6. Fingerling production

3.1 Influencing environmental factors

Similarly to rearing advanced fry, carp fingerlings are also reared in earth ponds where they are also part of the biological production cycle. The main environmental factors influencing production are:

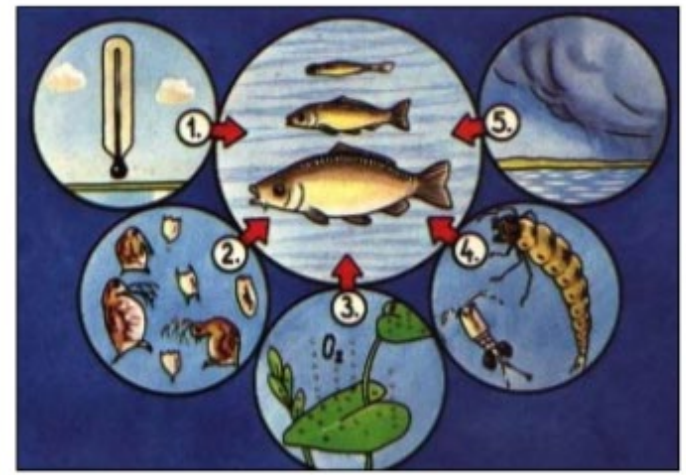
(1) Adequate water temperature.

(2) Availability of natural food.

(3) Dissolved oxygen content (5–8 mg/litre) of water.

(4) Number of predators (e.g. snails, insect larvae, larger fish, frogs, snakes, birds).

(5) Weather conditions are less important.

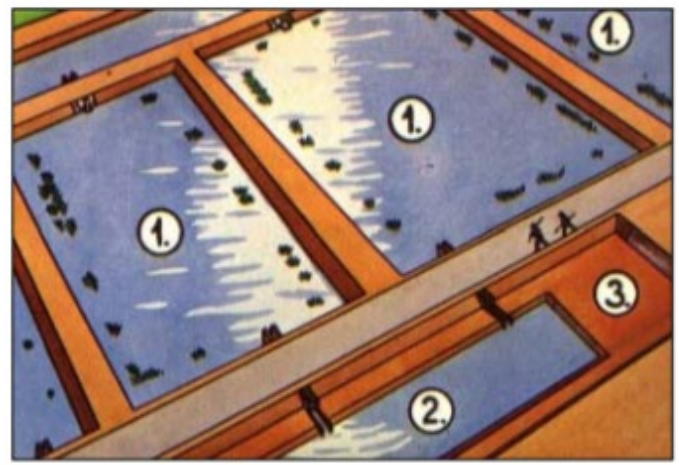


3.2 Pond preparation and stocking

(1) The size of fingerling ponds varies from 1 to 10 ha (average water depth: 1–1.5 m).

(2) Usually, a monk is the outlet structure of these ponds; it often connects the pond to a common fishing canal.

(3) Next to the harvesting area, a working platform with road access helps in the handling (e.g. sorting, weighing) of harvested fish.



3.4.2 Follow-up on fish health

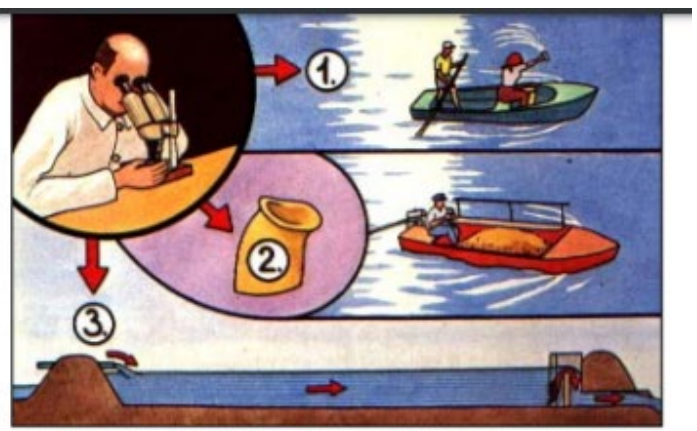
Health aspects of sampled fish should be examined under a binocular microscope. This is best done by a veterinarian or a biologist.

If necessary, therapeutic treatments are applied:

(1) Chemical treatment of pond water.

(2) Distribution of medicated feed.

(3) In simpler cases, increased water exchange in the pond may be sufficient.



During fingerling rearing, the most common diseases are:

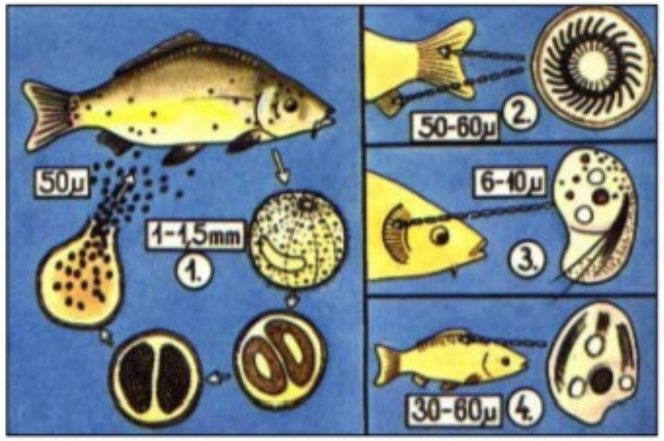
(1) White spot disease or "ich" (*Ichthyophthirius multifiliis*). It is a monocellular ectoparasite.

(2) *Trichodina* on fins.

(3) *Costia* on gills.

(4) *Chilodonella* on gills and fins.

Against the last three parasites, ponds should be treated with copper oxychloride, where it is an approved chemical. Its final concentration in the pond should not be higher than 4 ppm.



Other ectoparasites can also cause great damage:

(1) *Argulus foliaceus*.

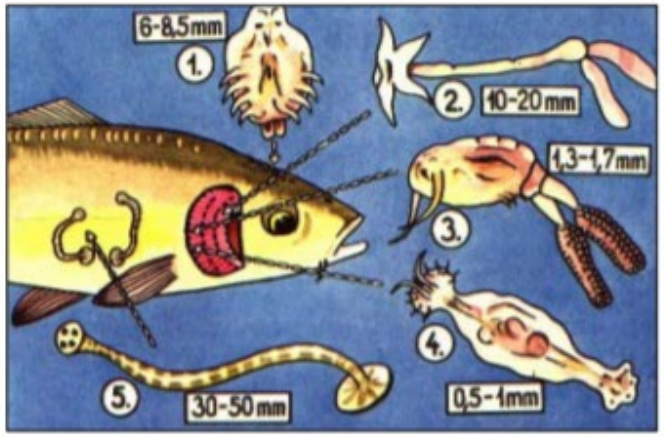
(2) *Lernaea cyprinacea*.

(3) *Ergasilus sieboldi*.

(4) *Dactylogyrus vastator*

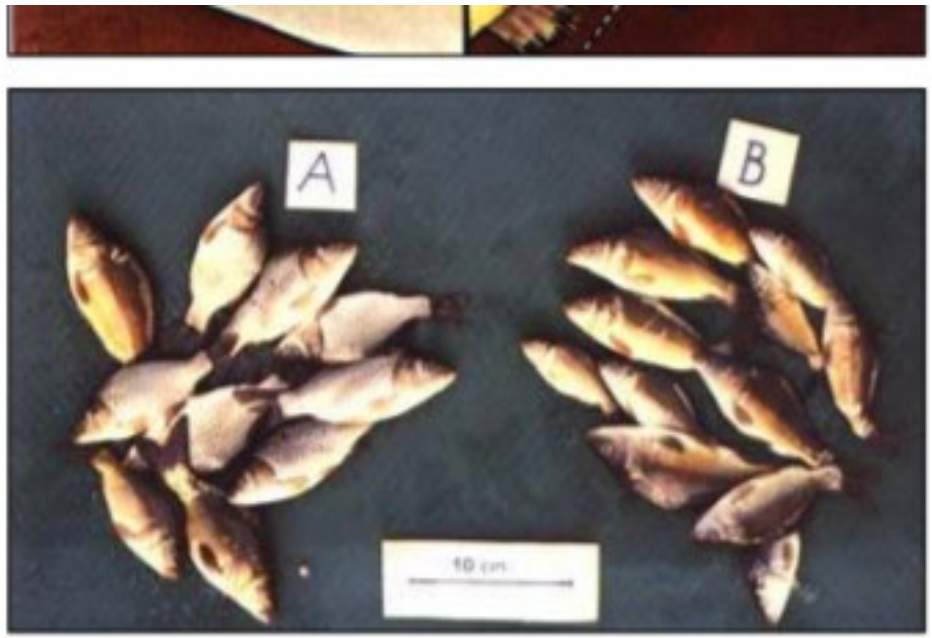
Against these parasites, the pond should be treated with an approved and previously tested agricultural insecticide in a final concentration of 0.2–1 ppm (0.2–1 g/m³).

(5) Leeches (*Piscicola geometra*)



Criteria of good quality fingerlings are:

Parameters		of **good** (A) fry	and **bad** (B) fry
Body shape:		deep, plump	slender, big head
Colour	**Belly:**	deep yellow	yellowish
	Back:	greyish green	dark
	Tail:	bright, shiny	dull
Tail movement:		very rapid and hardly visible	slow and easily visible



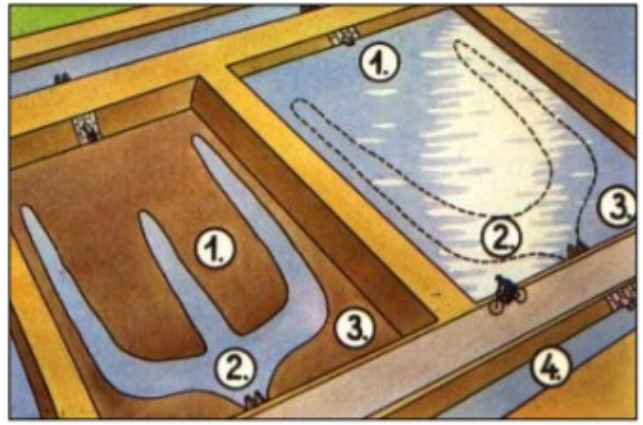
Before harvest:

(1) The water is partly (about half) drained.

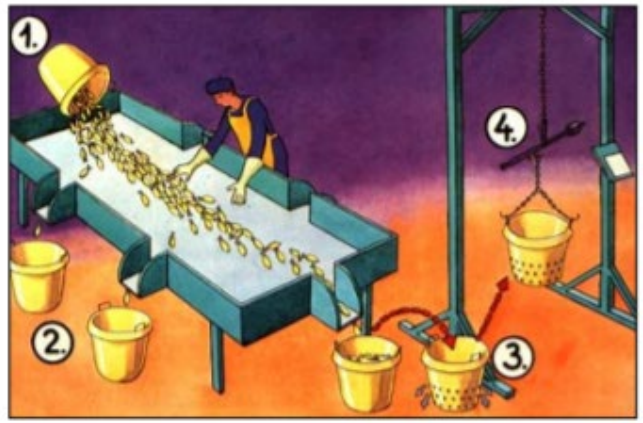
(2) Therefore, water and fish both concentrate in deeper parts of the pond (known as fish beds).

(3) These areas are fished with seine nets towards harvesting areas.

(4) Water drains out of the pond into a draining canal.



Harvested fingerlings are sorted by size and, if necessary, by species. (1) Fish are poured onto a sorting table. (2) Different species and sizes are sorted into different 50 litre containers. Live fish are kept in water until they are transferred.



For sorting large quantities of fish, a rubber conveyor belt moving horizontally can be used.

During transport to wintering ponds, approved and tested chemicals may be used against ectoparasites.

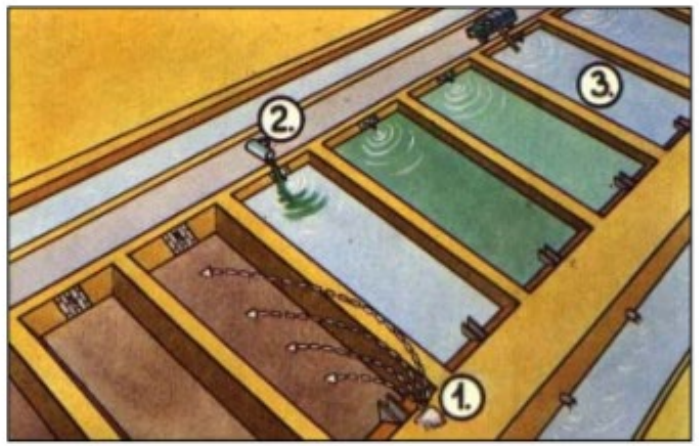
In a temperate climate, the wintering season starts when the water temperature sinks to below 10 °C. During winter, fish are stored in special small (600–1 000 m²) but deep (2 m) wintering ponds.

Preparation of wintering ponds:

(1) The bottom should be treated with lime (200 kg/ha)

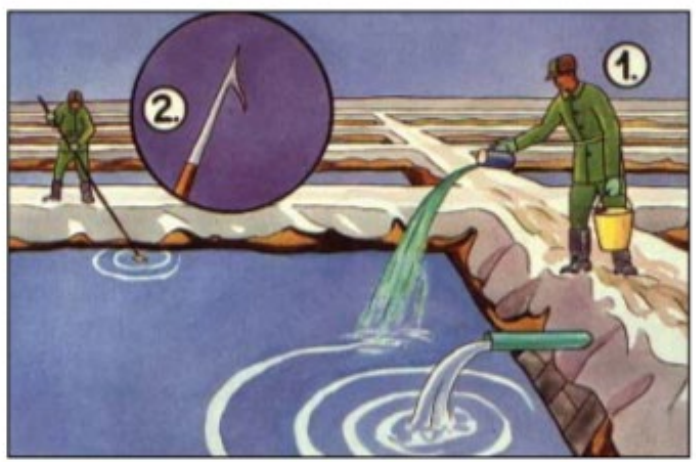
(2) The water should be treated with approved and tested chemicals for disinfection.

(3) After the chemicals used have been progressively washed out, fingerlings can be stocked (100 kg/10 litres/min water inflow).



In a pond 2 m deep with a surface of 1 000 m² that receives 600 litres of water per minute through an inlet pipe of 20 cm, a maximum of 6 tonnes of fingerlings can be overwintered (an average of 3 kg fingerlings/m³).

As common carp consume very little food below 10 °C, and practically stop feeding at 7 °C, still fingerling are still fed once a week in order to reduce weight loss during winter. The usual weekly quantity of good-quality fish feed is about 0.3–0.5 percent of the weight of the stored fingerlings.



(1) Every week, approved and tested chemicals should be used to prevent diseases.

(2) Every day, dead fish must be removed either with a scoop net or with a grappling hook.

Table A1-1:Application of lime at pond preparation and during production season

pH	Preparatory dose (kg/ha)	Monthly dose (kg/ha/month)
8	50–100	10–25
7.5	100–200	25–50
7	200–300	50–75
6	300–400	75–100
Less than 6	400–450	100–125

Table A1-2:Recommended quantities of manure and fertilizers in nursery ponds

Name	Total quantity (tonnes/ha)	% of total quantity	
		At start	Later
Manure	1.5–2.5	100	0
Carbamide (urea)	0.15	100	0
Superphosphate	0.1	100	0

This graph shows the strong inverse correlation between the number of stocked fish (number/ha) and the attainable size of fingerlings at different levels of production intensity.

The graph of fingerling[1] production of carps is based on the assumptions that:

- Advanced fry is stocked.
- The rearing period is about 10–12 weeks.
- The expectable average survival rate is about 60 percent, which in reality may vary between 50 and 70 percent.
- Expectable gross yields of fish weighing 25–100 g large are (Woynarovich and Woynarovich, 1998; Woynarovich *et al.*, 2011).

  1) At extensive production:

  Total weight: 300–500 kg/ha

  Harvested number: 3 000–20 000 fish/ha

  2) At semi-intensive production:

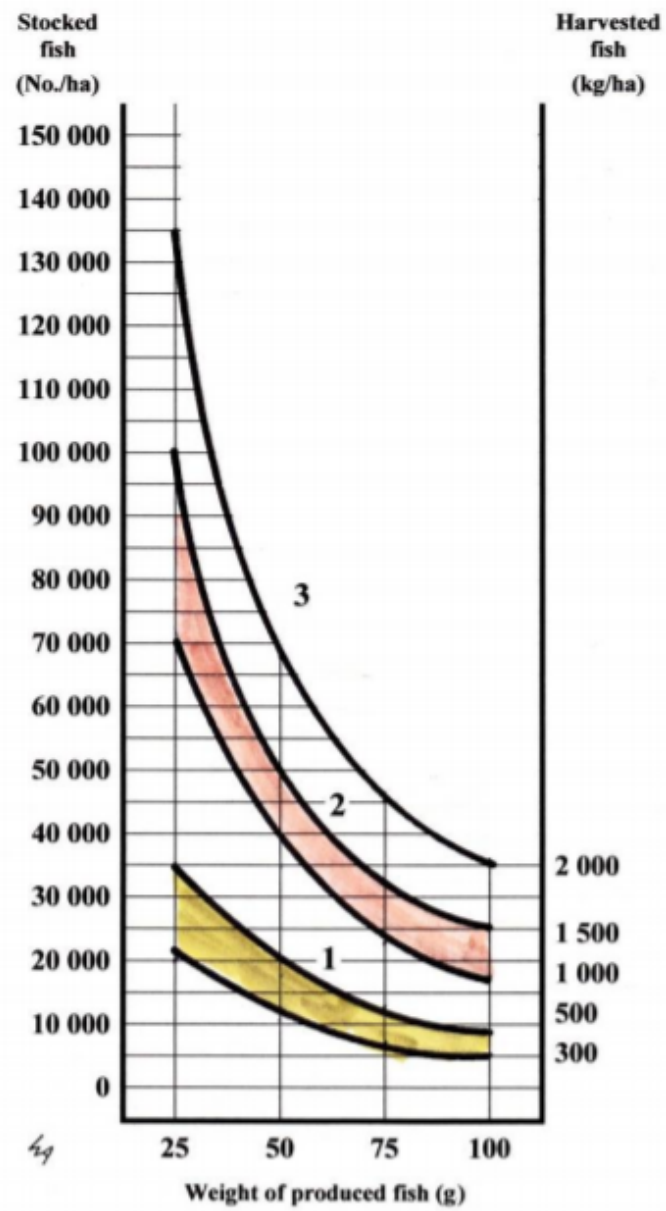
  Total weight: 1 000–1 500 kg/ha

  Harvested number: 9 000–60 000 fish/ha

  3) At intensive production:

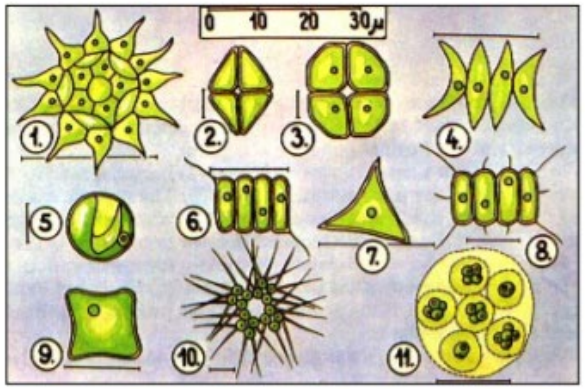
  Total weight: > 2 000 kg/ha

  Harvested number: 18 000–80 000 fish/ha

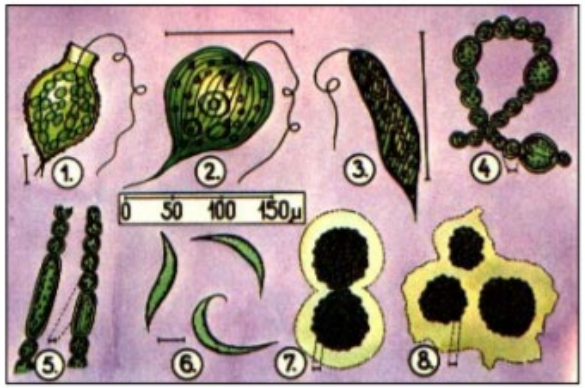


MOST FREQUENT PHYTOPLANKTON, ZOOPLANKTON AND PREDATORS FOUND IN AND AROUND FISH PONDS

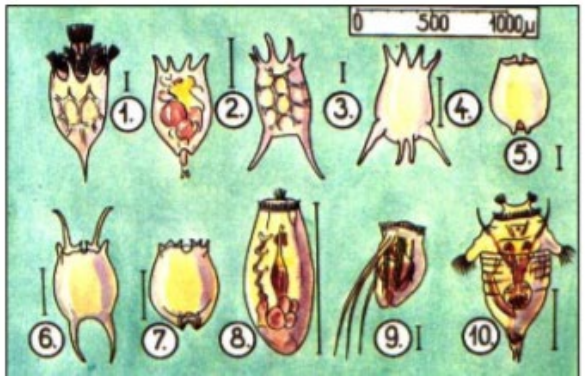
Green algae: *Pediastrum* (1), *Crucigena* , (2, 3) *Scenedesmus* (4, 6, 8), *Chlorella* (5), *Tetraedron* (7, 9), *Richteriella* (10), and *Gloeococcus* (11).



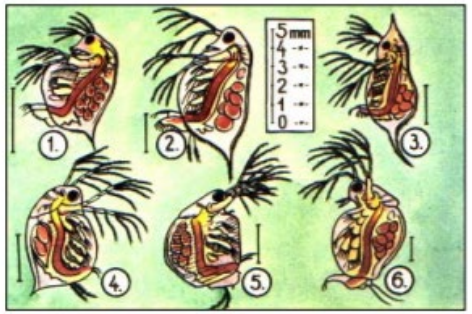
Blue-green algae (cyanobacteria) indicate unbalanced environmental conditions. Flagellates (1–3) develop well in polluted water. Some examples of flagellates are: *Trachelomonas* (1), *Phacus* (2) and *Euglena* (3). Examples of blue-green algae are: *Anabaena* (4), *Aphanizomenon* (5), *Dactylococcopsis* (6), and *Microcystis* (7, 8).



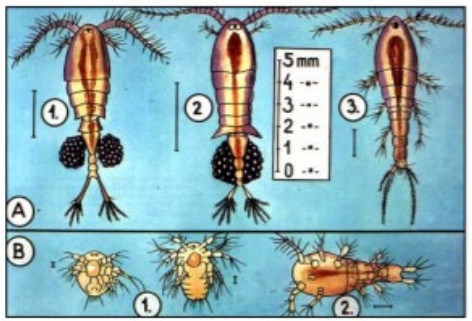
Slow-moving **rotifers** are the most important group of microscopic animals for the rearing of feeding larvae. They belong to zooplankton species. Some examples are: *Keratella* (1, 3), *Brachionus* (2, 4–7), *Asplanchna* (8), *Filina* (9) and *Synchaeta* (10).



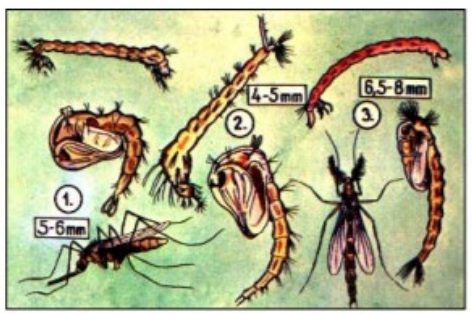
Large cladocerans are undesirable as they compete for food with smaller zooplankter. Some examples are: *Daphnia* (1–3, 5), *Simocephalus* (4), and *Moina* (5).



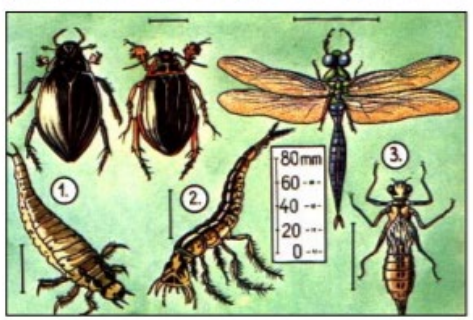
Adult copepods: *Cyclops* (1), *Diaptomus* (2), and *Canthocamptus* (3). Juvenile copepods (B) could be very useful natural food for carp fry, but in practice they cannot be separated from adults. Several juvenile stages exist such as nauplius (1) and copepodite (2) stages.



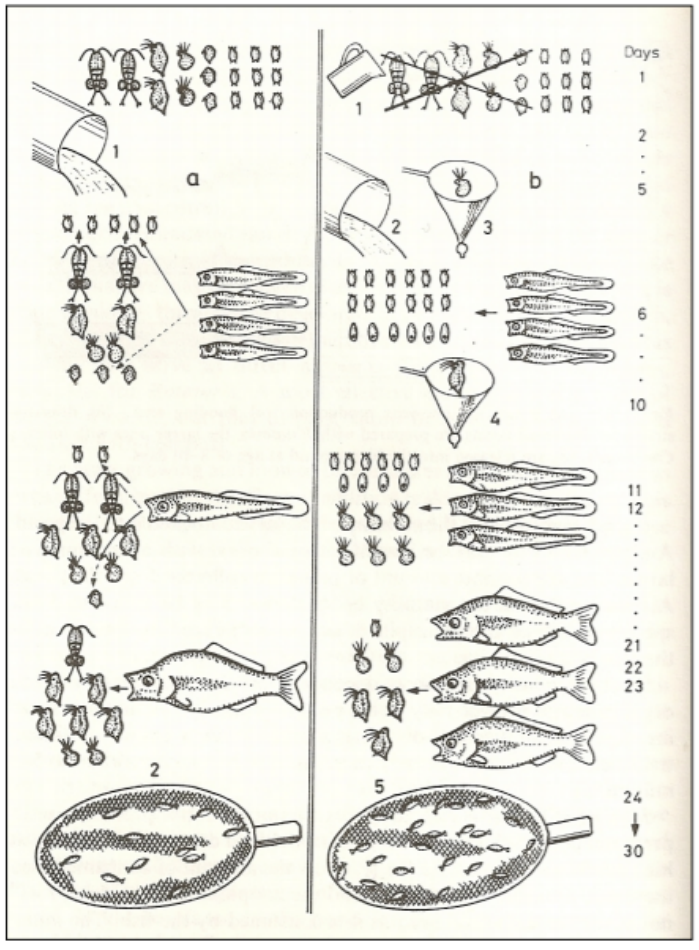
Mosquito larvae and pupae live near the water surface, hidden among aquatic vegetation as, for example, species of *Anopheles* (1) and *Culex* (2). Chironomid larvae and pupae such as *Chironomus plumosus* (3) live in the bottom mud of ponds.



Water beetle larvae *Hydrous piceus* (1) and *Dytiscus marginalis* (2), as well as dragonflies such as *Anax imperator* (3).



CHEMICAL PREPARATION OF NURSERY PONDS – SELECTIVE ELIMINATION OF LARGER ZOOPLANKTON



The above flowchart (Horváth, Tamás and Tölg, 1984) demonstrates the differences between an untreated (a) and a treated (b) nursery pond. It shows how important the selection of zooplankton is before the feeding larvae of carps are stocked.

There are various methods of plankton selection. An effective one is where a licensed and tested selective insecticide[1] is used[2] which leaves rotifers alive. Chlorinated lime in a quantity of about 10–15 kg/10 000 m^3 is less effective but can still be an acceptable solution in countries where the use of selective insecticides for nursery pond preparation is prohibited.

[1] Chemicals that contain either organophosphoric acid ester or trichlorfon are usually suitable for this purpose (Horváth, Tamás and Tölg, 1984). As rotifers are from another taxonomic group, they are not sensitive to insecticides. Before using a new brand of insecticides, laboratory and field tests should prove its suitability. The list of permitted or banned chemical products varies from country to country. Therefore, the use of some otherwise suitable insecticides may be banned in one country while permitted in another (Woynarovich, Moth-Poulsen and Péteri, 2010).