets containing 60 grams of Crisco. Each judge received samples from corresponding sections of all fish.

The score sheets (Fig. 8) provided for ratings on five factors; three of which were subdivided into desirability and intensity or quality. The ratings ranged from one to seven. Values of four or larger represented satisfactory ratings in those subdivisions which were concerned

Factor	Phase	7	6	5	4	3	2	1
Aroma	Intensity	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible
	Desirability	Very desirable	Desirable	Moderately desirable	Slightly desirable	Neutral	Slightly undesirable	Undesirable
Texture	Quality	Very fine	Fine	Moderately fine	Slightly coarse	Coarse	Very coarse	Extremely coarse
	Desirability	Very desirable	Desirable	Moderately desirable	Slightly desirable	Neutral	Slightly undesirable	Undesirable
Flavor	Intensity	Very pronounced	Pronounced	Moderately pronounced	Slightly pronounced	Perceptible	Slightly perceptible	Imperceptible
	Desirability	Very desirable	Desirable	Moderately desirable	Slightly desirable	Neutral	Slightly undesirable	Undesirable
Tenderness		Very tender	Tender	Moderately tender	Slightly tough	Tough	Very tough	Extremely tough
Juiciness	Quantity	Very juicy	Juicy	Moderately juicy	Slightly dry	Dry	Very dry	Extremely dry

Fig. 8. Score sheet for rating fish in palatability experiment.

with desirability. A high numerical rating does not necessarily indicate desirability for factors of intensity, quality or quantity. As each sample was evaluated by a judge the code number of the sample was placed in the appropriate column on the score sheet.

Average scores were calculated for each group of fish (Table 1). Analysis of variance tests showed that the grand averages are significantly different except in juiciness and in intensity of aroma and flavor. Although the trout were rated above the whitefish in some categories, the panel regarded the whitefish samples favorably since the grand averages in all subdivisions concerned with desirability were above the value of four. In all categories there is a significant difference in ratings resulting from variation in judge preferences. Examination of average values assigned by individual judges shows that two judges (numbers four and six) found considerable difference between the two groups of fish but the other four judges found little or no difference.

UTILIZATION

Most Montana anglers prefer whitefish smoked but a number also prepare them as they do trout. Information on preparation of whitefish was contributed by fishermen. Methods of cooking were developed by the Agricultural Experiment Station Home Economics Department. Information on smoking techniques was obtained from custom smoke house operators and from fishermen who smoke their own fish. In addition, over 300 fish were smoked to test small scale smoking techniques. The smoking units and methods were patterned after those commonly used.

Table 1. Average values assigned in the palatability experiment.

Judge Number		Aroma		Texture		Flavor		Tenderness	Juiciness
		Int.	Desir.	Quality	Desir.	Int.	Desir.		
1	Wh.	5.1	6.0	5.2	5.9	5.2	5.6	6.1	5.7
	Tr.	5.0	6.2	5.3	5.9	5.3	6.1	6.0	5.6
2	Wh.	3.6	4.8	4.0	5.9	4.1	4.5	6.2	5.5
	Tr.	3.6	4.8	4.0	5.8	4.0	5.5	6.4	5.0
3	Wh.	3.1	3.0	4.8	4.6	3.4	4.1	5.6	5.0
	Tr.	3.1	3.0	5.3	5.4	3.6	4.6	6.0	4.7
4	Wh.	4.3	2.7	3.9	3.5	4.6	3.8	4.7	4.8
	Tr.	4.2	4.7	5.8	6.0	5.6	6.4	6.4	5.6
5	Wh.	6.0	5.1	6.0	6.0	6.0	6.1	6.0	5.0
	Tr.	6.0	5.9	6.0	6.0	6.0	6.9	6.0	5.0
6	Wh.	4.9	3.3	4.6	4.5	5.3	4.2	5.0	4.7
	Tr.	4.1	5.1	4.4	5.3	5.0	5.6	5.9	4.9
Grand Averages	Wh.	4.5	4.2	4.8	5.1	4.8	4.7	5.6	5.1
	Tr.	4.3	4.9	5.2	5.7	4.9	5.8	6.1	5.1

Int.- Intensity; Desir.- Desirability; Wh.- Whitefish; Tr.- Trout.

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Methods of Preparation

Methods of preparing whitefish vary with individual preference.

Fish less than 10 inches in total length are usually scaled and pan-fried while larger specimens are often filleted. By removing the skin from the larger fish, a flavor that is objectionable to some people is eliminated. Mountain whitefish weighing one pound or more are satisfactory for baking. Fish that are to be baked should be scaled but not skinned.

Filleting: The steps for skinning and filleting mountain whitefish are shown in Figure 9. Fish that are to be filleted should not be eviscerated. With a sharp-pointed knife cut through the skin completely around the fish just behind the gill covers. Slit the skin along the midline of the back to the base of the tail. With a pair of pliers pull the skin downward to the belly on each side and leave it attached. The fillet is removed by cutting along the backbone and down between the flesh and the ribs (Fig. 9, step 2). The first cut is made approximately one-eighth inch from the mid-line to separate the fillet from the fatty deposit along the top of the vertebral column. The only bones that are severed are the dorsal ribs which project out from the vertebrae. These may be removed by cutting a narrow strip of flesh from that part of the fillet but it is not necessary.

Recipes

Several recipes for cooking whitefish were developed and tested. The fish were prepared and served to a panel of six judges. The score sheets provided for ratings of excellent, good, fair and poor on each

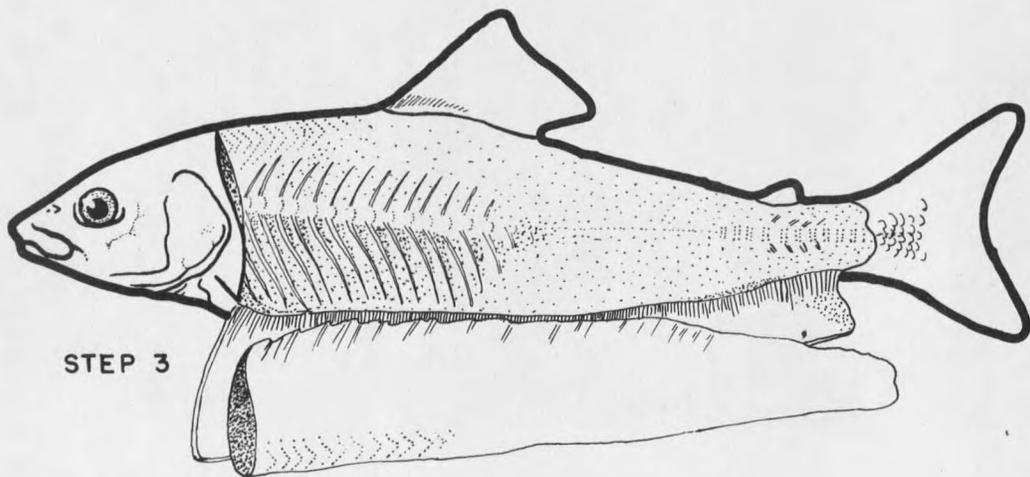
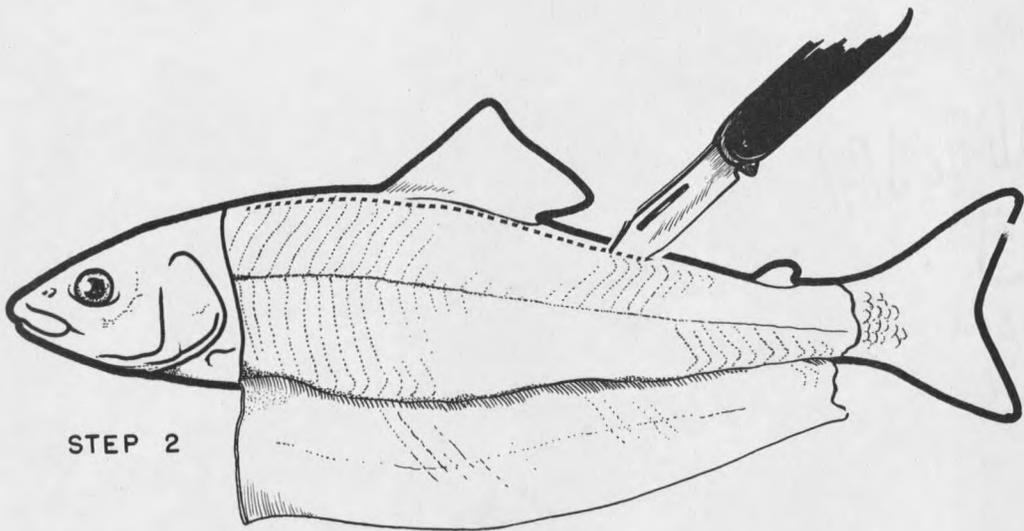
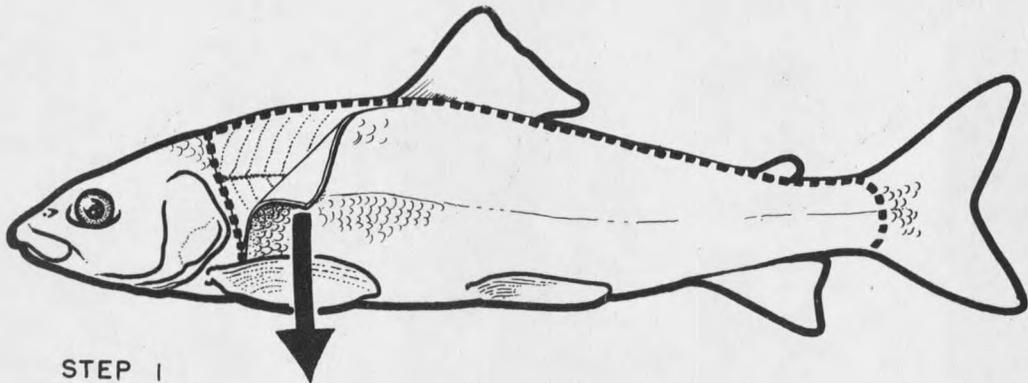


FIG. 9. SKINNING AND FILLETING

recipe. More than 99 percent of the ratings assigned by the panel were excellent or good. The tested recipes are:

Pan-fried Whitefish

1. Dip the slightly moistened pieces of fish in a cornmeal-flour mixture (2 T. flour, 6 T. cornmeal, 1 t. salt). Fry in skillet containing moderate amount of shortening. Turn carefully several times during cooking. Cook until well browned.

2. Dip the pieces of fish in egg-milk mixture (1 egg, 2 T. milk) and roll in cracker crumbs. Fry as above.

Baked Stuffed Whitefish

Whitefish are very satisfactory for baking stuffed. Select fish $1\frac{1}{2}$ pounds or larger. Scale but do not skin. Remove head, tail, and fins. Wipe cavity with damp cloth. Sprinkle with salt, inside and out and stuff loosely with dressing. Two or three ties with string will help hold fish and dressing together. Place fish on well greased shallow roasting pan and cook at 350° F. for 45 minutes ($1\frac{1}{2}$ lb. fish). Larger fish and dressing will require about an additional 10 minutes per pound.

Sage Dressing

This sage dressing is very pleasing with Whitefish and adds to its flavor.

$1\frac{1}{2}$ C. dried bread or cracker crumbs	$\frac{1}{4}$ T. butter or margarine
$1\frac{1}{2}$ t. grated onion	1 egg, beaten
$\frac{1}{4}$ t. sage	$\frac{1}{2}$ t. salt
3 T. chopped celery	pepper
6 T. hot water	

Cook celery and onion in melted butter until tender but not brown. Mix with the remaining ingredients and place in cavity of fish.

Bread Dressing

This is a milder flavored dressing.

$1\frac{1}{2}$ C. dried bread or cracker crumbs	6 T. hot water
$1\frac{1}{2}$ t. grated onion	$\frac{1}{4}$ T. butter or margarine
$\frac{1}{4}$ C. chopped celery	1 egg, beaten
1 T. chopped green pepper	$\frac{1}{2}$ t. salt
1 t. lemon juice	pepper

Cook celery and onion in melted butter until tender but not brown. Mix with the remaining ingredients and place in cavity of fish.

Baked Whitefish Creole

Remove skin from fish and cut into serving size pieces. Fillets of fish may also be used. Place in baking dish and add creole sauce. Bake uncovered at 350° F. for 45 minutes.

Creole Sauce

2 C. canned tomatoes	1 clove garlic, crushed
$\frac{1}{4}$ C. chopped onion	2 T. butter or margarine
$\frac{1}{4}$ C. chopped green pepper	1 t. salt
$\frac{1}{4}$ C. chopped celery	pepper
1 bay leaf	

Cook celery, onion, green pepper, and garlic in melted butter until tender but not brown. Mix with remaining ingredients and pour over fish.

Whitefish Loaf

$2\frac{1}{2}$ C. raw ground Whitefish (skinned and boned)	
$\frac{2}{3}$ C. dry bread crumbs	2 T. chopped celery
2 eggs, beaten	1 t. Worcestershire sauce
1 C. milk	$1\frac{1}{2}$ t. salt
1 T. grated onion	pepper
2 T. chopped parsley	dash of cayenne

Mix ingredients and place in well-greased baking pan. Bake at 350° F. for 1 hour. Any of the sauces suggested for use with the fish fillets may be served with this fish loaf.

Whitefish Chowder

1 lb. diced raw Whitefish (boned and skinned)	
4 strips bacon, diced	1 bay leaf
$\frac{1}{3}$ C. chopped onion	2 t. salt
2 C. raw potato, cubed	$1\frac{1}{2}$ C. water
$\frac{1}{2}$ C. diced carrot	3 C. milk
$\frac{1}{4}$ C. chopped celery	pepper

Cook cubed potatoes and carrots in $1\frac{1}{2}$ C. water for 5 minutes. Fry diced bacon until very slightly brown. Add onion and celery and cook until tender but not brown. Add the diced raw fish, seasonings,

Whitefish Chowder, continued.

and potato and carrot mixture. Simmer for 20 minutes. Add heated milk and butter just before serving. Milk may be slightly thickened with flour before adding. Carrots may be omitted if desired.

Alternate Method

The fish may be cooked in the water, then skinned, boned, and flaked. Cook potato and carrot in fish stock and proceed as above.

Broiled Whitefish Fillets

The skin is usually removed when Whitefish are filleted. However, if left on, place fillets skin side down on greased broiling rack. Dot fish with butter and sprinkle with lemon juice, salt, and pepper. Pre-heat broiler 10 minutes. Place rack 3 inches from heat and cook 10 to 12 minutes for $\frac{1}{2}$ -inch fillet. Baste frequently with lemon juice and butter while cooking. ($\frac{1}{2}$ C. butter, 3 T. lemon juice.) Do not turn fish while broiling.

Any of the following sauces may be served with the fish fillets.

Lemon-Butter Sauce

$\frac{1}{2}$ C. butter, melt and add
3 T. lemon juice
1 T. chopped parsley

Dill Sauce

$\frac{1}{2}$ C. Mayonnaise
1 t. ground dill seed
or
2 t. green minced dill
 $\frac{1}{2}$ t. Worcestershire sauce
1 t. grated onion
salt and pepper

Thin as desired with milk or juice from dill pickles.

Tartar Sauce

$\frac{1}{2}$ C. Mayonnaise
2 t. grated onion
4 T. chopped dill pickle
salt and pepper as desired

Piquant Sauce

- 4 T. tomato catsup
- 3 T. lemon juice
- $\frac{1}{2}$ t. salt
- 1 t. grated horseradish
- $\frac{1}{4}$ t. Worcestershire sauce
- or
- few drops of Tabasco sauce
- 2 T. minced celery

Smoking

Three types of units were found to be satisfactory for smoking whitefish. The first of these was constructed from a 55 gallon drum which had both ends removed (Fig. 10). Two rods welded in place support a series of smaller rods from which the fish were suspended by wire hooks. Smoke was carried from the fire box to the smoking chamber by two lengths of six inch stove pipe. A wooden cover fitted tightly against the top of the drum could be left ajar to provide a draft. Approximately 35 fish can be suspended in this unit and an additional 10 or 12 laid on top of the rods.

The second was a larger box-type unit (Fig. 11) constructed of asbestos panels. It was four feet square and six feet high, with no floor and a fire box placed on the ground inside. A small door and chimney provided draft. Fish were placed on removable wire-covered racks near the top of the unit. Each rack held approximately 50 fish. Additional racks could be installed but the lowest of these should be at least three feet from the fire box.

The third unit (Fig. 12) was a discarded refrigerator (An ice box is satisfactory). Racks installed near the top of the refrigerating compart-

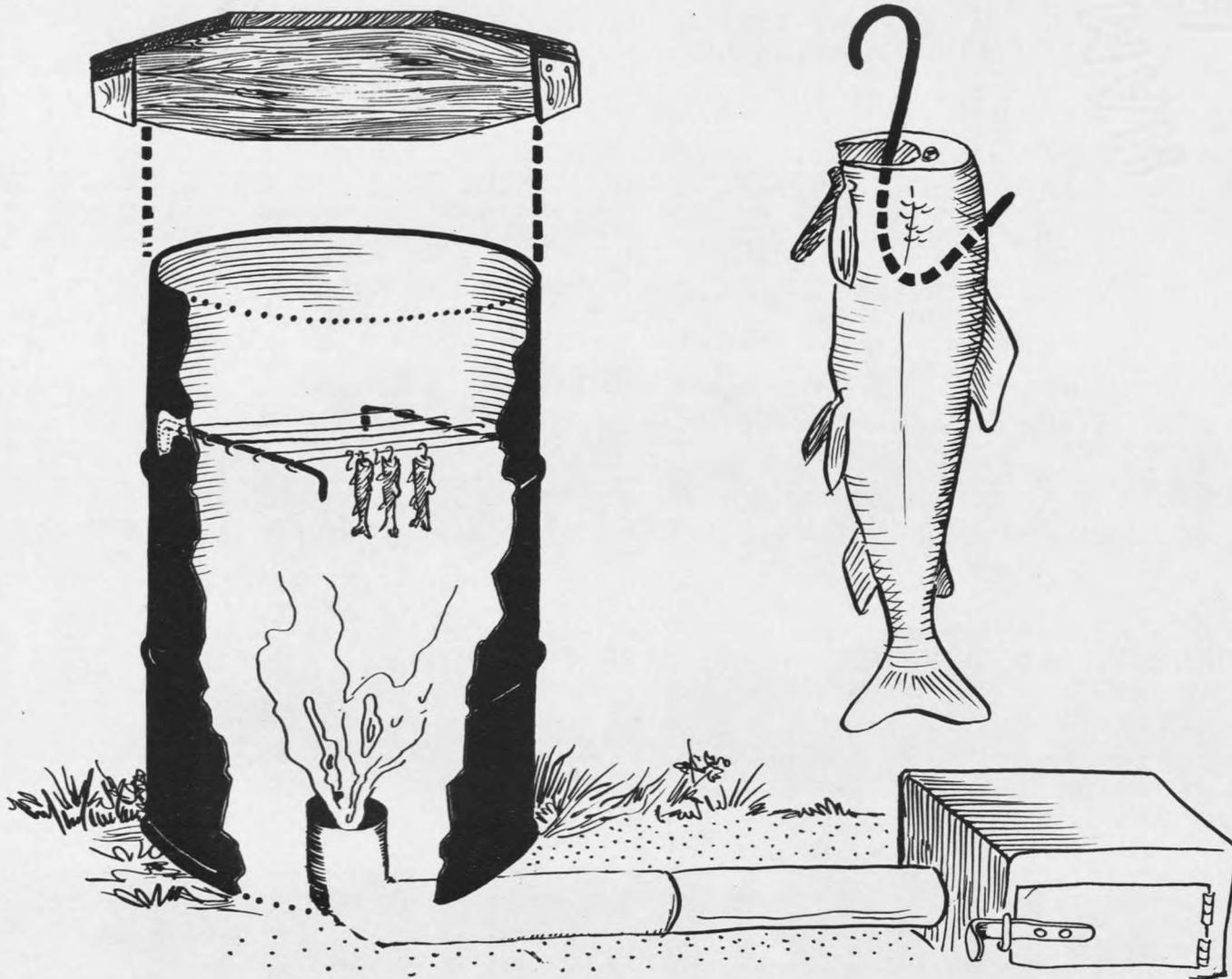


FIG. 10. BARREL TYPE SMOKING UNIT

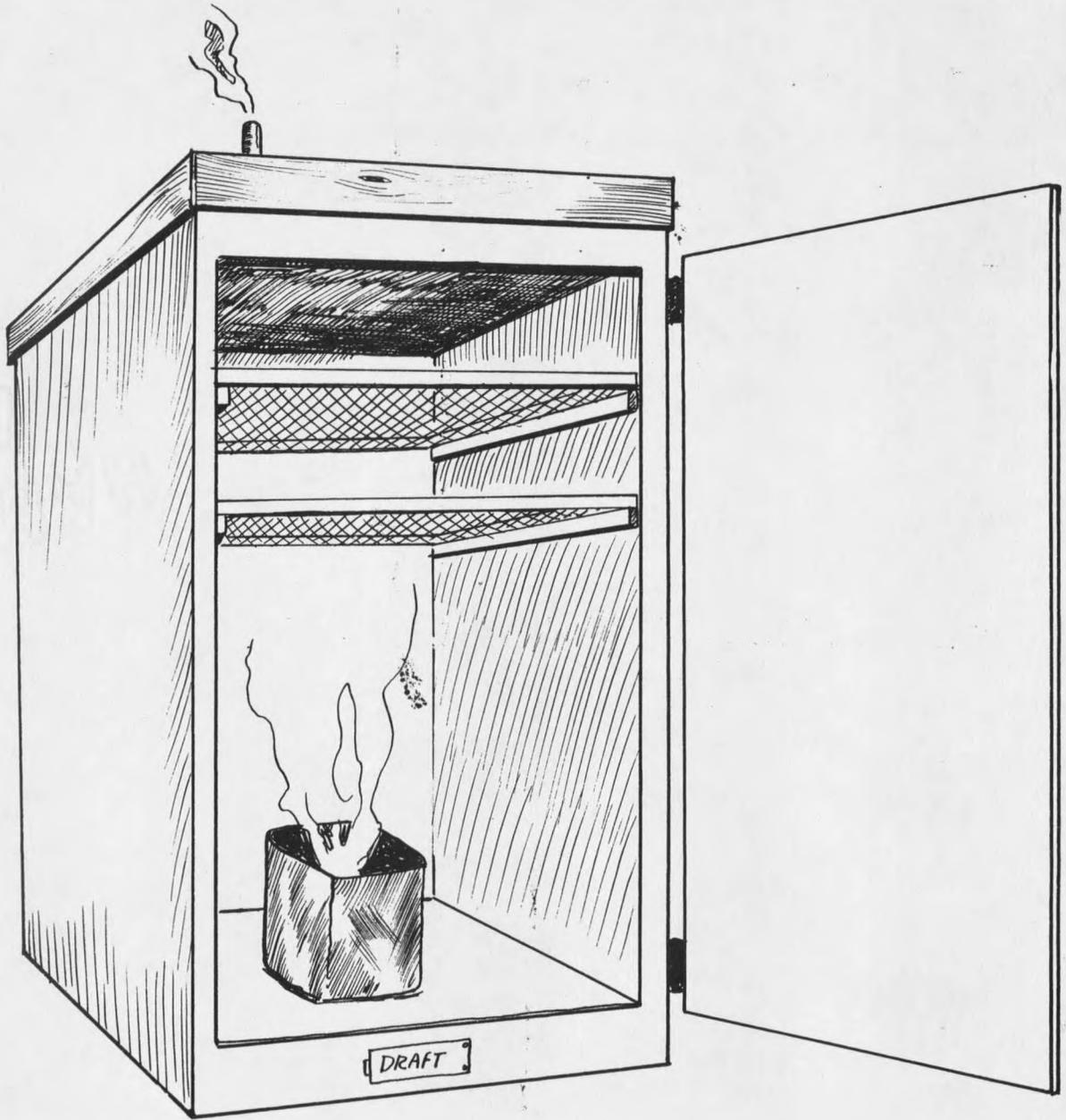


FIG. II. BOX TYPE SMOKING UNIT

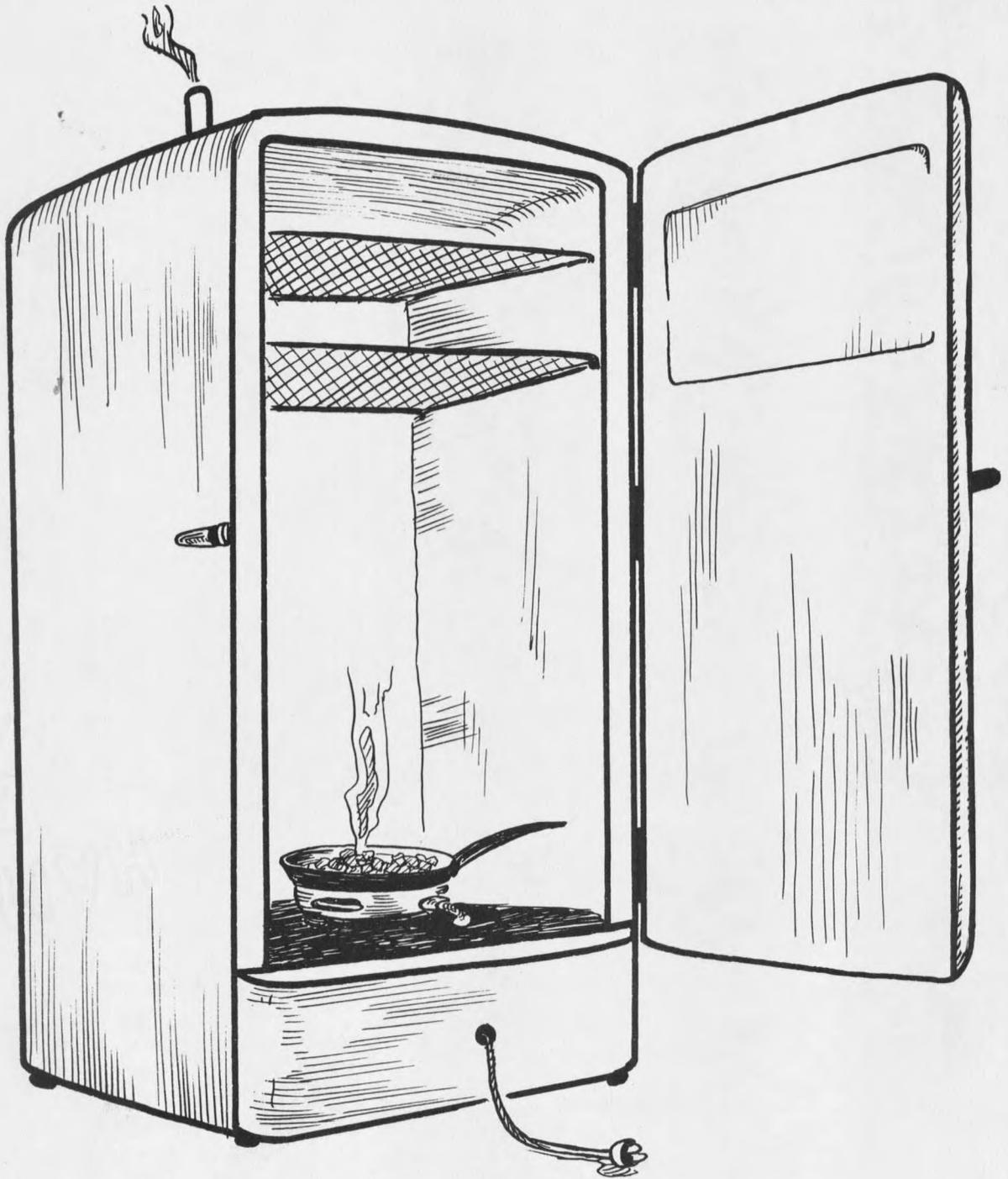


FIG. 12. REFRIGERATOR TYPE SMOKING UNIT

ment held the fish. Heat was provided by an electric hot plate and smoke was generated from a pan of wood chips placed on the hot plate. The chimney consisted of a piece of one-inch water pipe inserted through the top of the unit. A two-inch hole was cut in the bottom of the refrigerating compartment to provide bottom draft. The electric cord from the hot plate was inserted through this hole. The hot plate maintained a temperature of about 200° F. near the racks. Fish less than 12 inches were properly smoked in four hours; larger fish required one to two hours longer. This unit required little attention and only a small amount of wood. It was also practically fireproof. These advantages may be somewhat offset by the additional operating expense.

Apple wood is very desirable for smoking whitefish but satisfactory results were also obtained with alder, willow, aspen and chokecherry. A supply of green and dry wood is recommended. The dry wood is used during the cooking period and green wood later during the smoking interval.

In preparation for smoking, whitefish should be eviscerated but not scaled. It is recommended that fish be smoked within 48 hours after capture. If this is not possible, the fish should be frozen until they can be smoked. Fish over 16 inches in total length should be split along the backbone to allow uniform cooking and to shorten the smoking time. The fish are cured in plain table salt or in a mixture of equal parts of table salt and Morton's curing salt. Iodized salt should not be used because it imparts a very undesirable flavor to the fish.

Whitefish may be cured in a brine or by the dry salt method. The brine is prepared by adding salt to cold water until the solution is of

sufficient density to float a chicken egg with only the tip above the surface. This requires about one and one-third cups of salt per gallon of water. The amount of salt used can be varied according to individual preference. Fish should be kept in the brine for 24 hours. The dry salt method consists of rubbing approximately a tablespoon of salt over the skin and in the body cavity of each fish. The fish are then placed in a flat pan and allowed to stand for about 24 hours.

After curing, the fish are placed in the smoking unit and cooked at 180 degrees Fahrenheit for 30 minutes. Excessive heat will cause the fish to become very dry. After the initial cooking period, green wood is placed on the fire and the drafts are partially closed. This reduces the temperature and increases the production of smoke. The fish are exposed to the smoke for 10 to 12 hours at a temperature of about 100 degrees Fahrenheit.

Whitefish are smoked by custom operators. The charge for this service is usually 10 cents per fish. Sixteen operators who submitted records smoked a total of 29,281 fish during the winter of 1953-54. The largest number of fish smoked by an individual was 4014 and the average for this group was 1,829. It is estimated that more than 40,000 whitefish are smoked annually in custom plants within Montana. Custom smokehouses are generally open from October through February and a few commercial meat plants smoke whitefish during the summer as well.

If smoked whitefish are to be kept longer than two weeks they should be cooled, wrapped and refrigerated. When these fish are thawed, the

smoky flavor can be accentuated by heating for a few minutes in an oven.

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