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PONDFISHERIES AND INTERNATIONAL LIMNOLOGICAL SYMPOSIUM

Israel August 6-28, 1968

H. S. Swingle

We left Auburn, Alabama, on August 6, 1968, and arrived Telaviv on August 7, at 7:30 p.m. From Telaviv we were driven by car to Haifa where we stayed at Hotel Levi Di Carmel.

On August 8, the tour began of the fishing industry in several selected spots of Israel. Our first trip was to the Kishon Fish Landing at the Port of Haifa. This Landing has a market, ice machines for quick freezing equipment, boat and net repairs and an office of the Department of Fisheries.

Fisheries of Israel

Carp

Several changes have been made in the carp pond fisheries in Israel, partly dictated by the fact that they cannot sell as many fish as can be produced in the pond. Consequently, the ponds are now being operated at approximately 70 per cent of their capacity. As a result of this, only two crops of fish are raised yearly instead of the three that were raised previously. This, however, allows them to raise larger fish. Two sizes of Israeli carp are marketed: first-class fish are approximately 500 grams in weight, second-class fish are approximately 300 grams in weight. They are sold live at a fixed price of 75¢ per kilogram to the farmer. The amount sold is regulated by the Fish Breeders Association. When it is determined that additional fish are needed on the market, it is allotted to a particular Kibbutz (communal fish farm) to deliver this amount. If the fish are not needed, they are kept in special holding ponds and fed until they are needed on the market. This gives the Fish Breeders Association complete control over the sales of the fish.

The carp are brought live to market in tank trucks with large tanks on the back containing roughly 4 tons of fish in 4 tons of water. The tanks are also provided with aeration; in fact, the aeration causes a froth several inches deep which covers the entire surface of the water. One would think the froth might interfere with the exchange of gases with the atmosphere, however, Mr. Tal thought it protected the fish from the sun on the way to the market. There is no cover placed over the tanks. If the carp arrive at the market dead, they are sold at half price.

Carp are sold on a controlled market. Mullet, which are also raised in the ponds, are sold on a free market; that is, the fishfarmers can raise any number of mullet possible and sell them for whatever price they may bring. The price usually fluctuates from 80¢ to $1.10 per kilogram. _Tilapia aurea_ is also sold on a free market with the price varying from 70 to 85¢ per kilogram to the farmer. Both the mullet and the _Tilapia_ are sold as dead fish. They are taken from the ponds but are not scaled or gutted before preparing for market. They are packed in boxes and frozen. Consequently, they reach the market as frozen fish. I inquired as to whether there were any complaints about the guts of the fish being filled with plankton at the time of purchase, as this often gives bad flavors to fish. However, they said that they had no complaints, and that fish were always sold in this condition. This, of course, has its advantage to the fishfarmer in that it makes unnecessary cleaning and dressing the fish. It also allows him to sell the fish without the normal 40 per cent loss in weight upon dressing.

Tilapia

At this market we also saw T. aurea being prepared for shipment to the United States. These fish were being raised in a monosex culture by several of the Kibbutz fish farms to a uniform weight of 1/2 pound. These fish were scaled and gutted, but this was the only cleaning done on the fish before freezing The heads were left on. Each fish was placed in a separate plastic bag and frozen. They were then sent to the New York market. They had received from $1,200.00 to $1,400.00 per ton of fish. A trial shipment had been sent several months earlier and these had been well received. Consequently, approximately 15 tons were being prepared for shipment at the time we were visiting the plant. Twelve hundred dollars per ton is approximately 60¢ per pound of Tilapia, while $1,400.00 would be 70¢ per pound. This is the price the wholesalers paid upon delivery to the New York market. It was estimated that these fish would finally have to sell retail at approximately $1.25 or more per pound. In addition to sending fish to the United States, they were also sending shipments of carp to West Germany and several other parts of Europe.

Hake

They also obtained a certain amount of fish from the ocean. Four trawler ships are sent from Israel off the South African coast in the Indian Ocean or the Atlantic Ocean to capture Hake. They take annually about 5,000 tons of fish.

The fish are frozen as soon as they are removed from the water and returned to Israel in a frozen condition. Still frozen, they are cut into steaks and sold on the market in this form.

Annual consumption of fish in Israel is 10 kilograms per person per year. This compares with an annual consumption of 20 kilograms of chickens per person per year. As incomes have increased, there has been a decline in the consumption of fish per person.

Kibbutz Ein Hamifrets

In the afternoon we visited Kibbutz Ein Hamifrets, located along the edge of the Mediterranean, that had 1,650 dunnams of ponds. The salinity of the water varied from 700 to 900 milligrams of chlorine per liter which would be approximately 2 ppt total salinity. This fishfarm has an abundance of water as a nearby stream empties shortly into the Mediterranean and they can use the full supply from the stream. This is pumped to a height of roughly 4 meters in large ponds and from there runs by gravity in ditches to ponds built in series. Some of the ponds are built on sand dunes immediately adjacent to the Mediterranean. When first built, the seepage was rather excessive, but organic matter accumulates as the pond ages and the seepage is gradually being reduced to 0.9 cm per day and to a total of 1.9 cm for seepage plus evaporation.

There is an abundance of water at this Kibbutz and their method of pond culture is somewhat different from that in other areas. At the beginning of each season, all the old water is disposed of and fish culture is begun in new water to prevent a possible reduction in production due to wastes in the water previously used for fish culture. One large pump is used to provide water for the entire setup. This can pump at the rate of 5,000 cubic meters per hour. The fishing year is started in March to April, when each pond is filled with new water from the river.

Carp Spawning

At this point, we need to mention that there is another change in the operation of Israeli ponds. In the traditional method of operation, they have stocked 2 sizes of fish into the ponds; one size of approximately 100 grams each (these are the fish that will be harvested at the end of the growing period), and a second size of roughly 10 grams each is understocked in the ponds and these will be the fish that are kept to stock in the next fish production period. By that time, they will have reached a size of approximately 100 grams. This system has given good results except for one difficulty; that is, as these larger carp of 100 grams were placed in ponds of fresh water, occasionally there was heavy spawning (called "wild" spawning), and for a while the Israeli workers felt that this was due to some genetic characteristic and they hoped to eventually produce a strain of carp that would not spawn under these conditions. However, from our work at Auburn on repression, we felt that it was merely the result of stocking in the ponds carp of a size that could spawn before a repressive effect was built up.

For a short period of time, Mr. Pruginin had worked out a method of partial poisoning the edge of the pond to destroy many of these small carp, using the Auburn method of marginal poisoning. However, with more work, a better method of handling this was devised. This consists of stocking into the new ponds in the spring only carp that were spawned in late fall instead of early spring the year before. This made necessary work to find how to get spawning of carp during a period of August or September.

Mr. Tal said their method was adapted from methods used in Indonesia. The carp in Israel normally spawn in February or March, or sometimes in April and the young from this spawn, when placed in production ponds the following spring when about 1-year old, spawn within a few weeks. If fall-spawn carp were used similarly in production ponds, these did not spawn, apparently because they were still not of the right age for spawning. Brood fish that normally spawned in the spring were gradually taught to spawn at later periods of the year by keeping them in storage ponds past the normal period of spawning. Mr. Tal said that for the first year the spawning was retarded about two months; the second year, two more months, and gradually the fish were acclimated to spawning in August. However, to obtain spawning in August, it was necessary to give the fish pituitary injections. These fall-spawned carp were then raised to approximately 70 to 100 grams for stocking the following spring. This is said to be practically 100 per cent effective in preventing "wild" spawning of carp during this period. The use of the fall-spawned carp is now uniformly practiced throughout Israel for stocking during the spring period. One record from this Kibbutz is also worth recording where a 2-hectare pond was stocked with 14 female plus 14 to 20 males Israeli carp. This produced 1.5 million fingerlings for stocking ponds. Newly cut brush was piled in various parts of the pond to receive the eggs.

Grey Mullet

At this Kibbutz the grey mullet is a very important supplemental species. The mullet that have been raised previously in ponds to a size of 100 grams are often stocked along with carp at a rate of 250 carp plus 100 mullet per dunnam[1]. The fish are fed sorghum or pellets. The mullet sometimes reach a size of 600 grams by the end of the next growing period. As a result of the work done at the Dor Experiment Station, pelleted feeds are used in some of the Kibbutz and they report that they have excellent results with them. The composition of the pelleted feed was not explained, except that it contained 25 per cent protein. Both the sorghum and the pelleted feeds were applied to the ponds with a big tank truck, equipped with a blower that blew the feed out into the ponds a distance of approximately 30 to 100 feet from the shoreline. The fish are fed only once daily. The conversions ranged from 1.6 to 1.7 with the pellets and over 2.0 where sorghum was used.

Tilapia zillii

Tilapia zillii is considered to be trash fish. It apparently grows at a much slower rate than T. aurea and attempts are made to prevent it from becoming abundant in the ponds. In the two-crop system used at this Kibbutz, the operation are as follows: Start in March to April by filling the ponds with new water. The ponds are then stocked with carp, from the previous August spawn, a size of approximately 80 or more grams each. Carp are stocked at rates from 250 to 400 per dunnam. However, if the higher rate is used, some of the fish are removed

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1. A dunnam is 0.1 hectare of 1/4 acre.

at a size of roughly 300 grams or less and used for stocking other ponds for the second crop. Whenever possible, the early stocked ponds are also stocked with 1-year-old grey mullet, weighing 80 to 100 grams. Larger mullet up to 300 to 350 grams are used if available. By July, at the end of the first crop, these will weigh up to 700 grams. The most common method of stocking would be to use 250 carp plus 100 mullet per dunnam.

The second crop is stocked out in July or late June, using 400 1-gram carp from the August spawning to produce fish that will be used the following spring in the main crop. In addition to this, around 250 to 300 carp (50 to 100 grams) are stocked for the fall crop. These large carp will reach a size of approximately 500 grams by fall and the 1-gram carp will reach a size of between 50 and 80 grams for the spring stocking.

In some of the Kibbutz, these special carp are raised alone in nursery ponds using 1,000 small carp per dunnam. These are fed and raised to a size of 80 to 100 grams for stocking the following spring. If no feed is to be used, they would have to be stocked at not over 100 fish per dunnam. In the feeding the standard method of determining the rates of feeding, developed in Israel, is used. That is, the average rate of growth per day is determined approximately every two weeks by seining. The gain per dunnam per day is then multiplied by a factor depending upon the size of the fish and varying from approximately 1.5 to 4. If *Tilapia* and carp are raised together, the rate of feeding is based only upon the gain in weight of the carp. The same is true if carp are raised with mullet.

In the monosex culture of *T. aurea* for sale abroad, the small *Tilapia* fry are placed in ponds and fed pellets until they reach a size of approximately

50 grams, when they can be sexed. It is possible for a worker to sex approximately 2,000 fish per day. The records kept by this Kibbutz showed the use of pellets resulted in a lower cost per pound of fish produced than from the use of sorghum. Fish fed sorghum contained 30 per cent fat, while those fed pellets contained 6 per cent fat.

Pond Research Station at Dor

On August 9, we made a trip to the Pond Research Station at Dor. This is along the Mediterranean on the Plains of Sharon. This Station has 128 experimental ponds having a total area of 260 dunnams or 26 hectares.

Experiments with Marine Fishes

Tanks are provided with running seawater for experiments on the spawning of Mugil cephalus and *Mugil capita*. *M. capita* has been spawned and raised to an age of approximately 30 days, when all the fish died apparently from cold water. A cold spell occurred at this time. However, it is not definitely known whether death was caused by cold water or lack of the proper food for the young fish. *Mugil capita* was described as a surface feeder, while *M. cephalus* fed upon detritus on the pond bottom.

Dicentrachus punctatus, a fish taken from the nearby Mediterranean, was considered to be possibly useful in pond culture. This apparently belongs to the former genus *Morone.* This species feeds on fish and appeared to be a predator that might be usable in carp and *Tilapia* ponds. The young are very abundant along the coast.

Pond Fishes

In experiments with carp and Tilapia, where 250 carp were stocked per dunnam, T. aurea, between 500 and 700, gave evidence of direct competition with carp for food. However, with 300 there was no competition and when stocked at this rate they actually increased the production of carp. Silver carp, also spawned at this Station, grew at a rapid rate up to 800 grams at the age of one year in experiments. In similar experiments where 20 carp were present, they grew from 0.5 grams to 300 grams. The conversion of silver carp was less than 1.0. Peixie rei, a pond fish from Argentina was introduced and the fry suffered a fright psychosis. Many became unconscious and died. At this point, it would be well to record that Mr. Kawamoto, who was along on the trip, said that he had successfully spawned P. rei in Japan and apparently had acclimated them to conditions there. This is the only case I have yet heard of where this has been successful.

At Dor, also, the breeding work of Moav, Wohlfarth and associates are being carried on. We saw the blue and gold strains being used for markers of carp. Mr. Kawamoto, while at this Station, showed a short movie on the breeding of the silver carp in the Tone River in Japan. It was principally of interest that in handling these large fish, which are so strong it is almost impossible to hold them, a solution of MS 222 was poured over the gills from an oil can to rapidly anesthetize the fish. The fish were given pituitary injection. When they began to spawn in concrete tanks, the fish were removed and eggs were stripped into screened boxes where they were left to hatch. The fry were removed to hapas[1] to grow to fingerling size. They were fed boiled eggs which were broken up and strained

1. Cloth cages stacked into the top water of ponds as in India.

through fine sieves. This was then mixed with water and sprayed on the surface of the water in the hapa.

Fish Feeds

In research on fish feeds at this Station, it was found that best results were obtained if at least 20 per cent of the feeds were fish meal. Where the base was soybean meal and the amino acids present in the fish meal were added up to the amounts present in the fish meal, the growth rate of fish was much less. The growth factor in fish meal was not known.

Production of Chironomid Larvae

At the Station, Chironomid larvae were also being produced in a tank. The bottom of the tank was covered with pond muds, over which was approximately 2 inches of water. Water flowed from the tanks where fish were fed through this tank where chironomids were being raised. The larvae were cropped about eve two days for use in feeding fish in the laboratory. Apparently no definite record were kept on exactly how many were produced, but they thought they were harvesting at least 50,000 Chironomid larvae per square meter during the course c a year. The in-flowing water came in the bottom of the tank up through the mud and then passed out the top of the tank. Mud was 1 inch deep.

Kibbutz Gan Shmuel

In the afternoon we visited Kibbutz Gan Shmuel. This Kibbutz varied from the first one in that it was farther inland and operated on a minimum amount of water. Water was obtained in part from a small stream and all rainwater was kept by making relatively deep ponds. Most of the fish ponds in Israel have a depth of approximately 1 meter. However, these had a depth of approximately 3 to 4 meters. At the end of the dry period, these ponds have lost approximately 2 meters of water. They also solved the water problem by shifting the water from one pond to the other as it was needed. In part, they solved the problem of the gradual reduction of depth of the pond by removal of part of the fish by seining. The fish that are removed are approximately 300 grams and are sold or the market or to other Kibbutz to raise to a larger size.

Monosex Culture of Tilapia

This fish farm also raises Tilapia in a monosex culture and mullet as a supplemental species. The Tilapia raised are hybrids between T. nilotica and T. aurea. The young fish are then raised to a size of approximately 50 grams when they can be sexed, and only the males are used in stocking the production ponds. Where stocked with carp, they added roughly 600 kilograms per hectare to the total production. Dr. Fishelson was doing a considerable amount of the work here with Tilapia crosses. The cross T. nilotica x T. aurea gave approximately 70 per cent males. During the past season, they produced approximately 3 million hybrids. He also found that parents at different ages gave different sex ratios of the hybrids. The crosses, however, always grew better than the parent.

At this point, Dr. Prowse stated that he had been successful in hatching eggs of T. mossambica by taking them away from the parent fish and hatching them away from the parent fish and hatching them in aquaria by aeration. Dr. Fishelso stated that he had done this by placing the eggs in bottles and using aeration or flowing water.

The increase in the rate of growth of the hybrids was approximately 20 to 30 per cent over that of the parent fish. Mr. Pruginin reported that in Africa he used a cross T. hornorum x T. nilotica and this gave fast growing hybrids. Another advantage of using T. hornorum as the male in the cross was that the hybrids could be easily distinguished from the parents. He also stated that Tilapia verabalis male x female T. nilotica gave all male hybrids. Also, the Lake George T. nilotica x female regular T. nilotica in Israel gave all males. In the F_2 generation, however, 2/3 were females and 1/3 were males.

Fish Culture

The following is taken from a report on the operations at Gan Shmuel, prepared by their organization:

Fish farming was established 20 years ago. It started with a few tens of dunnams and with little professional knowledge. During the first 10 years, the ponds area expanded to 1,000 dunnams. During that period, the water from wells was used to feed the ponds. By government policy this source of water was diverted to other branches and it was necessary to find another source.

The solution was catching the surface flow during the rainy season (November to April) and deepening the ponds to store the water for the whole growing period.

In addition, special arrangements were made to transfer the water from each pond to neighboring ponds for re-use. In the beginning, carp was the only species reared in the ponds; 300 fingerlings of 20 to 30 grams were stocked per dunnam. These were cropped after they reached 300 to 350 grams. The ponds were cropped 5 times in two years. Later, when the market required larger fish, the rates of stocking were changed to 150 to 200 fish per dunnam and the fish were allowed to reach 500 to 600 grams. When they were 200 grams, a second group of fingerlings of 10 grams were added to the pond for nursing. In this method, the fish were cropped two times a year.

The market demand for other species encouraged the rearing of grey mullet (Mugil cephalus). The fry were caught in the estuaries during the winter and stocked directly into the fattening ponds without counting. Often, however, upon draining the ponds there were no mullet.

Consequently, a system of nursing the fry in special ponds was developed. Approximately 2,000 fry per dunnam were stocked. One hundred carp of 200 grams (to avoid wild spawning) were added to control weeds and algae. The nursing period is November to June-July. At the end of this period the fingerlings weighed 30 to 50 grams. The fingerlings were then transferred to the fattening ponds which contained two groups of carp, 250 grams and 10 grams. This method has doubled the production of mullet from 10 to 20 tons.

In the years that enough fry were caught, a second group was prepared for stocking in November-December. This increased production to 40 tons, which is 50 kilograms per dunnam (1965).

Tilapia aurea was grown in addition to mullet. At first 200 fry 1 to 5 grams were stocked in July and the yield was 15 kilograms per dunnam, which totaled 9 tons a year.

With the help of Dr. Fishelson, experimental work in hybridization was begun. Male *T. aurea* x female *T. nilotica* resulted in 75 to 80 per cent males in the F_1 generation. The use of the hybrids increased the yield up to 40 kilograms per dunnam. By sexing the hybrids at 50 to 100 grams and using only the males for stocking (with carp and mullet) at the rate of 100 per dunnam, they reached 300 grams from April to July.

In July 300 *Tilapia* of 10 grams per dunnam were stocked. In some ponds this yielded 60 kilograms per dunnam until December.

Seven hundred dunnams are operated for fattening and production for marketing is 218 to 225 tons. The quota is 210 tons which is composed of 130 tons of carp, 40 tons of *Tilapia*, and 40 tons of mullet. Because of marketing limits, the farm produces only its quota and not the full capacity of the ponds.

On the following page, there is a sample showing the yearly production of a dunnam for the three species.

Gan Shmuel is a member of the Carp Breeders Union which consists of five farms in various parts of the country. The aim of the Carp Breeders Union is to produce improved breeding stock. Each of the member farms spawn and nurse each year 5 to 6 groups of carp of different genetic origin, all of which are growth tested at all the farms.

Improvement of breeding stock is attempted by selection, hybridization and

Yearly Production for a Dunnam at Gan Shmuel

Species	Total Weight Cropped	Average Weight in Cropping	Total Weight in Stocking	Average Weight In grams	Number Of fish July	Total Weight Cropped	Average Weight in Cropping	Total Weight in Stocking	Average Weight In grams	Number Of fish Decemb
Carp	90	600	30	150-200	150	105	700	30	150-200	150
Carp	37.5	150	5	20	250	40	200	4	20	200
Mullet	40	500	3.2	40	80	40	500	6.4	80	80
Tilapia	60	200	4.6	15	300	30	300	7	70	100
Totals	227.5		42.7		780	215		47.4		530

introduction. The breeding scheme presently under investigation involves two groups of inbreds, genetically marked by color genes. One group is blue-grey and the other group is gold. The aim of the breeding scheme is to isolate crosses between the inbreds showing fast growth rate due to heterosis. Hybrids between the inbreds have the normal coloration.

A unit of 10 aquaria was built in order to study the reproduction cycles of the Tilapia and to try to control its spawning by using light and temperature.

During the last years economical evaluations were made in correlation with different ratios among the species bred (carp, mullet and Tilapia).

Laboratory for Research of Fish Diseases

We spent the morning of August 9 at the Fish Disease and Parasite Laboratory at Nir David. Dr. Shilo was there also as he works intimately with the Fisheries Department. His work is partly at Nir David and the rest of it is in the Division of Microbiology at the Hebrew University in Jerusalem.

The laboratory here, officially known as Laboratory for Research of Fish Diseases, is under the direction of Mr. S. Sarig. The laboratory has worked out various methods for the control of external parasites on carp, Tilapia and mullet and feel that these problems are no longer serious as they have controls that can be used in the ponds for all of them.

They are working on the blue-green algae as they do occasionally cause fish kills. They are trying to find a relationship between types of fertilizers and the blue-green algae. They feel that since the blue-green algae can synthesize nitrogen, probably the nitrogen may favor some other types of microscopic plants over the blue-green.

Dr. Shilo reported finding a Cytophagous cell which destroyed blue-green algae. They are beginning to work on this, which is probably a virus, to determine its usefulness in the control of the blue-green algae. He has already found that its presence is quite widespread. Apparently, it may occasionally be primarily responsible for the death of the blue-green bloom. Mr. Sarig reported that they still had not found a satisfactory control of myxosporidian parasites in their fish. He stated that it would be controlled by PMA; however, since this is a mercury compound, its use on fish is not allowed in most countries. Some fish did have a skin disease which they called Pitheiloma, which apparently is related to injury to Argulus. It is probably caused by a virus.

Ectoparasites of fish were controlled by Bromex, however, the toxicity of this material increases to fish as the salinity decreases and it is not useful for the control of parasites of fish in waters of low salt content. Blue-green algae was considered to be one of the principal problems and toxicity or low oxygen due to these algae has caused the loss of approximately 200 tons of fish yearly. This laboratory has four full time workers and a budget of approximately $40,000 per year.

In Israel, as in the United States, Karmex was considered to be the best control for blue-green algae. There it was used at the rate of 0.1 to 0.05 ppm.

Fish Problems in Israel

Bad Flavors in Fish

It was found in some of the fish farms that bad flavors developed in carp and this was finally found due to a small form of filamentous algae, Oscillatoria tenuis. The fish farmers now examine the bottom muds of their ponds about every ten days by placing a small amount of the bottom mud in a bottle with water and setting it aside for a while and then examining it for the waving filaments of Oscillatoria, which are visible to the naked eye. It apparently grows both on sand and on mud bottoms. The ponds where this alga was found to be present were treated before stocking with fish once yearly, using 100 ppm copper sulfate, applied directly to the water. After the copper sulfate has been in the water for approximately four days, the toxicity has decreased to a point where the fish can be stocked. Here it should be noted that probably one reason for the rapid decrease in toxicity of copper is that these ponds have a rather high hardness which rapidly reduces the solubility of the copper.

Control of Prymnesium

This microscopic plant grows in salt water and brackishwater ponds. In the brackishwater ponds it produces a toxin poisonous to fish. It has been the cause of the loss of many tons of fish in various parts of Israel during the past years. Prymnesium has been found to be rather widely scattered throughout the world and the Israelis feel that the work they have done will be widely applicable to other areas where the salinity is sufficient for Prymnesium to become a problem. In only about 7 per cent of the ponds where this organism is present does the microscopic plant produce sufficient poison to cause the death of fish. This poison will kill carp, Tilapia, mullet, and many other species. Professor Shilo and his group in Microchemistry at the University of Jerusalem have worked out in detail the conditions under which these microscopic plants produce the toxin. The toxic material combines with a certain number of sodium atoms, and to become extremely toxic must then combine with a certain number of calcium and magnesium atoms. They found that certain buffering solutions could be prepared that greatly increased the toxicity of the poison, up to at least 20 fold. From this, they worked out a bioassay method of determining when sufficient poison was accumulating in ponds for a treatment to be necessary. The fish farmers are taught to examine the water two to three times weekly with a microscope to determine if Prymnesium is present. When it is found, bioassays are made using Gambusia minnows to determine those waters that are becoming toxic. To the water a tablet, prepared by Mr. Shio and his group, is added which increases the toxicity of the poisonous material 20 fold. Gambusia are then placed in this solution and if sufficient toxicity has been developing in the pond, they will die within 2 hours at 28° C. From this they can determine the number of ichthyotoxin units. When 5 units are present, the pond must be treated to control Prymnesium. These procedures are given in a reprint which is being sent to Auburn. The control treatment consists of using liquid ammonia at the rate of 15 ppt when the pond water has a pH of 8.6 or higher. If the pH is less than 8.5, it is much better to use copper sulfate at 2 ppm. The hardness of this water is between 70 and 90 ppm as $CaCO_3$. The salinity is approximately 2 ppt total salts. The liquid ammonia is applied from a drum directly underwater with trailing tubes similar to the method developed here at Auburn for the distribution of formalin and other materials. When ammonia is applied for the control of Prymnesium, no more nitrogen fertilizer is applied for several months. They feel that the danger of Prymnesium kills is now over since all their fish farmers know how to apply these tests and can prevent kills from occurring.

Fish Breeders Association

During the afternoon of August 11 we had a meeting with the Fish Breeders Association in Jerusalem with Mr. Ben Ahron, who is in charge of the Association, and with various other members of the Fisheries Department and fisheries men from the various fish farms. A discussion was held on the future of fish pond research. The most important subjects for research were thought to be: (1) Methods of controlling the spawning of fish, both methods for making them spawn and preventing them from spawning; (2) Studies on the blue-green algae and their control; (3) Studies on the general ecological succession of algae in ponds; (4) Fish feeds; and, (5) The methods of counteracting the effect of wastes in ponds on fish production.

Notes on Some Papers Given at the Limnological Symposium

J. Shapiro, United States, gave a paper on the characterization of organic iron and its significance. He was able to fractionate iron from its reaction with potassium thiocyanate at different pH levels. This indicated that a number of different types of iron were formed. However, to make his tests effective, the iron must be in concentrations of 50 ppm or more, which practically never occurs in our freshwater ponds. If the tests were more sensitive, it would be of considerable interest to us.

S. V. Ganapati, Section of Sanitary Biochemistry, M.S. from University of Boroda, Boroda-2, India, reported on village ponds which were 1 to 5 meters deep with steep walls. In these, for centuries, probably, there has grown 3 to 4 species of Microcystius. This has apparently not interfered with fish production as these ponds produce sizeable amounts of Indian carps, Tilapia and Chanos. In fact, he cited a case in which Chanos grew to a length of 2 feet in a pond where Microcystius was the main microscopic plant. He wished to make the point that, apparently, Microcystius was to a certain extent desirable. In another section, it was reported that Microcystius and other blue-green algae gave out toxins which were poisonous to man. He said that the villagers had been drinking the water from these ponds containing Microcystius for centuries with no ill-effects.

T. J. Hall, Cornell University, United States, and W. E. Cooper, Michigan State, United States, gave a combined paper on the "Manipulation of Nutrients and Predators (Insects) in Experimental Ponds". This work was done in the experimental ponds at Cornell University and mainly showed that fertilization of ponds increased fish-food organisms and the growth of bluegill.

A. Yashouf, Israel, reported on use of combinations of fish species in ponds. His work indicated that at certain levels of stocking, species were often complementary and in certain cases, the presence of one species even increased the production of another. At higher levels of stocking, the fish became competitive and reduced the production. Consequently, the problem was to find a level of stocking which was below the level at which competition occurred.

J. A. Maciolek, United States. reported on freshwater lakes of Hawaii. These lakes are in a volcanic deposit and percolation rates through the soils of up to 1 meter per hour occured in the upland areas. In the higher lakes the temperature ranged from 0 to 13° C. Calcium content was 0.2 ppm. Sodium-potassium 0.2 and total salts was 8 ppm.

The paper was of particular interest to us because of the high rate of seepage in volcanic soils in Hawaii. This may be pertinent to the volcanic soils in Mindanao and we do not have any figures on the rate of percolation of water down into these soils.

Dr. D. G. Frey, who was in the Philippines when Dr. Moss and I visited there, gave a report on "Limnological Reconnaisance of Lake Lanao in the Philippines". This lake is at Mindanao State University and is the lake from which we expect to get water to supply the experimental ponds which will be built there. Dr. Frey was there for one year and reported that he had made provisions for the supplies to be ordered six months before he left for the United States. This was through the Ford Foundation. Most of the equipment did not arrive during the year he was there and now six months after he has left, the equipment is still arriving. The lake is approximately at a 700-meter elevation and was formed by a flow of lava across the valley forming a dam and impounding the lake. He reported that during the typhoon period, the waters in the lake were stirred up so much that the entire lake was very muddy from bank to bank. Also, during the rainy season, with winds, the lake usually became slightly muddy. This finding would be quite pertinent to us in the operation of ponds using the lake as a water supply. Maximum depth of the lake was 114 meters. Total drainage area was 4 times the size of the lake. Four rivers flow into the lake and the flow of each was measured. Rainfall was 2.9 meters per year. Runoff was 2 meters annually. Outflow from the lake down the river was 106 cubic meters per second. Total area of the lake was 350 square kilometers. The outflowing river comes out of the shallowest end of the lake. He has decided that the classification of this lake is monomictic (whatever that means). Usually the lake had oxygen to the bottom, but there was a small amount of stratification. There was a turnover during the period January to March. The annual differences in water temperatures were from 24 to 28^{o} C. He gave the methyl orange alkalinity as 1.2 miliequivalents, I presume of calcium carbonate. This would be approximately 150 ppm; however, he stated that he had not finished summarizing all the data. Conductivity was 120. These last data were in answer to questions and were not part of his prepared talk. It is possible that they are not exactly accurate.

Dr. G. Prowse, Malaysia station, gave a paper on the "Role of Cultured Pondfish and the Control of Eutrophication in Lakes and Dams". However, the paper dealt largely with the use of fish for control of aquatic weeds. He considered that _T. zillii_ and _T. melanopleura_ were both very good for the control of aquatic plants and that _T. zillii_ was the best. He also pointed out that these fish should not be introduced into many countries because they would eat rice seedlings.

Etana Padan and Moshe Shilo, Israel, gave a paper on the "Spread of Cyanophages in Natural Habitats and Their Interaction with Plectonema in Ponds". Samples and algae from fish ponds scattered throughout Israel were collected and found that the cyanophages were present in most algal blooms and occasionally became abundant enough to cause a termination of the blooms. The cyanophage is a virus. It was first described by Safferman amd Morris from the United States. They considered it to be similar to that in the United States if not identical. One contributor from the audience added that fungi often cause the decay of algal scums.

Dr. L. Fishelson, Israel, reported on the use of *Tilapia* in brackish-water ponds near the Dead Sea. He said that he got very good results on growth of *Tilapia* in waters having up to 10 ppt total salinity. The rate of growth was 10 kilograms per hectare per day. He used principally hybrids, male *T. aurea* x female *T. nilotica.*