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THE WADDELL CREEK EXPERIMENTAL STATION FOR TROUT AND SALMON STUDIES

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The California Trout Investigations, working under a cooperative agreement between the United States Bureau of Fisheries, the California Division of Fish and Game, and Stanford University have been carrying on a study of the steelhead trout since the fall of 1931. These studies have been directed towards obtaining such facts regarding the life history and habits of the steelhead as would assist in their conservation and fullest utilization.

It early became apparent that what was most vitally needed was more exact quantitative data as contrasted with the observational character of the material which had been obtained in previous years.

The most important facts in the life history of the steelhead center in their migrations, first as young fish from the streams to the ocean, and, second, as adults when they return to the streams to spawn. These migratory movements are directly important as an outstanding feature in the life of the steelhead and indirectly for the opportunities for conservation which they make possible.

In order to gain the fullest knowledge regarding these migratory movements a trap was desired which when installed in some small stream would take all of the adult fish entering from the ocean and a sufficient portion of the small fish moving in the opposite direction to give a satisfactory sample at all seasons of the year.

Due to the nature of the coastal streams there is considerable difficulty involved in designing a trap which will meet the above specifications. These streams carry only a small amount of water during the summer months but during the winter and spring, when most of the migrations occur, they increase tremendously in volume and carry a large amount of debris from the forested hills which they drain.

Scott and Waddell Creeks in the northern part of Santa Cruz County were selected for experimental work. The former has been used as a source for steelhead eggs for over twenty years and a state hatchery was built on one of its tributaries in 1926. Two miles from the mouth of Scott Creek is the egg taking station which consists of a dam that is impassable to fish moving upstream and a fish ladder which leads into a trap and thence to holding tanks where the fish are kept until ready for spawning.

During the summer of 1933 a similar dam and trap were constructed on Waddell Creek* with the addition of facilities for taking a portion of the small fish moving downstream at all seasons of the year. This trap has now been in continuous operation for two years and has been sufficiently successful to warrant its description in considerable detail.

* The Waddell Creek Station is available through the kindly interest of Dean T. J. Hoover, who provides residence and laboratory facilities on the grounds.

Figure 34 is a photograph of the station in operation during high water. To the left is the dam, the apron covered with water, and the swinging galvanized sheets which prevent the passage of fish. On the right is the tank which forms the trap proper and between it and the apron is the flume which brings water from above the dam, and below it is the entrance to the fish ladder leading to the upper end of the trap.

FIG. 34. The Waddell trap during high water.

Excess water from the flume can be seen spilling through the screened by-pass just before the flume enters the lower end of the tank.

The construction and method of operation of the trap can be more readily understood by reference to Figure 35 which is a ground plan of the trap, flume, fish ladder and a portion of the dam. The arrows indicate the course of the water flow and the gates which are used for control of the water have been numbered from I to VI, inclusive.

The water enters the flume from above the dam through gate I which is a 12 by 36 inch opening in the protecting wall. This opening is set below the level of the dam so that its upper edge is just level with the crest of the dam. This was done to insure a flow of water into the flume at all stages. To further insure this the crest of the dam was given a slope of 4 inches from the opposite bank towards the trap. The flow of water through gate I is controlled by a gate which slides in slanting grooves. This gate is put in place from the outside but during high water can be raised and lowered from inside the flume by the use of a pinch bar. The water passes down the flume to gate II which is a spillway that makes it possible to control the water flowing into the tank at gate III without changing the adjustment of gate I. It also makes it possible to handle water in excess of that which can be cared for by the screens in the tank. This gate was originally covered by a stationary screen that has recently been replaced by a moving

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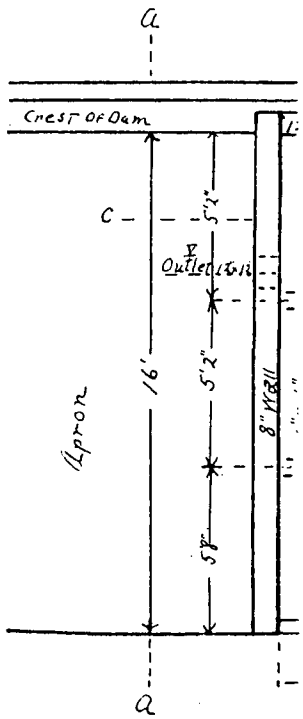

FIG. 35. Ground pla

the upper end of the trap. Th
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holds these gates in a closed
so that in following the current
tank. The steps in the ladder
fish moving upstream are also

screen of spiral weave conveyor belt. The remaining water passes through gate III and drops into the tank where the water is carried at a depth of between 3 and 3½ feet.

The water passes through the tank in an upstream direction and is strained through two sets of screens. The first screen is of half inch mesh and the second of quarter inch mesh. Both are made in two sections of 3 by 6 feet to make them easier to handle. All fish coming into the flume from upstream are thus trapped below these screens. The use of the two sizes of mesh makes it easier to keep the screens clear of debris and also segregates the small fish from the large, including the cottoids.

The water then passes through outlet IV into the upper step of the fish ladder and then down through the two remaining steps and back into the stream. The adult fish come to the fish ladder through inability to pass the dam and ascending it pass through inlet IV into

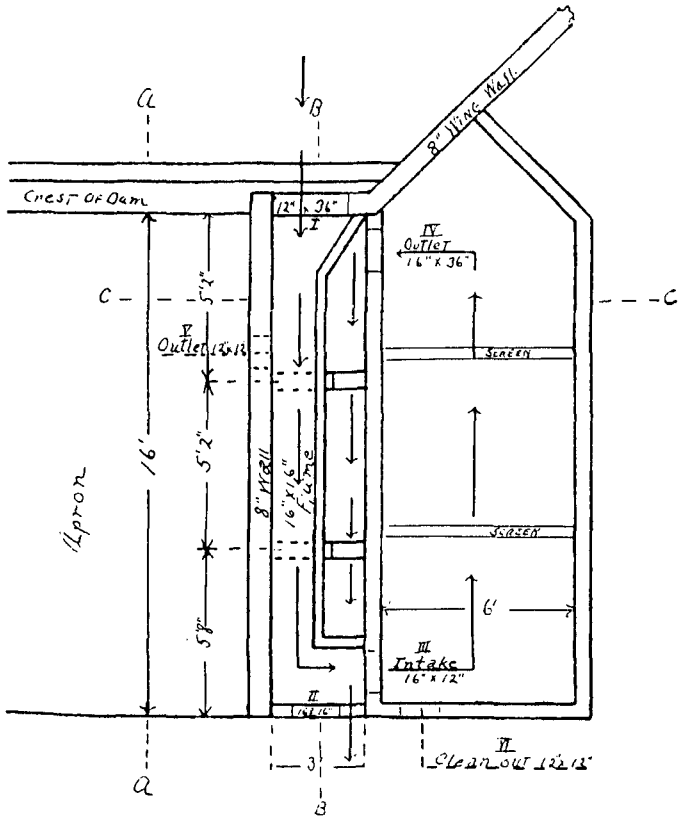

FIG. 35. Ground plan of the Waddell Creek trap.

the upper end of the trap. Their return into the fish ladder is barred by pivoted finger gates which nearly close the opening. The current holds these gates in a closed position but they move freely enough so that in following the current the fish can push them open to enter the tank. The steps in the ladder are only 14 inches high so that small fish moving upstream are also taken in the upper end of the trap.

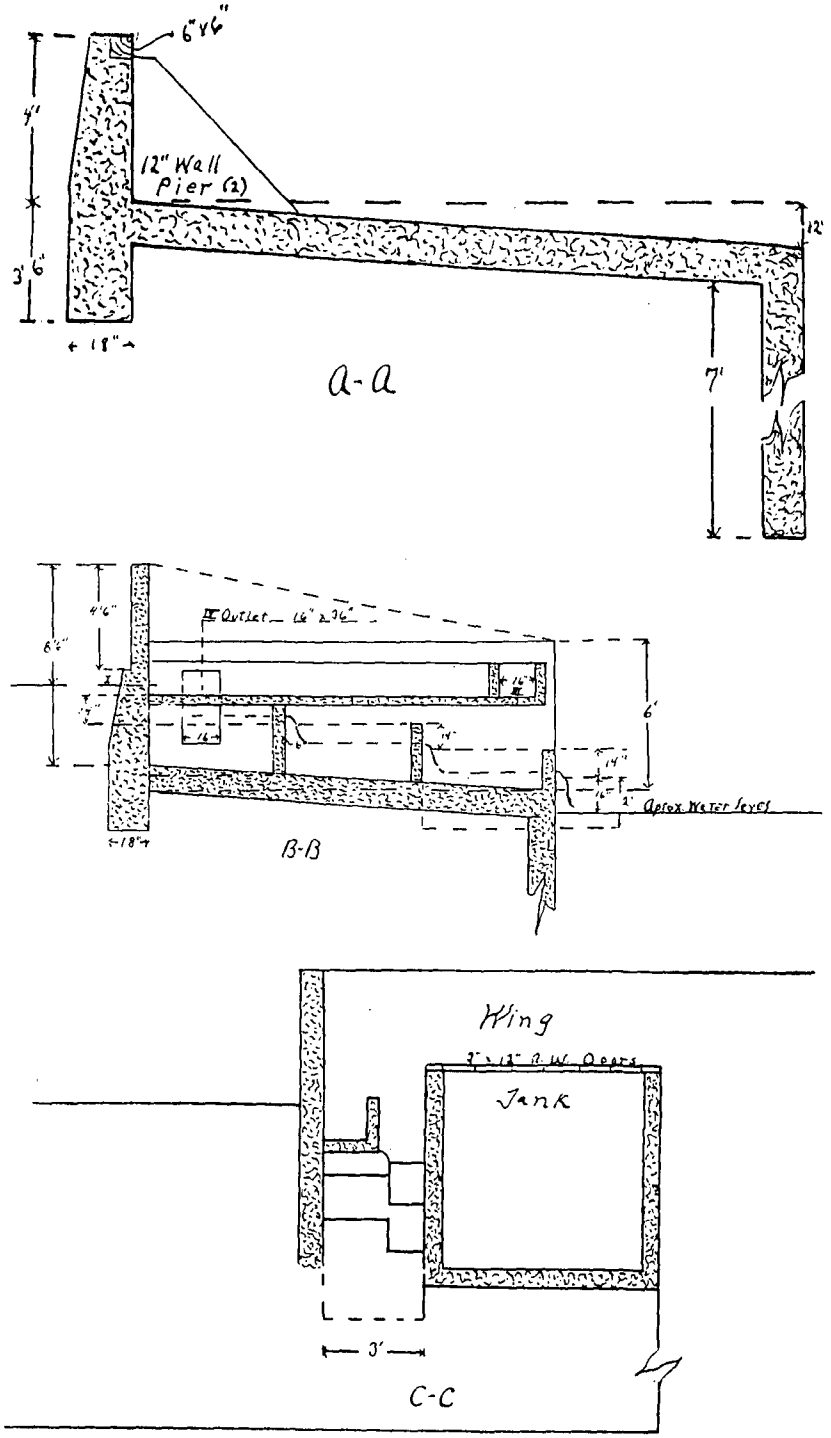

FIG. 36. Sectional plans of the Waddell Creek trap and dam.

Outlet V opens from cut on to the apron of the level in the tank when it i been trapped. When it is level of the port of the up the bottom of gate IV. It gate IV set from 8 to 12 i aid in netting the fish. Flo a gate which is attached t and is held closed by water by means of a hook as it wo during high water. Gate V and is used only during low lated on the bottom of the t

In constructing the da them as low as possible due been known to rise to the lev at the right in Figure 34.

Every foot that the causing flood waters to pas result the apron was lowe which is approximately a f During the first season of such as shown in Figure 34 an extent that the adult fis the eddies back of the s remedied by the installatio Figure 34. A ⅜-inch cable dam and from it the 6-foot 1 by 2-inch redwood strips

This arrangement has w jumping the dam and at th pass without hindrance. La without serious damage to t through the opening between the dam due to the fact tha where it strikes the apron a almost vertical jump which w

Our seasonal catch cove September 30 of the followi the 1933–34 and the 1934–3 fish so far taken in the trap. manders and snakes swimmi included.

TABLE 1. FISH TA

Silver Salmon, adults upstrea	
Steelhead, adults upstream	
Silver Salmon, migrants dow	
Steelhead, migrants downstre	
Cottoids, downstream	
Totals	

Outlet V opens from the bottom of the upper step of the ladder cut on to the apron of the dam. This gate is used to lower the water level in the tank when it is desired to work with the fish which have been trapped. When it is opened the water, which has been held at the level of the port of the upper step in the ladder, falls to the level of the bottom of gate IV. It would probably be an improvement to have gate IV set from 8 to 12 inches lower than indicated in Figure 36 to aid in netting the fish. Flow of water through outlet V is controlled by a gate which is attached to the lower side of the opening by hinges and is held closed by water pressure. It is opened from the fish ladder by means of a hook as it would be impossible to get at it from the apron during high water. Gate VI is a clean-out at the bottom of the tank and is used only during low water to remove debris which has accumulated on the bottom of the trap.

In constructing the dam and the apron it was necessary to keep them as low as possible due to the fact that in the past the water has been known to rise to the level of the bank at the top of the steps shown at the right in Figure 34.

Every foot that the dam was raised increased the danger of causing flood waters to pass around the dam and wash it out. As a result the apron was lowered to low water level at its lower edge, which is approximately a foot below the level shown in Figure 36. During the first season of operation it was found that at flood stage, such as shown in Figure 34, the water piled up on the apron to such an extent that the adult fish were able to jump over the dam from the eddies back of the supporting piers. This was immediately remedied by the installation of the galvanized sheets which show in Figure 34. A ⅜-inch cable was strung 5 feet above the crest of the dam and from it the 6-foot sheets were hung after being framed with 1 by 2-inch redwood strips for stiffening.

This arrangement has worked very well in preventing the fish from jumping the dam and at the same time allowing water and debris to pass without hindrance. Large logs and trees have passed through without serious damage to the sheets. The fish are unable to jump through the opening between the bottom of the sheets and the crest of the dam due to the fact that the water is very swift and turbulent where it strikes the apron and prevents their getting a start for the almost vertical jump which would be necessary.

Our seasonal catch covers the period October 1 of one year to September 30 of the following and we now have complete figures for the 1933–34 and the 1934–35 seasons. Table 1 shows the number of fish so far taken in the trap. A miscellany of sticklebacks, frogs, salamanders and snakes swimming downstream into the trap has not been included.

TABLE 1. FISH TAKEN IN THE WADDELL TRAP

	1933–34	1934–35
Silver Salmon, adults upstream	498	595
Steelhead, adults upstream	433	544
Silver Salmon, migrants downstream	3,430	3,567
Steelhead, migrants downstream	3,117	1,795
Cottoids, downstream	3,357	1,830
Totals	10,835	8,331

and dam.

It is obvious that one of the major objectives that might be attained through the operation of the trap is an enumeration of the spawning fish and their resulting progeny when they return as adults from the ocean. Since the life of the steelhead before maturity is divided *by their migration* into the two major periods of stream and ocean life it would be desirable also to have a count of the number of young fish migrating to the ocean each year in order to segregate the mortalities occurring in the two parts of the life cycle. Only a portion of the water flowing in the stream can be passed through the screens of the trap during high water and therefore only a portion of the fish passing downstream can be taken. In order to determine the total number of young migrants most of these trout and salmon taken in the trap are marked by the removal of fins. The total number of migrants is then determined through the ratio of marked to unmarked among the adult fish when they return and are taken on their upstream migration. This ratio can only be used after the fish have been aged through a reading of their scales.

During the coming season of 1935–36 sufficient additional returns should be received from the marking of migrants during 1933–34 to make possible the determination of the total number of migrants during that season. It will thus be possible to calculate the percentage of the total number of migrants taken by the trap and this will be reported upon at an early date.

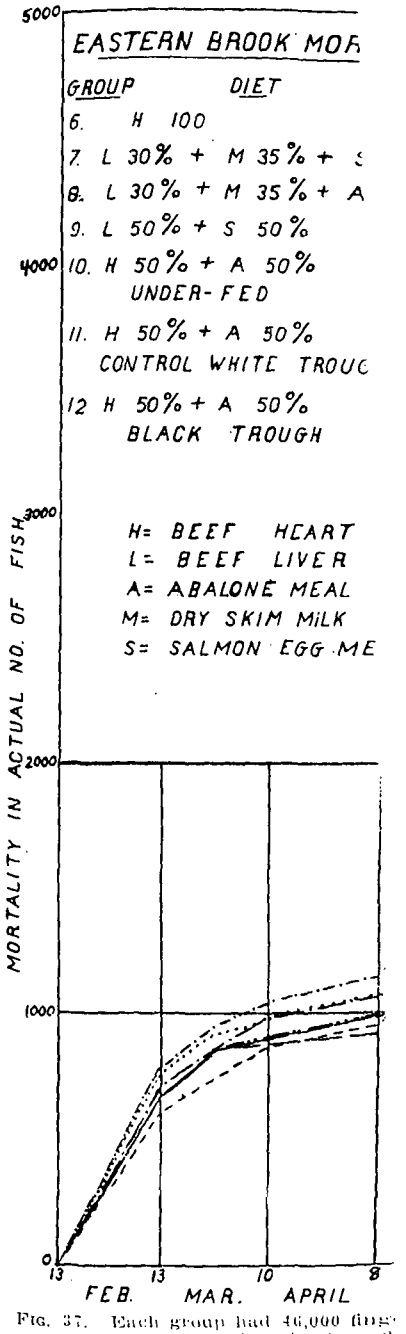

FIG. 37. Each group had 46,000 fing
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7, 8, 9. On July 24, 10,000 fish w

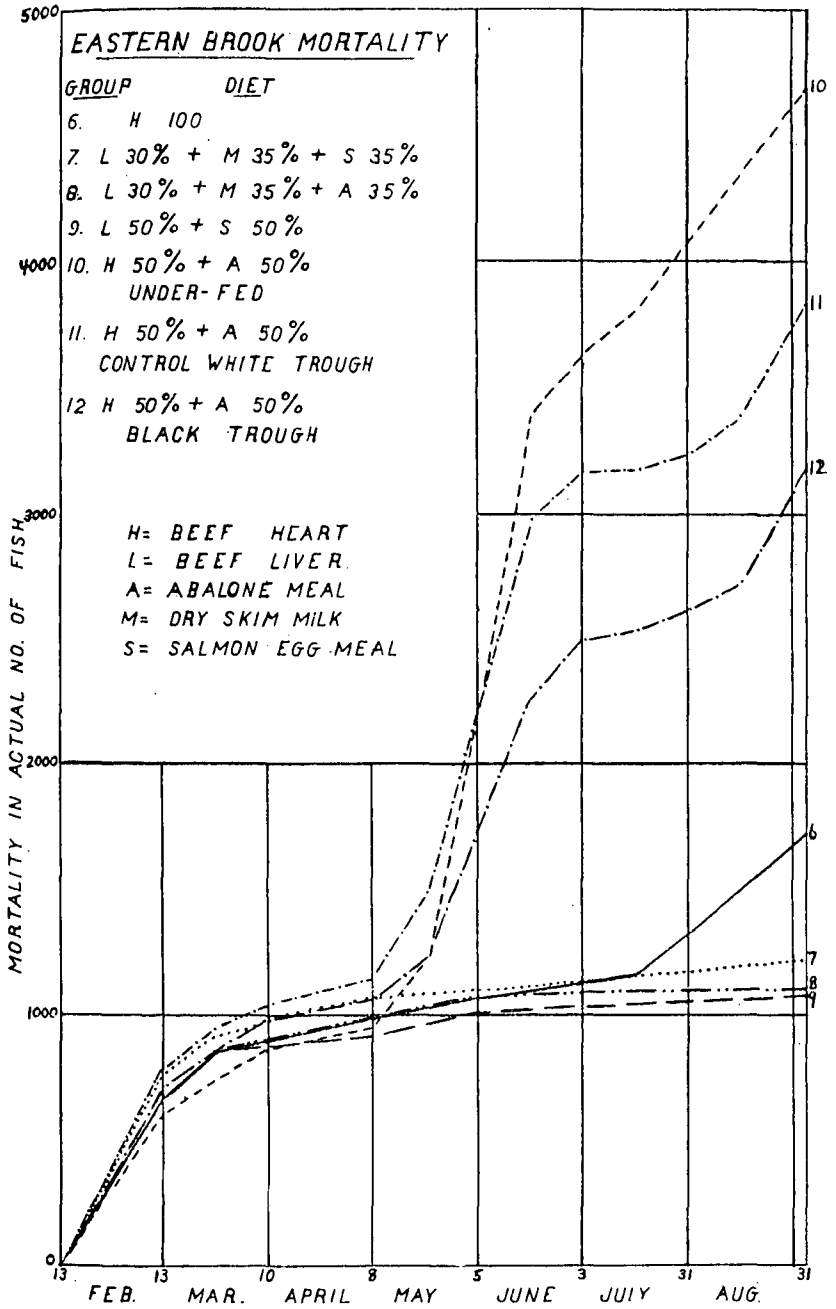

FIG. 37. Each group had 46,000 fingerlings at start. This number was reduced to 30,000 on May 29. On June 25, 10,000 fish were removed from groups 6, 7, 8, 9. On July 24, 10,000 fish were removed from groups 7, 8, 9.

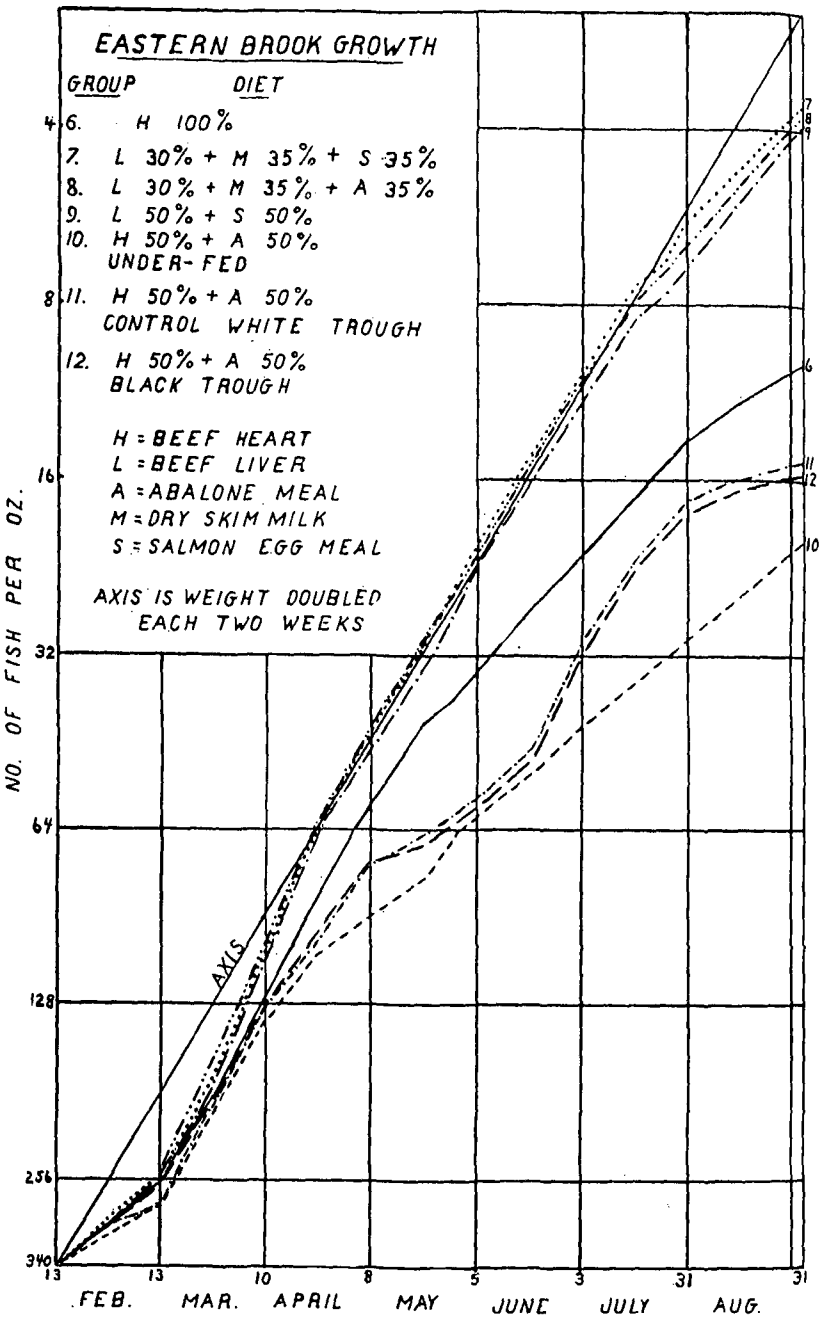

FIG. 38. Growth curve comparing the Eastern Brook diets with an "axis" which represents a doubling of weight each two weeks. Each group had 46,000 fingerlings at start. This number was reduced to 30,000 on May 29. On June 26, 10,000 fish were removed from groups 6, 7, 8, 9. On July 24, 10,000 fish were removed from groups 7, 8, 9.

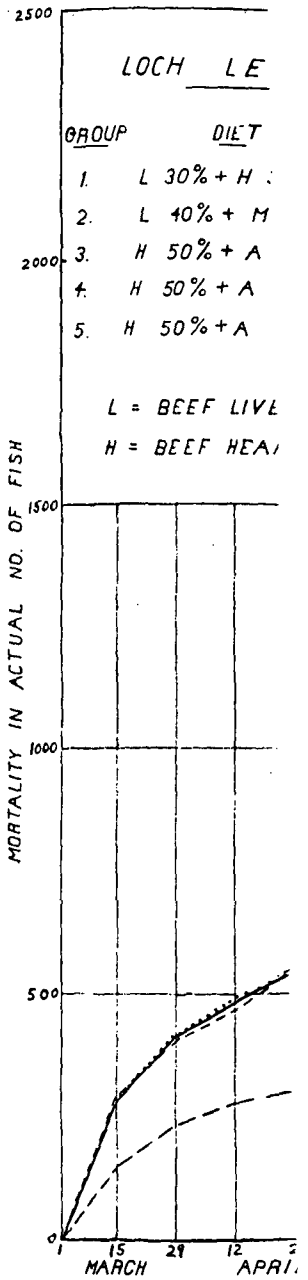

FIG. 39. Each group had
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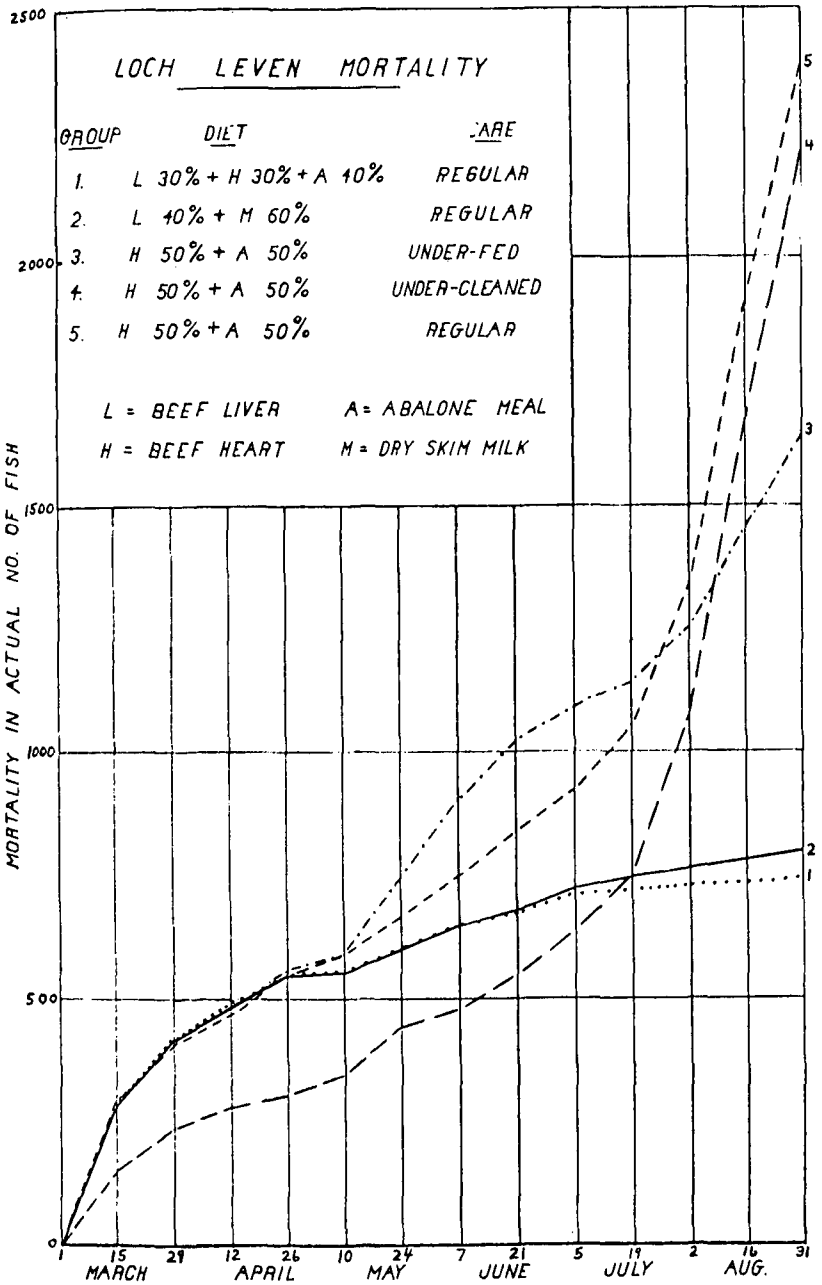


FIG. 39. Each group had 46,000 fingerlings at start. This number was reduced to 30,000 on July 5. On August 2, 10,000 were removed from each group.

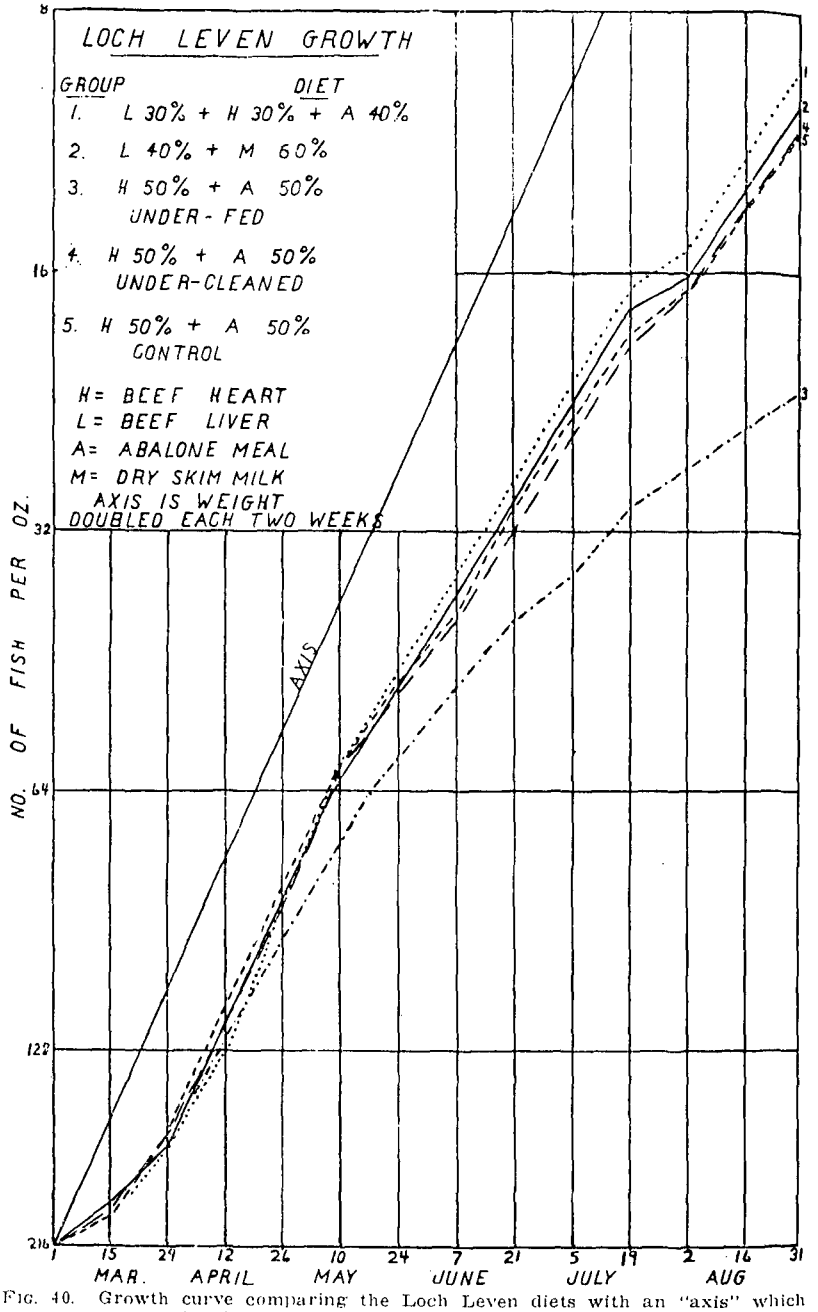


FIG. 40. Growth curve comparing the Loch Leven diets with an "axis" which represents a doubling of weight each two weeks. Each group had 46,000 fingerlings at start. This number was reduced to 30,000 on July 5. On August 2, 10,000 were removed from each group.

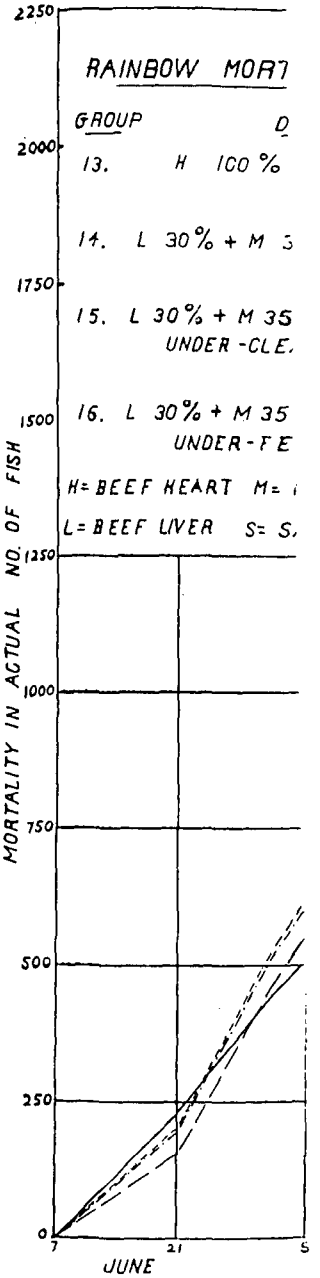
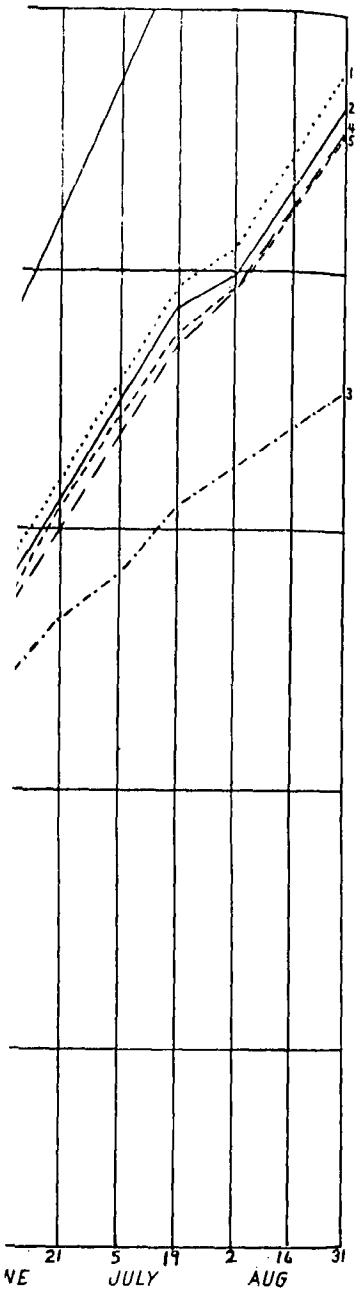


FIG. 41. Each group had 46,



Leven diets with an "axis" which
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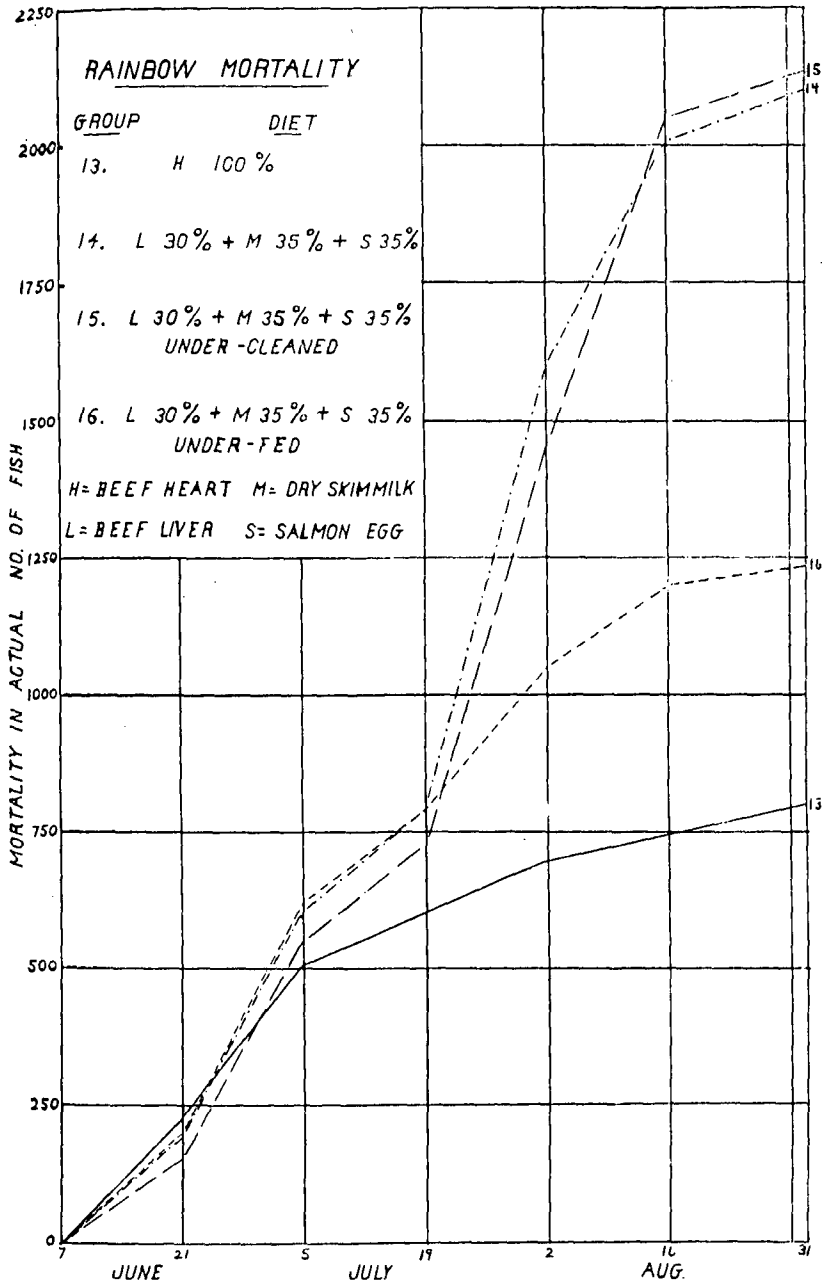

FIG. 41. Each group had 46,000 fingerlings at start. This number was reduced to 30,000 on August 16.

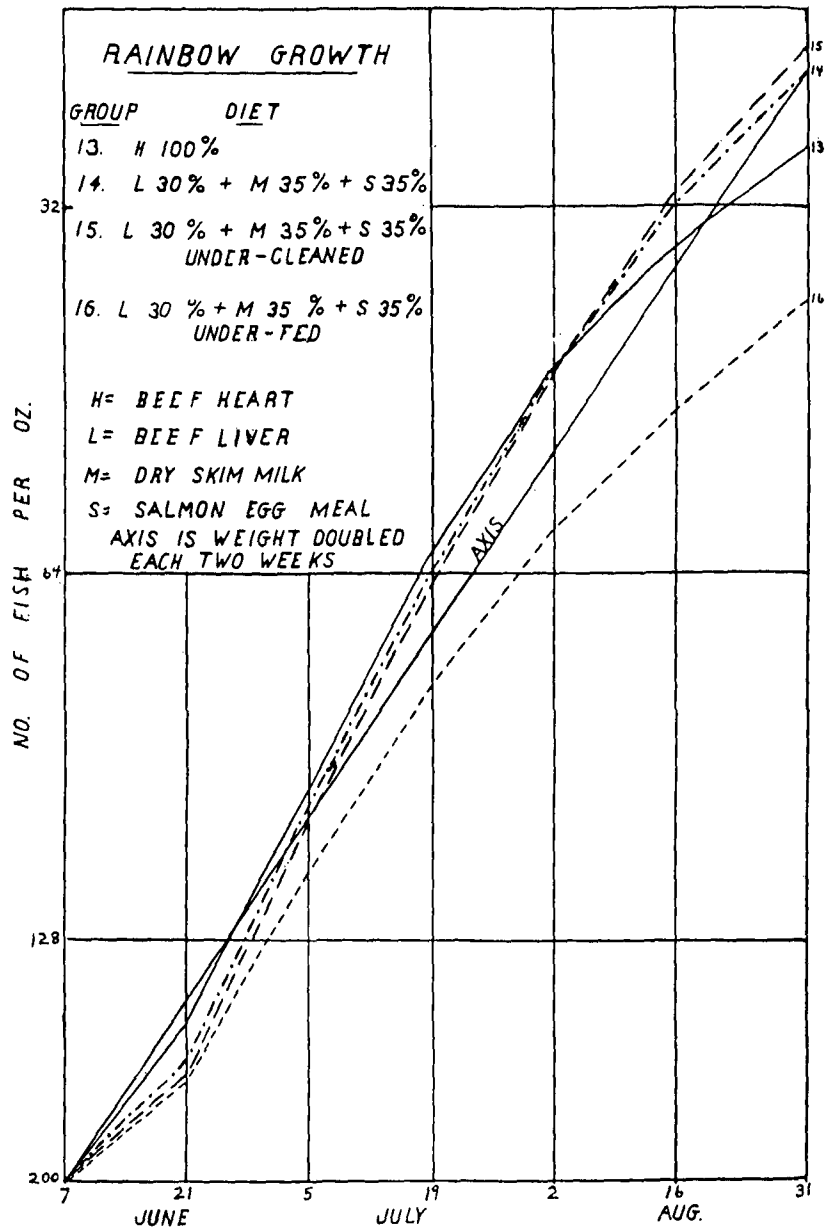

FIG. 42. Growth curve comparing the Rainbow diets with an "axis" which represents a doubling of weight each two weeks. Each group had 46,000 fingerlings at start. This number was reduced to 30,000 on August 16.

PROGRESS REP
EXPE

By J. H. \

This is the second repo
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Trout Hatchery located at M
These experiments are
of food and the feeding met
eries. However, other probl
trout are being studied.
The recent advance in
apparent than ever before t
Previous investigators have f
foods and we have reached th
1934 and 1935. We have f
adequate and can be used eco
first six weeks of feeding. W
method of feeding these meal
forated bottoms is not practi
spread use of meal substitutes,
has been devised. Experime
conducted at the present time

OBJECTS

The experiments to be re
to: 1. Compare beef heart wit
and when they were fed in c
To determine the effect of cert
bow as well as upon Loch Le
sively in the 1934 experiment
feeding fingerlings. 4. To disc
health of fingerlings if the tro
are at present in California.
black troughs would be more
white troughs.

DESCRIPTION OF THE EXP

The Loch Leven or Brown
stock at Mt. Shasta. Those use
ber 20, 1934, from unselected fis
of these were placed in each
hatching on January 16, 1935
Before they began to feed the
per trough. This of course me
as each group is composed of a
is 16′ x 16″ and holds about 80
lons per minute. On July 5, e

* California Fish and Game, Vol.
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