LABORATORY REARING EXPERIMENTS ON ARTIFICIALLY PROPAGATED INCONNU

(Stenodus leucichthys)

by

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INTRODUCTION

Attempts to rear Inconnu, *Stenodus leucichthys*, in some localities popularly known as sheefish, in hatcheries in Alaska have been unsuccessful to date (Alt, 1973). Unexplained, catastrophic death of all fry has occurred repeatedly. Pond rearing has been more successful in regard to growth, but due to several factors, these experiments have always been prematurely terminated. For instance, cooling ponds on military establishments have been used with fair success but because these ponds are managed primarily in conjunction with the operation of the power plant, the fish have been killed by such occurrences as a drop in water temperature caused by a shut-down in the plant.

A somewhat successful attempt to rear these fish in a hatchery was conducted at the Garrison Dam National Fish Hatchery at Riverdale, North Dakota, in 1968. The fish grew very slowly in the hatchery on commercial foods but growth improved markedly when the fish were moved to shallow ponds which had been fertilized to promote the growth of zooplankton.

In conjunction with their efforts to hatch and raise Inconnu at Lost Lake during 1973, the Sports Fisheries Division of the Fairbanks office of the Alaska Department of Fish and Game requested that the Institute of Water Resources of the University of Alaska also attempt to raise some of these fish in controlled laboratory conditions.

The objectives of this project were:

1. To try to raise the sac fry until a suitable lake became open about the beginning of June.
2. To attempt to raise these fish to fingerling size.

Unstated implied objectives were the testing of holding temperatures and foods. With the aid of the cooperator, Ken Alt of the Alaska Department of Fish and Game, two temperatures and four foods were chosen for testing.

The temperatures chosen were 5°C (41°F) and 8°C (46°F). The foods the investigators selected were hatchery chow, trout starter, algae, and brine shrimp nauplii. Trout starter proved to be unavailable and freeze-dried daphnia was substituted.

METHODS

Temperature Control

Selected constant temperatures were maintained as well as possible throughout the experiment period by immersing one- and two-gallon glass aquaria in Living Streams and Instant Oceans cooling baths (manufactured by Frigid Units, Inc., and Aquariums Systems, Inc., respectively). Temperature was monitored in each with a thermocouple which was wired to a Honeywell Psychrotherm 24-point recorder. Adjustment was occasionally made as the ambient temperature fluctuated to maintain one of each type of bath at 5°C and one of each type at 8°C.

Light Control

Each cooling bath was screened from room light by placing sheets of opaque black plastic over the glass windows and styrofoam covers (later replaced with masonite) over the tops. These light covers were eventually removed for reasons explained in the Results and Discussions section of this paper.

Water

The water used was obtained from the piped Fox Spring located at Fox, Alaska. The water brought into the laboratory on January 12, 1973, was analyzed with a Hach test kit without calibration of the colorimeter with standards. Total hardness was measured as 257 mg/l as calcium carbonate, and the calcium hardness was measured as 126 mg/l as calcium carbonate. The pH was 6 as measured with pH paper. Alkalinity was measured as 129 mg/l as calcium carbonate. Chloride was measured as 57 mg/l, copper as 0.22 mg/l, and iron at 0.07 mg/l. Nitrate nitrogen was measured as 4.2 mg/l and orthophosphate was measured as 5.5 mg/l.

Some of the water brought into the laboratory on January 27, 1973, formed a thick orange layer at the bottom of the containers. When this was examined microscopically, it appeared to contain a rod-shaped, motile bacterium, probably *Ferrobacillus* sp., rust, and unidentified flagellated invertebrates. This water was discarded and replaced.

Foods Presented

Four separate foods were presented to the Inconnu. Each food was presented to fish incubated at 5°C and 8°C and in both types of cooling baths where possible. The foods presented were freeze-dried *Daphnia* sp.; nauplii of brine shrimp, frozen and freeze-dried; a laboratory culture of algae, mainly *Selenastrum* sp.; and Oregon mash, a commercial hatchery food.

Frozen nauplii of brine shrimp were unsuitable as they tended to foul the water, even when washed. Therefore, the fish started on this food were switched to pulverized freeze-dried nauplii of brine shrimp. Freshly hatched brine shrimp nauplii were never fed as the attempted culturing operations were a failure due to fungal growth.

Seed for the culture of *Selenastrum* sp. was obtained from a continuous culture maintained by the Institute of Marine Science at the University of Alaska at Fairbanks and was incubated in five-gallon battery jars filled with water from the Fox Spring illuminated with Gro-Lux lamps. This culture was fed ammonium nitrate and sodium orthophosphate whenever it became yellow in appearance. Flagellated protists were found in the culture as soon as it began to grow, and as it aged, colonies of *Anabaena* sp. became established. Care was taken when removing algae with a pipette for feeding the Inconnu to avoid the colonies of blue-green algae.

Fish

The fish were air-freighted as sac fry to the laboratories of the Institute of Water Resources at the University of Alaska at Fairbanks from the Fire Lake Hatchery at Anchorage. They arrived in two shipments.

The first shipment of 4,500 arrived on February 1, 1973. These averaged 10.0 mm in length. Another shipment of 5,000 arrived on February 22, 1973, averaging about 14 mm in length.

RESULTS AND DISCUSSION

Mortality

Feeding of the fry began on February 25, 1973. The first shipment of Inconnu had just experienced a large mortality beginning on February 23. The fish in the first shipment, incubated at 8°C, had most of their yolk sacs depleted by that date while the fish incubated at 5°C still had some yolk material. Though the fish in the second shipment were approximately the same size as those of the first shipment at this time, they still had about half of their yolk material, and were reported to have hatched just prior to their arrival on February 22. It is possible that this mortality of the fish of the first shipment was due to starvation. Food had been presented to some of these fish prior to the mortality; but when they did not seem to feed, it was decided to postpone regular feeding to avoid oxygen stress by wasting food.

The numbers of dead fish removed twice daily from the tanks was recorded beginning March 13, 1973. This data is presented in Figures 1 through 4-d where the number of survivors for the particular experimental condition is plotted against a time factor, indicated by date. When it is considered that each shipment of Inconnu contained about 5,000 fish, and that on March 13, there were a total of 514 survivors from shipment #1 in comparison with 4142 survivors from shipment #2, it is obvious that peak mortality for shipment #1 occurred before March 13.

The survival of the remaining fish in shipment #1 appears, upon examination of Figures 1 through 2 , not to have been significantly influenced by temperature or food differences. Small differences can be noted such as that there were some survivors ($\sim$10) on March 31, 1973, in each of the 5°C aquaria whereas the 8°C aquaria for the most part had no survivors by this time.

Figures 3a through 4d , illustrating the survival of the fish of the second shipment, seem to indicate that overcrowding of the fry may have been a factor that caused mortality. This is indicated by a heavy mortality over a few days followed by a decline in the death rate except in the aquarium containing the brine shrimp-fed fish. There were initially

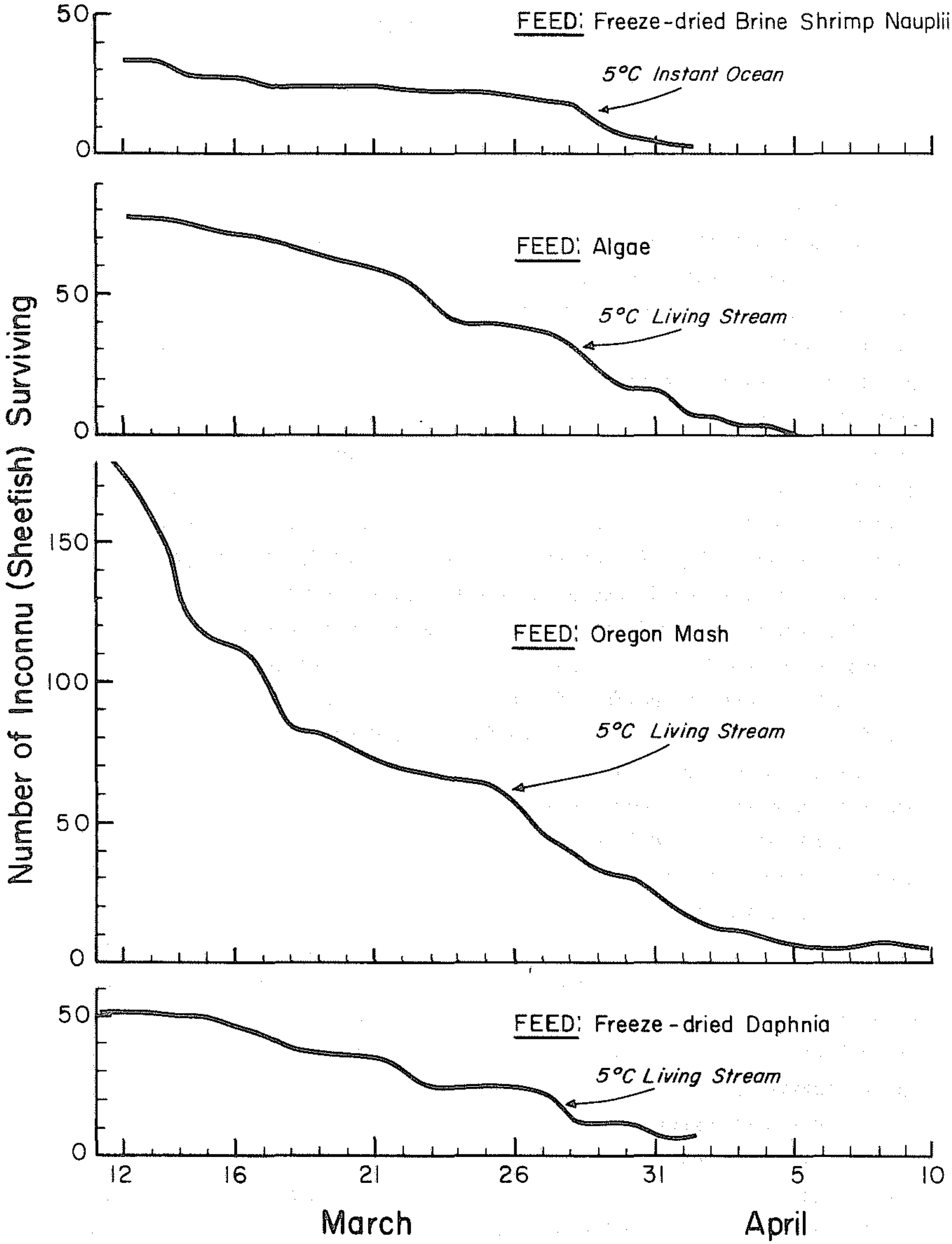

Fig. 1. Survival of Inconnu incubated at 5°C from Shipment Number 1.

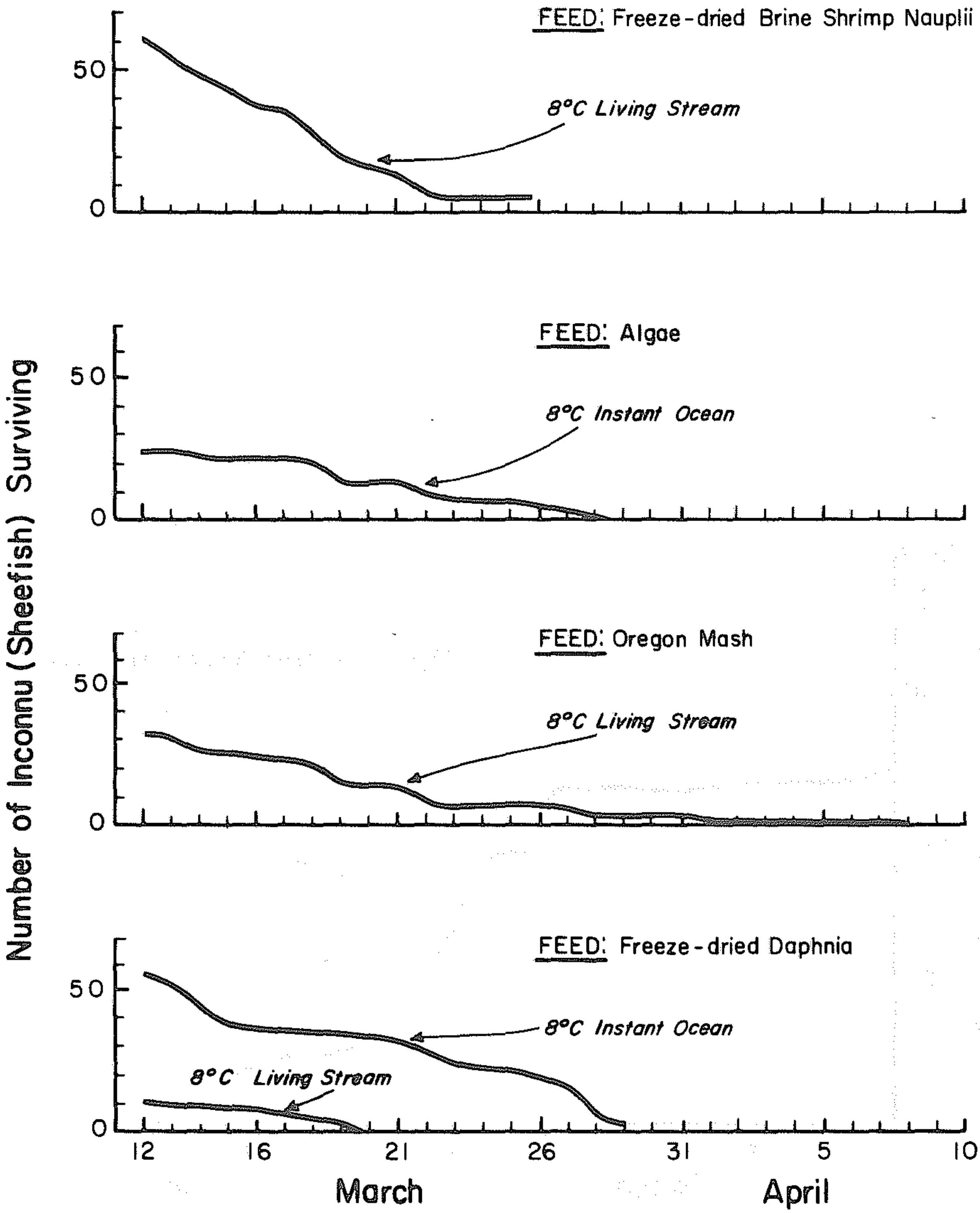

Fig. 2. Survival of Inconnu incubated at 8°C from Shipment Number 1.

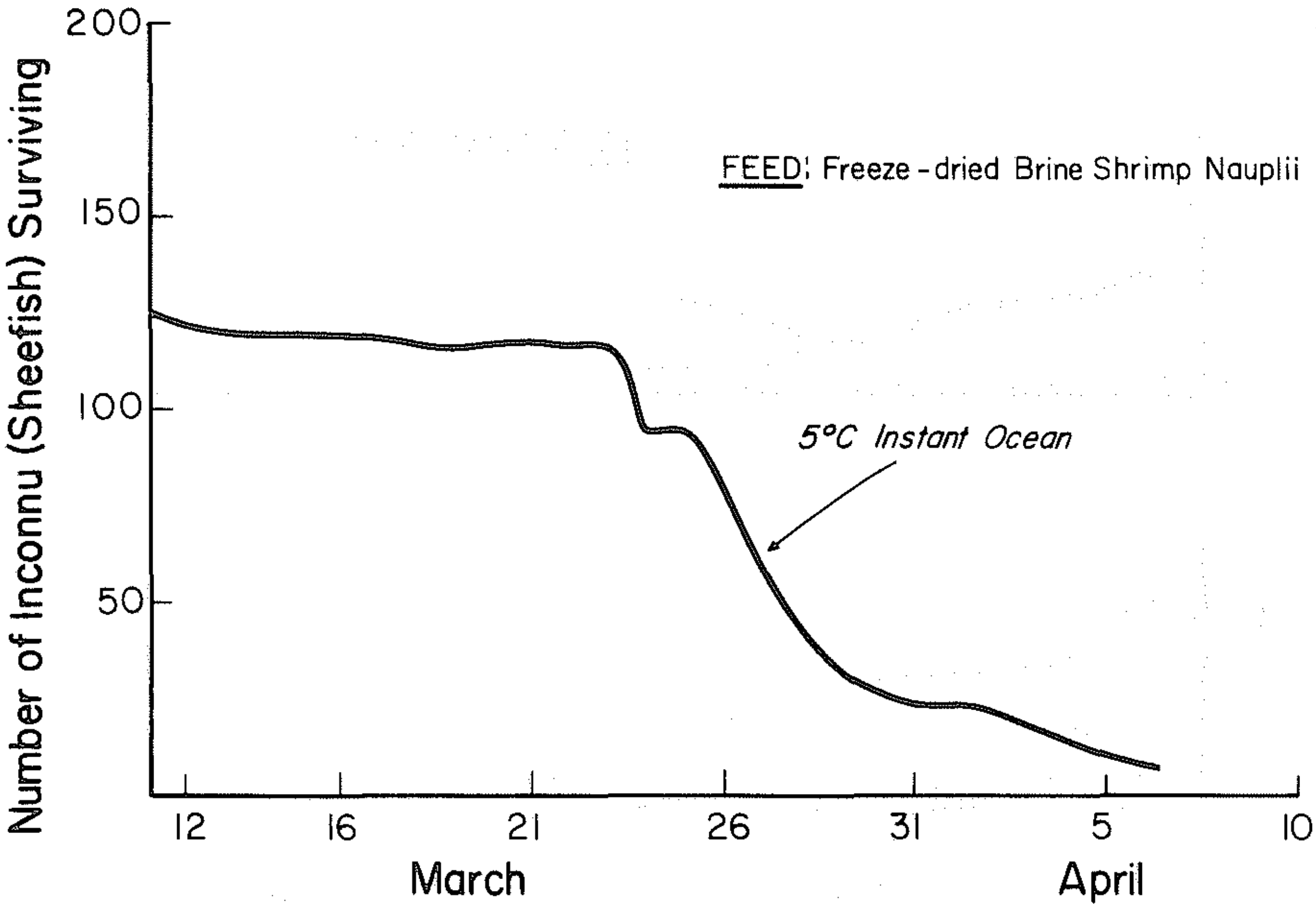

Fig. 3a. Survival of Inconnu incubated at 5°C from Shipment Number 2.

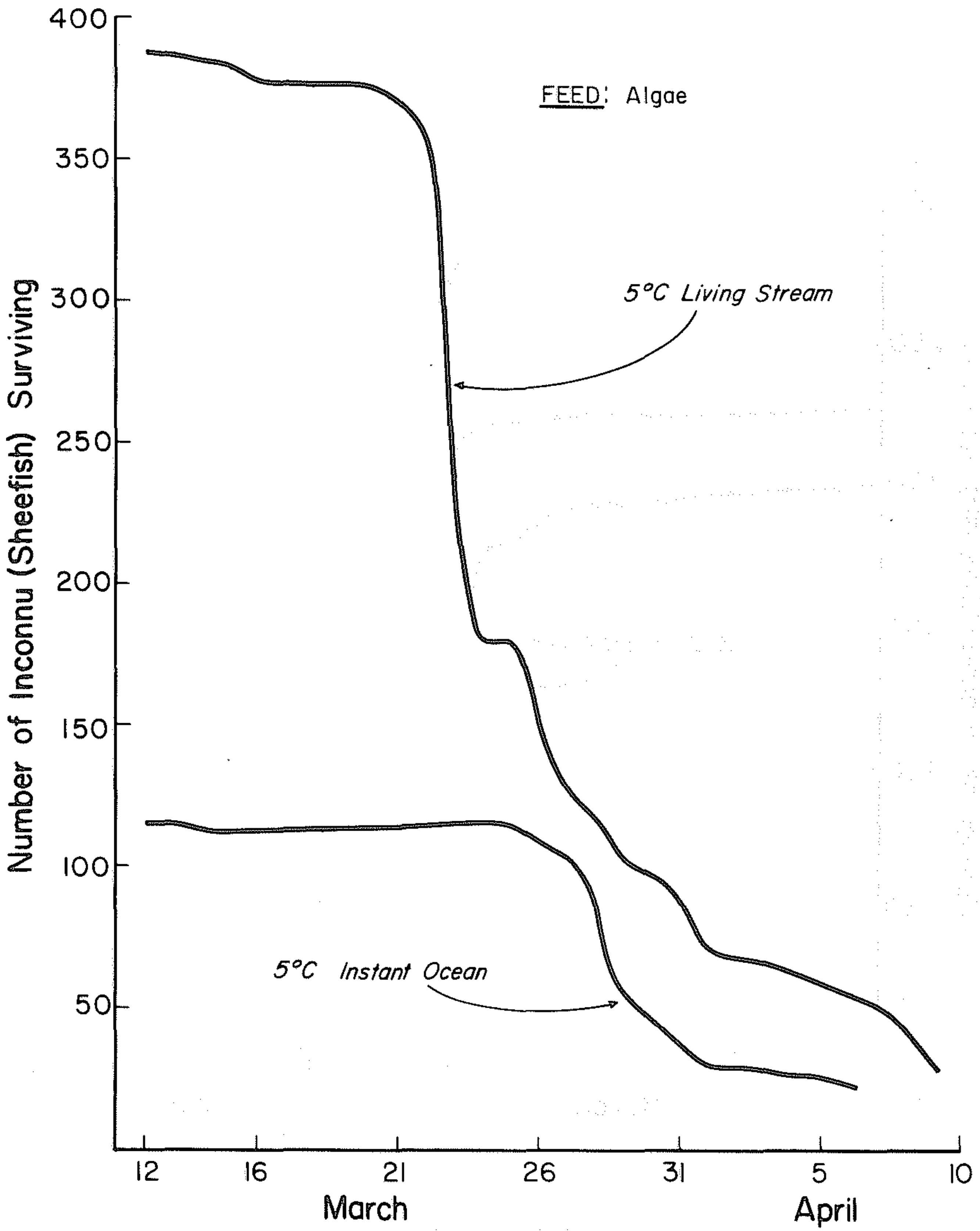

Fig. 3b. Survival of Inconnu incubated at 5°C from Shipment Number 2.

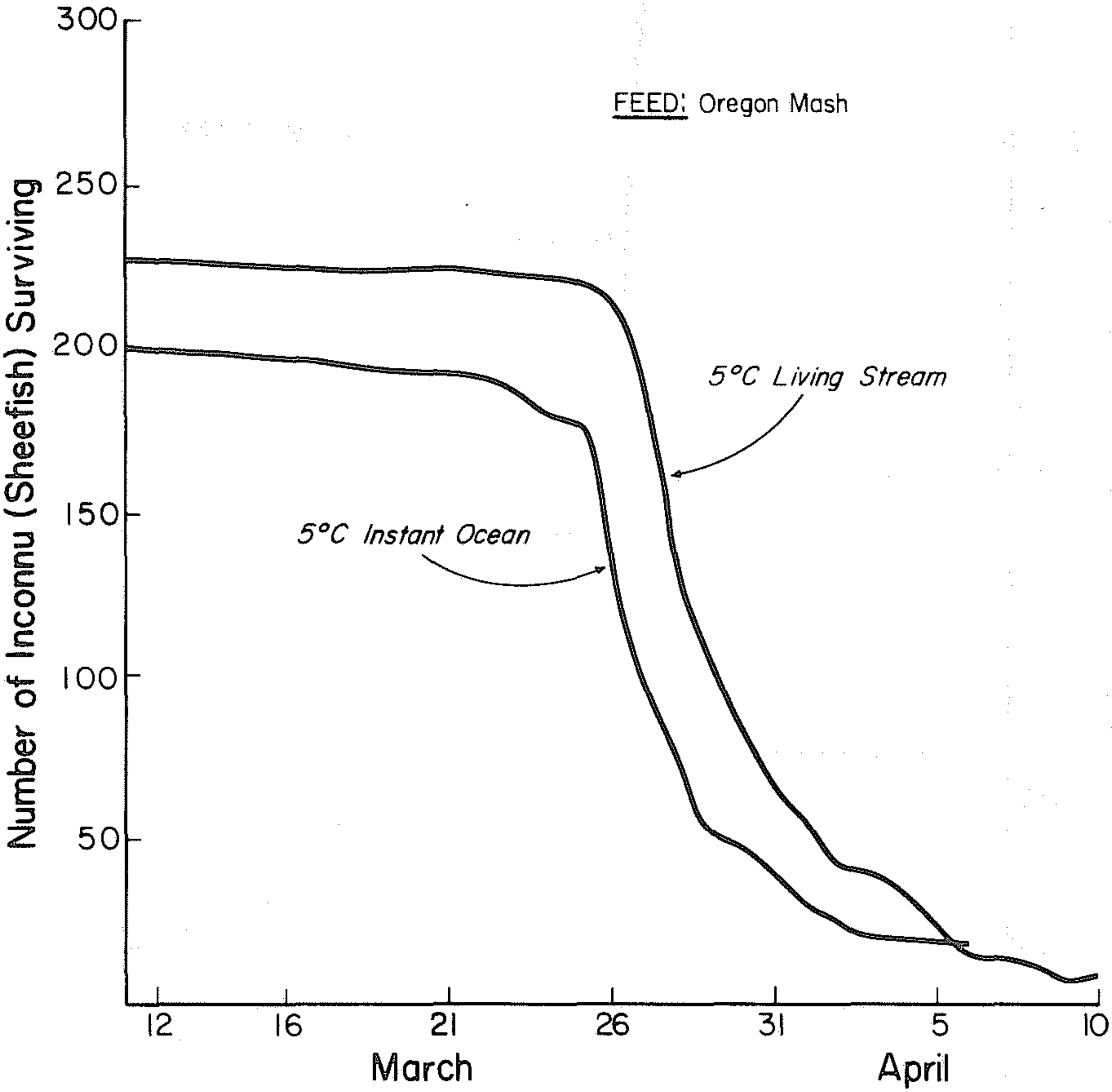

Fig. 3c. Survival of Inconnu incubated at 5°C from Shipment Number 2.

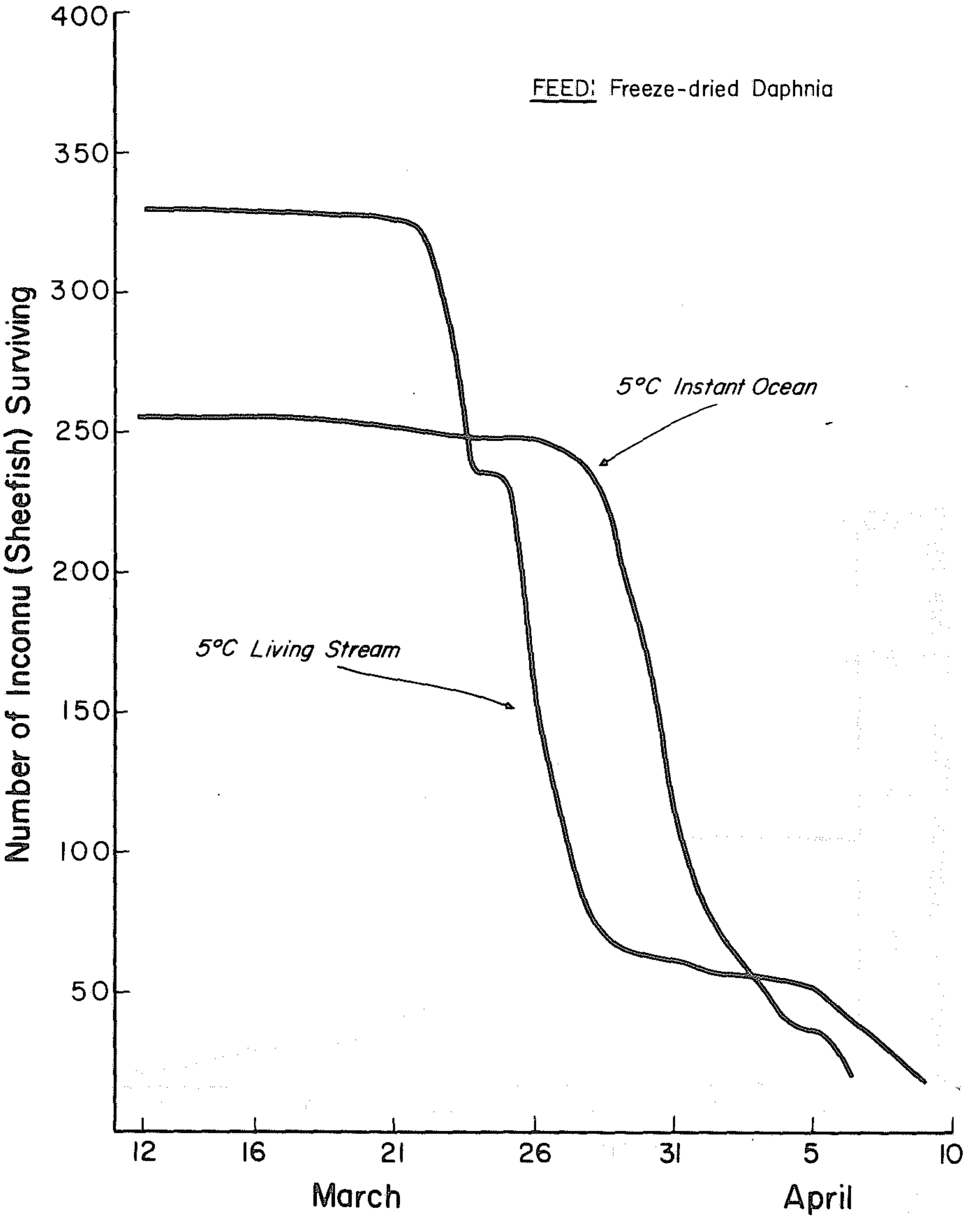

Fig. 3d. Survival of Inconnu incubated at 5°C from Shipment Number 2.

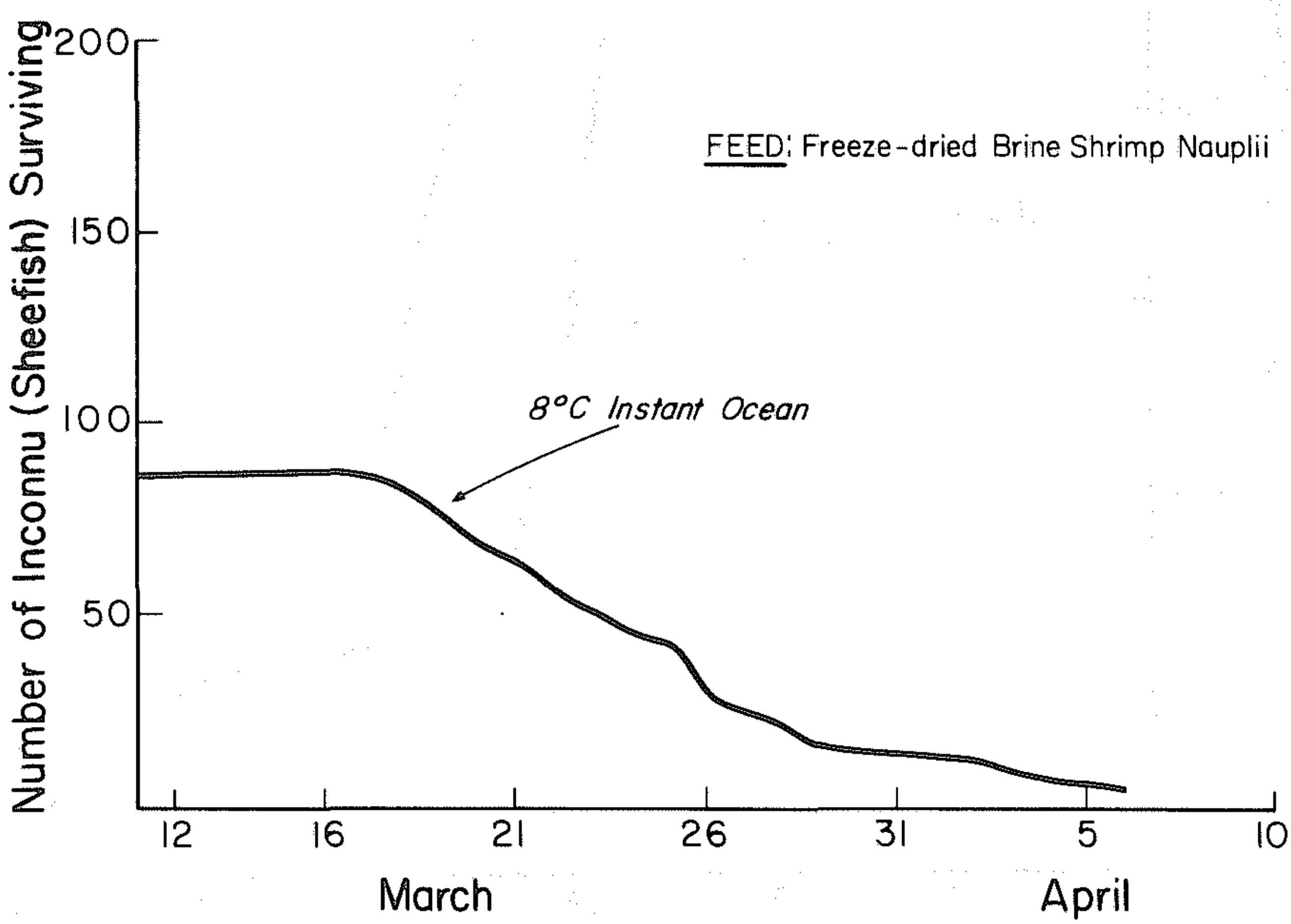

Fig. 4a. Survival of Inconnu incubated at 8°C from Shipment Number 2.

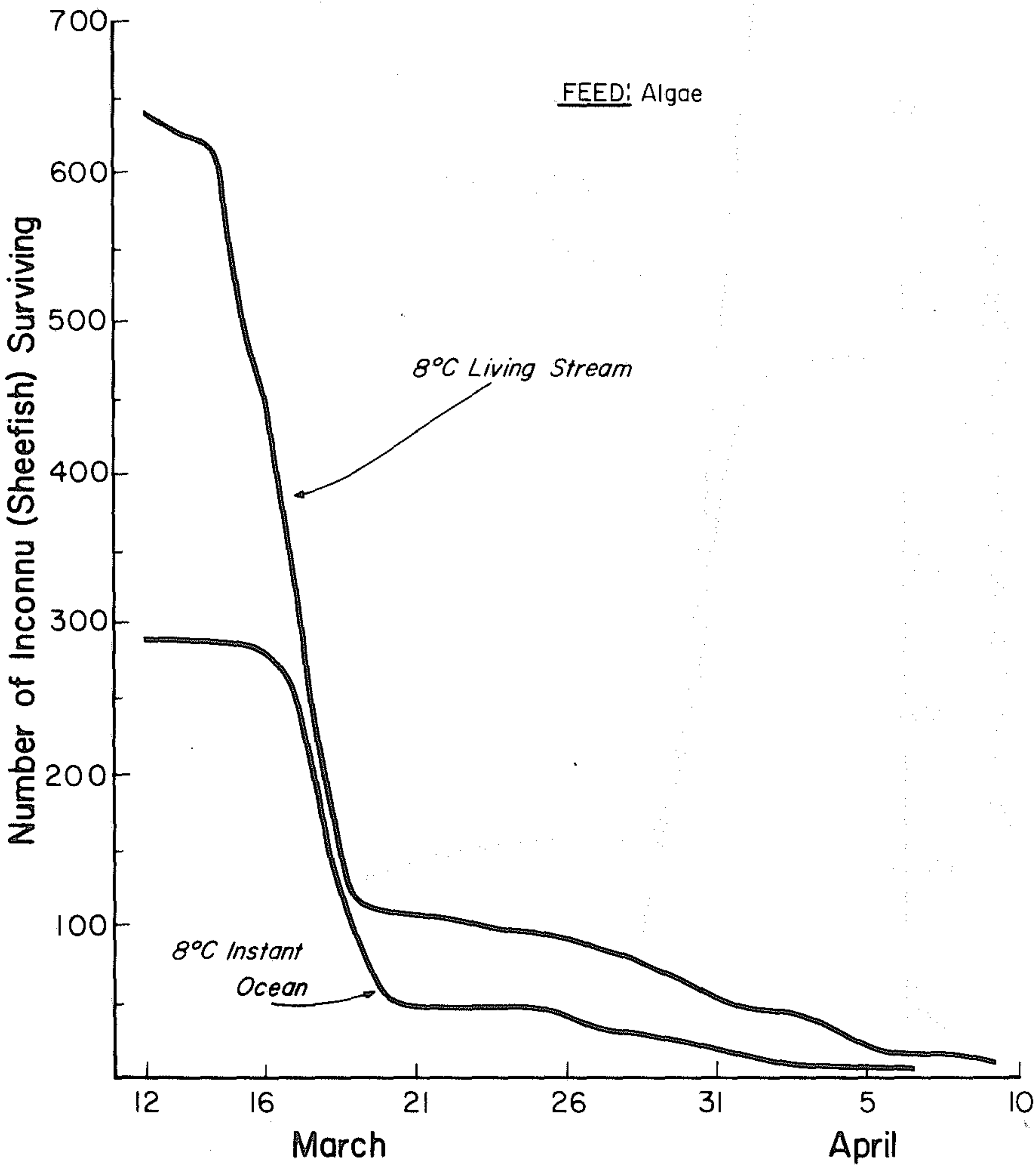

Fig. 4b. Survival of Inconnu incubated at 8°C from Shipment Number 2.

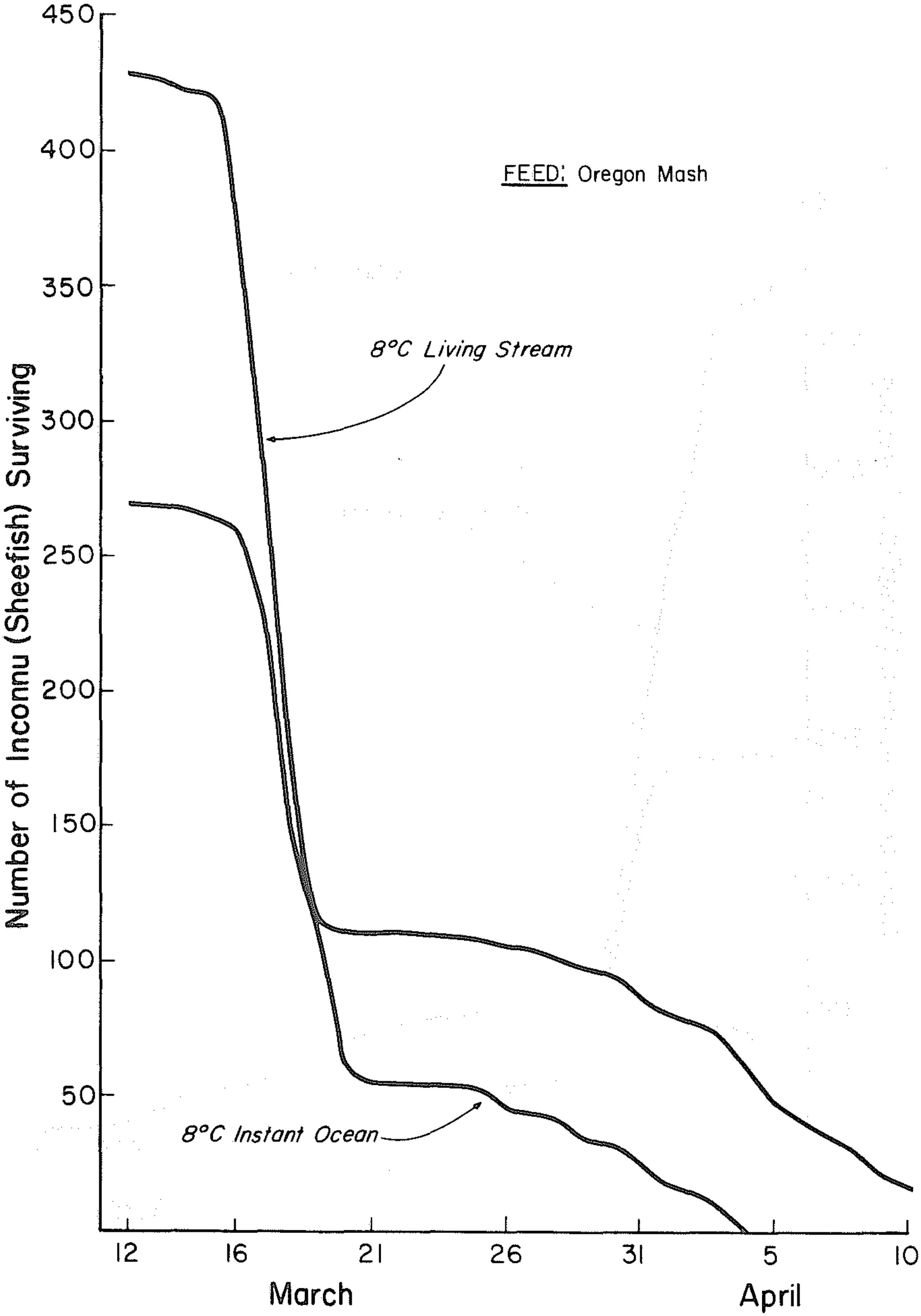

Fig. 4c. Survival of Inconnu incubated at 8°C from Shipment Number 2.

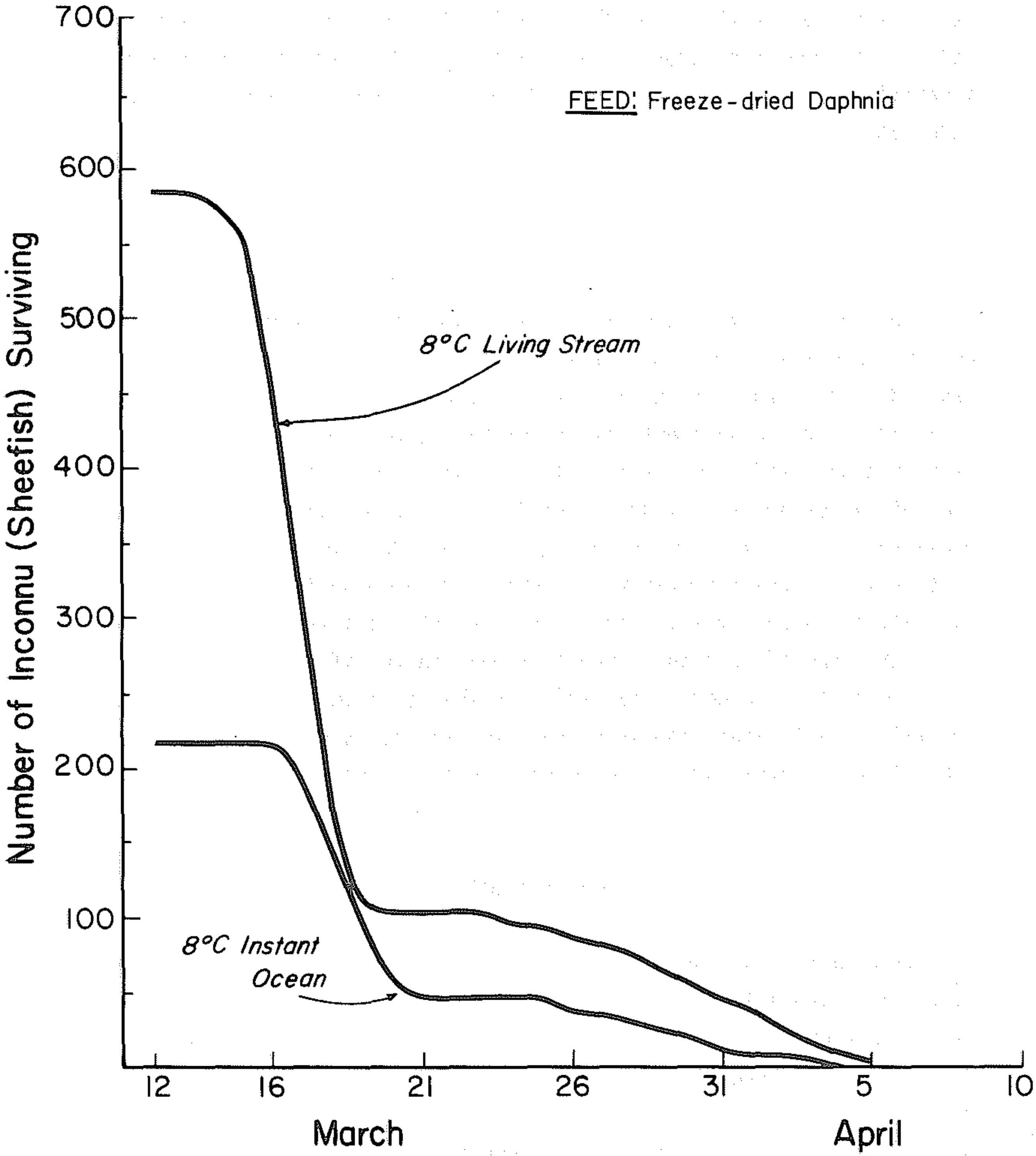

Fig. 4d. Survival of Inconnu incubated at 8°C from Shipment Number 2.

only about 200 fish in this aquarium. However, there are contra indications against this conclusion such as the gradual decline in numbers in the 5°C aquaria for up to two weeks before the sudden mortality.

The mortality curves seem to indicate that when a certain stage of development was reached, the fry were limited by one or more environmental factors and death ensued. Temperature influenced this occurrence temporally, apparently by causing slower development in those fish incubated at the lower temperature.

Growth

The growth of the fish of the two shipments as illustrated in Figures 5 and 6 was slow as was previously experienced in the prior Alaskan and North Dakotan hatchery work. The measurement taken was a non-standard length measurement the author has termed spine length. The fish were measured from the tip of the lower jaw to the last visible bone of the spine projecting upward into the caudal fin. Some of these measurements were made on the fish of one particular aquarium to represent growth in the temperature and shipment named while others were made to evaluate representatives on all four of the different feeds.

This type of data could probably have shown differences between treatments if there were a sufficient number of fish to allow weekly removal of replicates from each treatment for measurement. Unfortunately, initial large mortalities made this impossible.

Development

Despite slow growth, some fish went through normal development when compared to the illustrations in the paper by Smolianov (1957). Drawings of a representative fish were made with the aid of a dissecting microscope on February 16, March 27, and April 23, 1973. These are illustrated in Figure 7 , which is not drawn to scale. The fish selected on the last two dates were the same length, 15.0 mm.

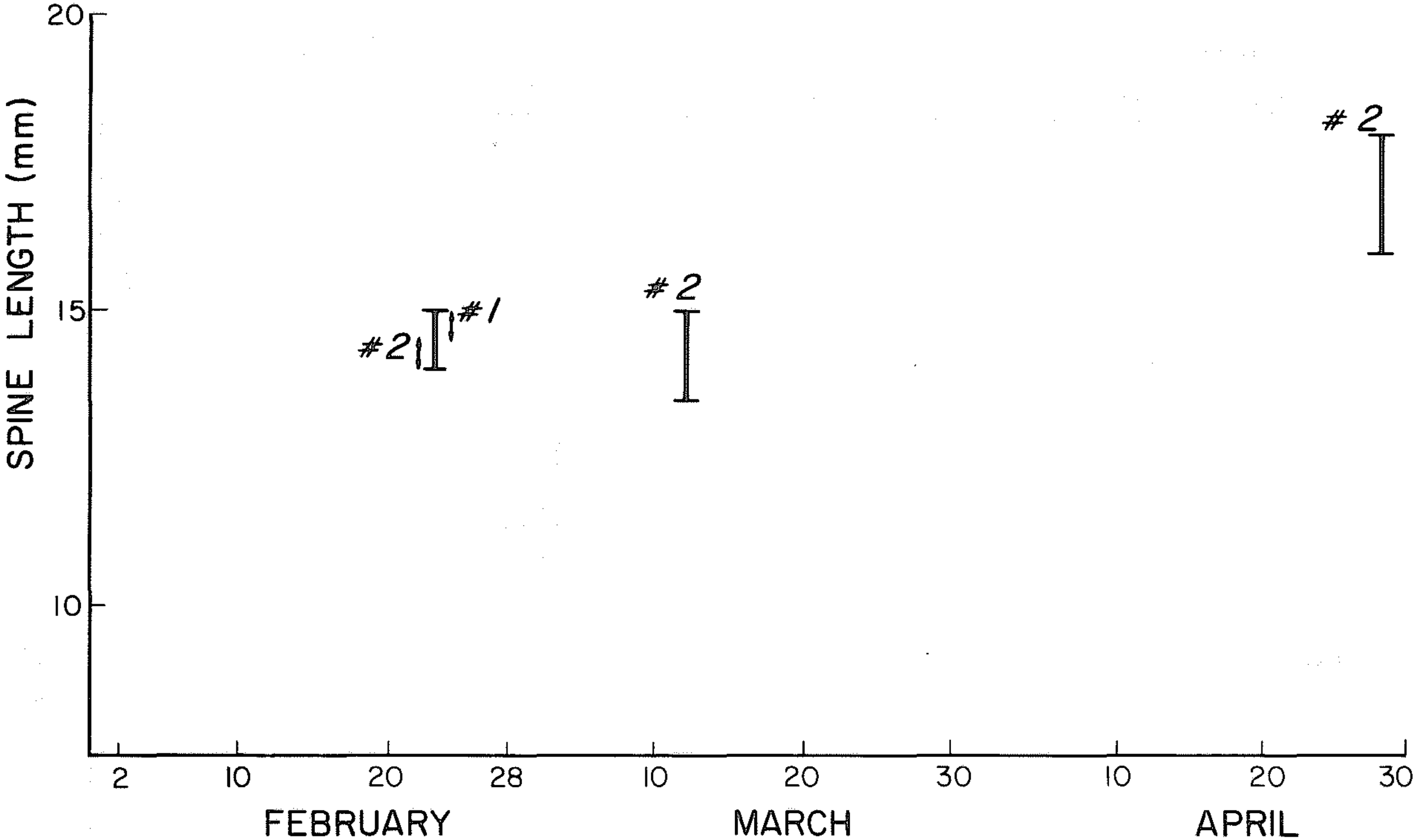

Fig. 5. Growth of Inconnu incubated at 8°C. Bars indicate the range of size. The shipment number is also indicated.

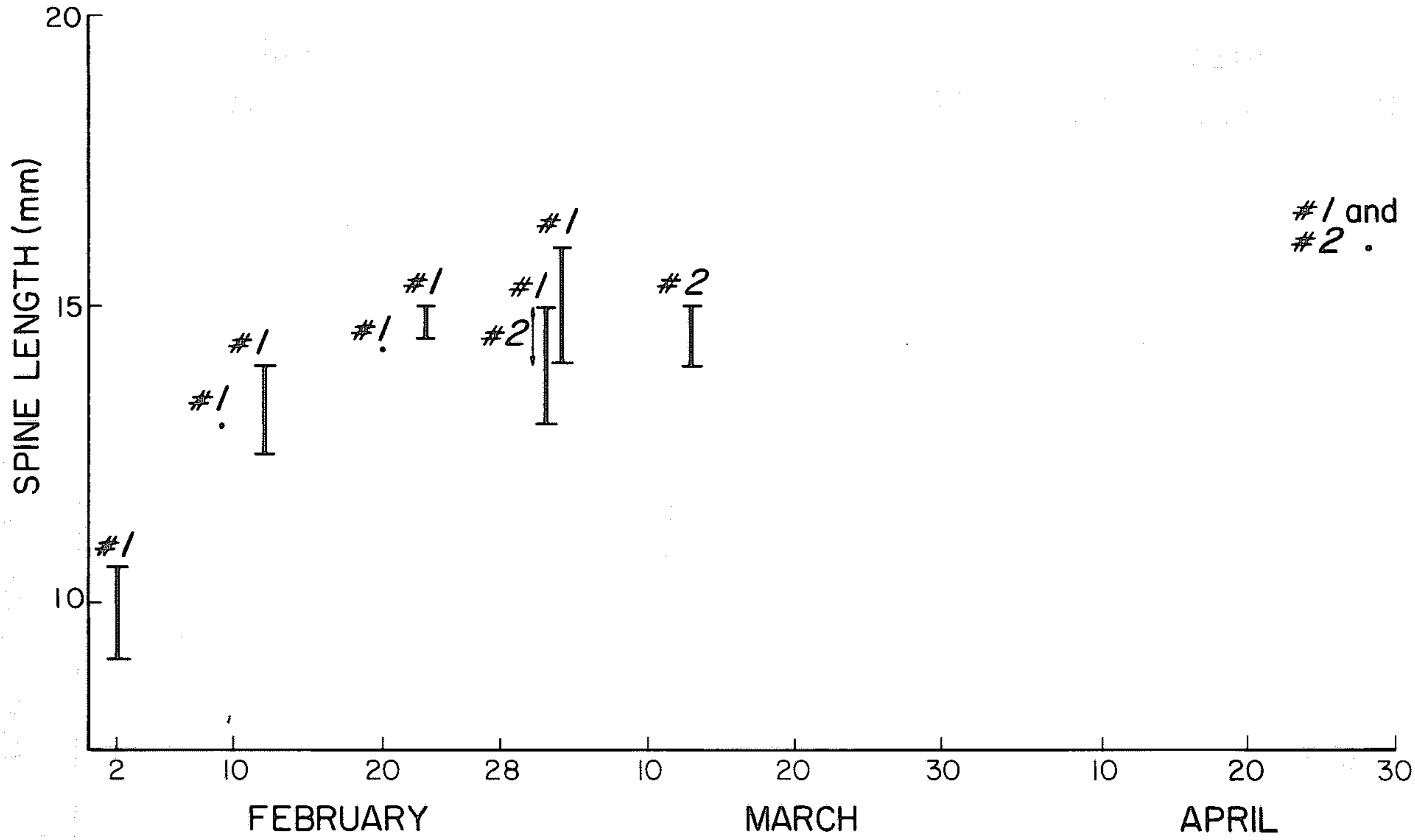

Fig. 6. Growth of Inconnu incubated at 5°C. Bars indicate the range of size. The shipment number is also indicated.

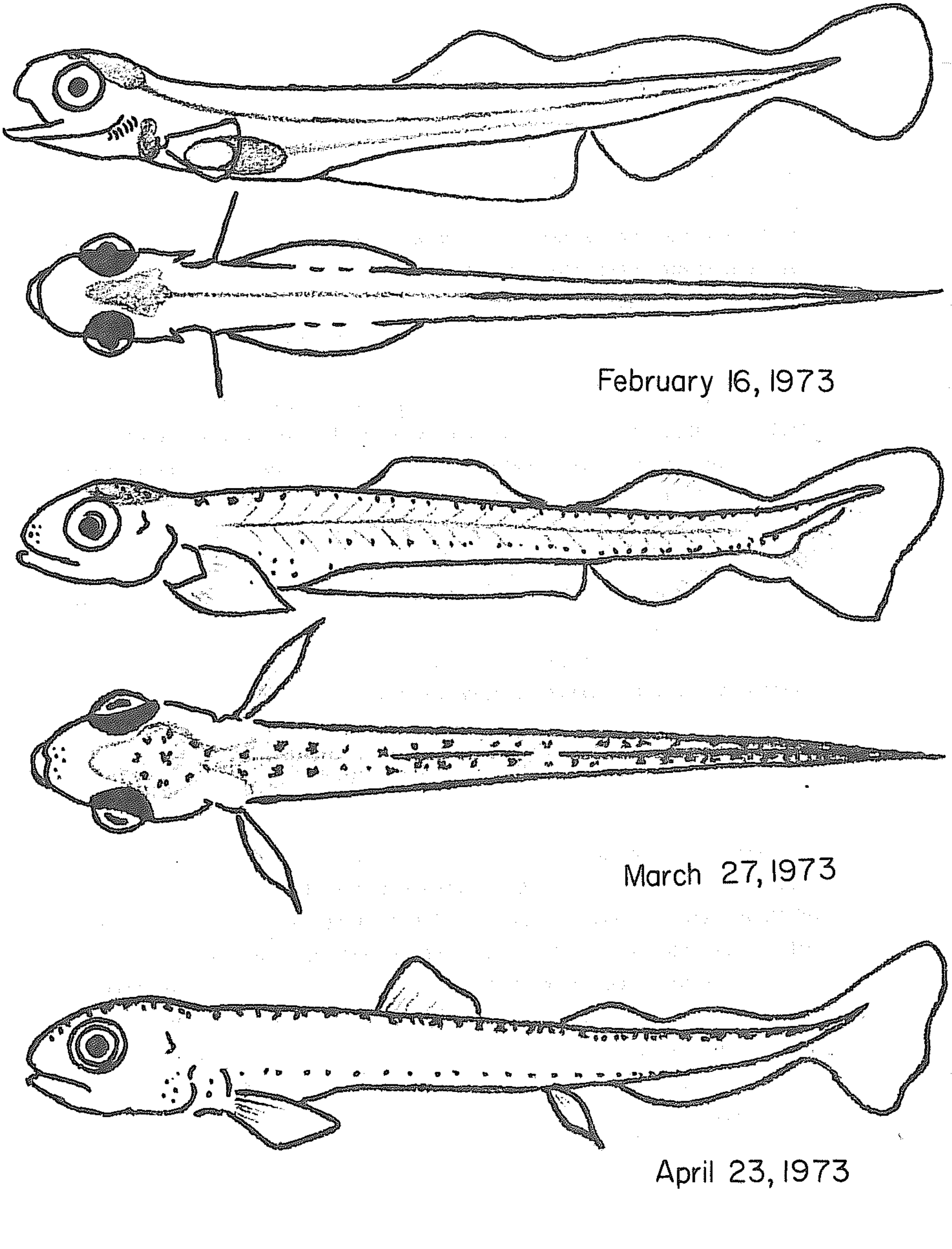

Fig. 7. Development of Inconnu young as seen through a dissecting microscope at three dates during early life.

Photoperiod

Perhaps the most significant finding made during this project was that Inconnu kept in the dark appear to enter a state of sleep. Recovery from this state is gradual over approximately 30 minutes during which time they may appear to be dead. This was discovered by accident when the covers were removed for feeding and the fish all appeared dead but slowly revived. After about May 11, 1973, the covers were left off the tanks and the black sheet plastic removed from the ports in the tanks.

During recent examination of the papers by Karzinkin (1951) and Chalikov (1951) these were found to contain the information that Inconnu do best in captivity when exposed to continuous light as this increases feeding activity. This fact could indeed be significant, as it may account for the poor growth and survival of many of the fish. It is possible that the fish from shipment #1 were removed when the investigator thought them dead when actually they were in a sleeping state. It may also account for the lack of interest in food shown by the fish of the first shipment when actually they may well have been ready to begin feeding had light conditions been correct.

Foods

The papers by Karzinkin (1951) and Chalikov (1951) seem to indicate that Inconnu do best on cultured copepods and cladocerans which are part of their natural food in streams. The fish seemed to do about equally well on all four of the foods that we presented. For hatchery rearing, it would probably be advantageous to avoid having to raise the food. Future testing should probably include a starter feed such as trout starter to assure proper size distribution (which we achieved by grinding the feeds with a mortar and pestle) and also to assure that nutritional needs of the fry are met.

Temperature

We have found in these experiments that starvation was retarded by a lower temperature environment. However, we observed on a few of the longest lived fish that growth was better in the higher water temperature. This has been discovered previously by a Russian worker (Karzenkin, 1951) who has reared them in water temperatures as high as 20°C with increased growth relative to corresponding increases in temperature.

SUGGESTIONS FOR FURTHER LABORATORY RESEARCH

1. Inconnu should be exposed to a photoperiod of 24 hours sunlight which approximates natural conditions in areas in which they are indigenous.

2. Experiments should be tried with higher water temperatures to stimulate growth.

3. Starter feeds should be used as treatment.

4. Experiments should be made with live feeds.

5. Fish should be evenly distributed to treatments, perhaps by weight, to facilitate statistical analysis and application of the data.

6. Dead fish should be counted, measured, and weighed from the onset of experimentation.

7. Treatments should be terminated at a preset level of survival, perhaps zero, not arbitrarily.

8. No current should be applied to the aquaria unless oxygen depletion is noted at higher temperatures, and then the most gentle bubbling of air should be used.

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