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METHODS FOR PROPAGATION OF WALLEYE FINGERLINGS IN MICHIGAN

by

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and

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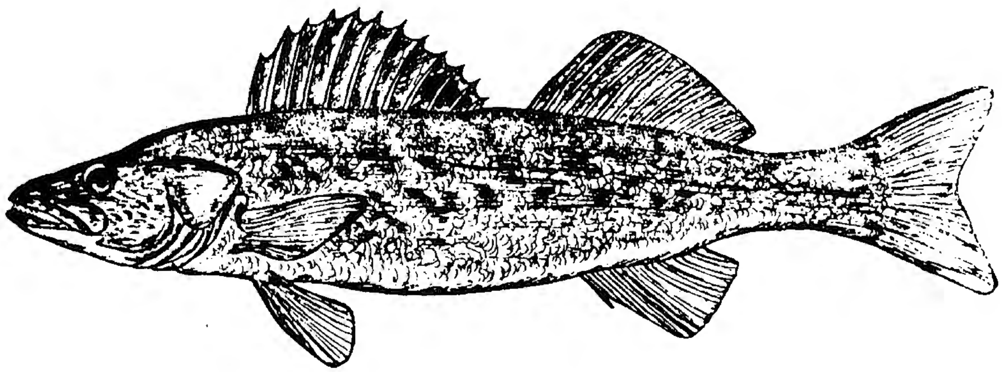

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Introduction

The walleye, Stizostedion vitreum vitreum (Mitchill), is popular with the fishing public apparently because of its eating quality. There is also a certain mystique surrounding the walleye, which makes this fish much in demand, even though it is difficult for anglers to catch, and has limited fighting ability.

Propagation of the walleye is difficult, and results vary, even though much work has been done in its culture. Minnesota and Wisconsin have extensive programs for propagation in ponds. Since 1964, Michigan has not tried to raise walleye fingerlings, except in experimental hatchery projects, and in a few trials at rearing ponds, mostly in cooperation with sportsmen's groups. Attempts to raise walleyes in northern pike marshes generally have met with failure, possibly because of excessive vegetation and heavy predation in the marshes.

The general procedure for raising fingerlings is to place sac fry in either drainable ponds, or in natural ponds or small lakes. Production of zooplankton is stimulated by fertilization. Under these conditions walleyes may be raised on a diet primarily of crustaceans to a size of 2.5 to 3 inches, before starvation and cannibalism become major factors of mortality.

Sufficient information is available to establish criteria for construction and development of rearing ponds for walleyes. Development of rearing areas should follow these criteria as closely as possible. For a walleye propagation program to be regarded as successful, minimum production standards should be met. The following guidelines come from 23 years of experience and research in rearing walleye fingerlings in Minnesota (John Dobie, personal communication), supplemented by review of the literature, and recent experiences in Michigan. Although each rearing pond may present peculiar problems, especially as relates to fertilization, the following procedures will provide basic guidelines for the pond manager.

Rearing ponds--General

The suggested stocking rate for fry in rearing ponds is 50,000 to 75,000 per acre.

Predacious aquatic insects can inflict severe mortality on stocked walleye fry:--such as diving beetles (Dytiscidae), whirligig beetles (Gyrinidae), water scavenger beetles (Hydrophilidae), giant water bug (Belostomatidae), water scorpions (Nepidae), back swimmers (Notonectidae), and water boatmen (Corixidae). Such insects should be controlled with an application of 3 gallons of fuel oil per acre of pond. The oil can be sprayed or poured on the pond surface. Application should be done on a relatively calm day, since to be effective, an oil film should persist on the water surface for at least one-half hour. Nonpredacious insects are not affected by this treatment, since these insects do not come to the surface to breathe. Oil should be applied about one week prior to introduction of the fry. A second application of fuel oil can be applied a few days after the fry are planted, if reinfestation of predacious insects is noticed. Control of predatory insects has increased fingerling production considerably in Minnesota and Wisconsin.

The cannibalistic nature of small walleyes demands that an abundant supply of food be provided in rearing ponds up to the time of harvest. Goals are to produce large crops of micro-crustaceans in May and June to insure good fry survival, and enough micro-crustaceans and insects to feed the fish in mid-summer. Various methods of fertilization have been tried to help meet these goals. Fertilizers that have been experimented with in Minnesota include ammonium nitrate, superphosphate, muriate of potash, dried sheep manure, "paunch manure" (by-product of a sewage plant), yeast, and green fallowing. In general these fertilization methods (green fallowing excepted) have produced adequate zooplankton populations in May and June when the fish are small and the total quantity of food required is therefore small. In July and August, when the fish are larger and require a much greater quantity of food, these fertilizers did not meet the need.

In many places where fish are raised, ponds are fertilized with inorganic fertilizers. These fertilizers appear to be most practical in ponds with soils of very low fertility. The danger of filamentous algae becoming a nuisance is greater when using inorganic fertilizer, since the rate of release of nutrients into the water is more rapid from inorganics than from organics. The use of organic fertilizers, rather than inorganics, is recommended for rearing walleye fingerlings. However, if inorganic fertilizer is the only choice, an initial application of 10-10-10 fertilizer at the rate of 25 pounds per acre-foot of water is probably adequate. Subsequent applications will depend on trying to maintain a large population of zooplankton without troublesome filamentous algae. In summary, extremely close control of ponds must be maintained when inorganic fertilizers are used.

Experiments in Minnesota have shown that most fertilizers (even organic) liberate sufficient quantities of phosphorus into the water to cause troublesome algae blooms. Copper sulfate has been used successfully in controlling filamentous algae. In pond waters with total alkalinity at 50 ppm or more, copper sulfate applied at the rate of 1/2 ppm is usually adequate; the rate should be 1/4 ppm in waters with less than 50 ppm. Greater quantities of copper sulfate may be toxic to fish; therefore these recommended rates should not be exceeded. "Cutrine," a chelated copper complex--manufactured by Marine Biochemists, Inc. of Waukeska, Wisconsin, 53186--also has possibilities as an algaecide.

In studies on growth of walleyes in Minnesota, fingerlings did not grow faster on a diet of fish than on plankton and insects. A more rapid growth of walleye fingerlings in natural lakes, with perch as forage, was due to reduced density of walleyes. The same rapid growth was obtained in ponds on a diet of plankton and insects, when the walleye density was reduced. The relationship between growth of walleye fingerlings and population size in drainable ponds in Minnesota is shown in Figure 1.

Weekly observations on the ponds should include dissolved oxygen, water temperatures, plankton samples, and fish samples. A healthy walleye population requires at least 5.0 ppm dissolved oxygen (Moyle and Clothier, 1959). Sustained temperatures above 85 F are detrimental to walleyes. Quantitative and qualitative data are needed on the populations of zooplankton necessary to insure walleye survival and growth. Procedures for collecting and analyzing plankton samples should be standardized for each pond. Valid comparisons can then be made among the samples. A plankton net of No. 10 mesh nylon is recommended. A good indication of pond conditions can be obtained by comparing the growth of fish in the pond with the "normal" growth curve (Fig. 1). Accurate records can aid in

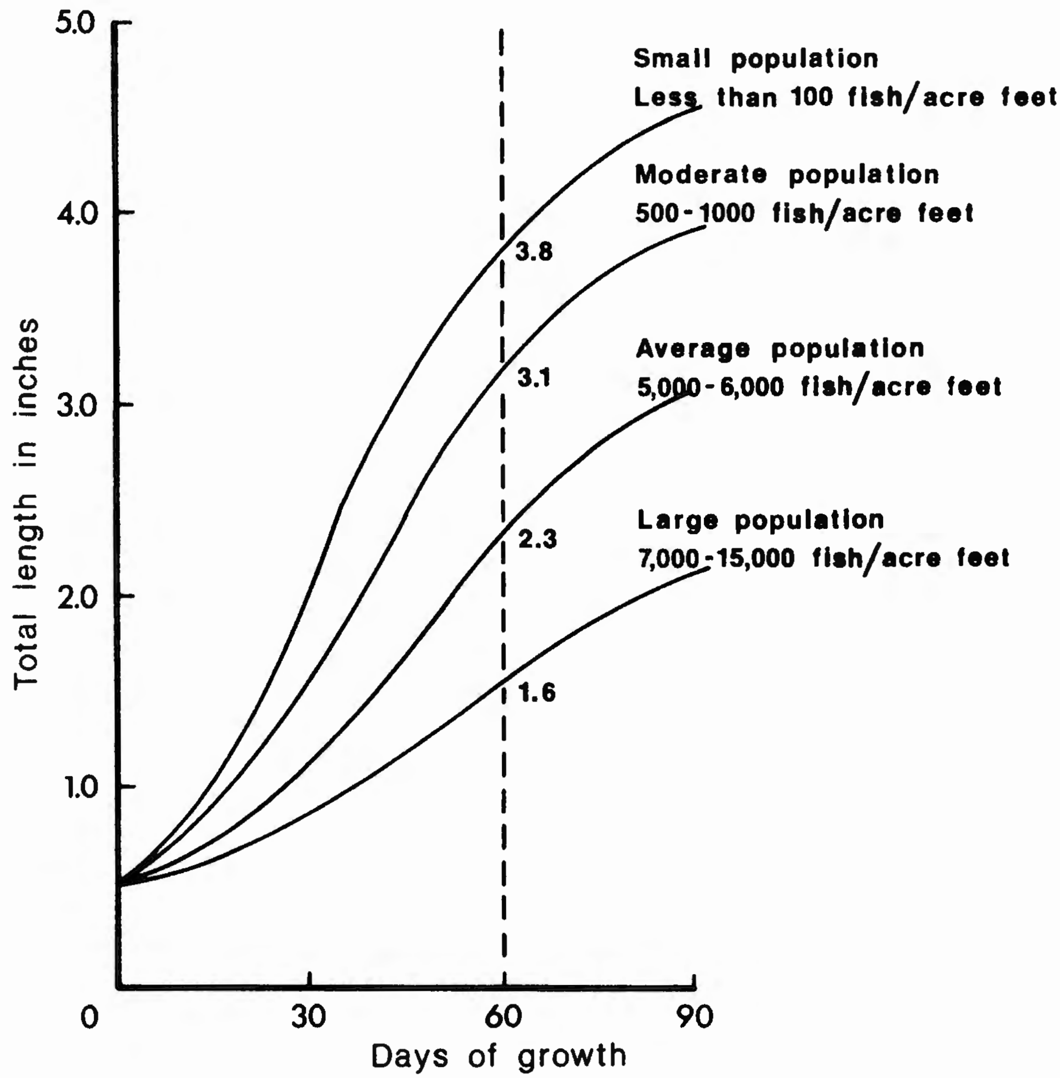

Figure 1.--Relationship between growth of walleye fingerlings and population density in drainable walleye ponds in Minnesota (from John Dobie, personal communication).

determining when to remove fish before large losses occur, and also in determining when losses are likely to occur in subsequent years; thus action can be taken to avoid such losses.

Obviously the method used for harvesting fish should be one that is least harmful to the fish. Walleye fingerlings are delicate, especially during the warm months when harvesting is usually done. One procedure used in Minnesota is to produce a current of water, either by gravity flow or by pumping, and direct the current through a fish trap (John L. Skrypek, personal communication). Walleye fingerlings seem to be attracted even by a moderate amount of flow and move toward the current. Different kinds of traps have been used. One successful kind is a 4' by 4' by 4' box trap with two funnels and a near-vertical lead extending from the trap to the pond bank. The trap is covered with screen or hardware cloth, for which the size of the mesh is selected to match the size of fish that are being harvested. When the current is introduced, fish move along the pond margin toward the trap; the funnels should be placed at right angles to the inflowing water (Fig. 2).

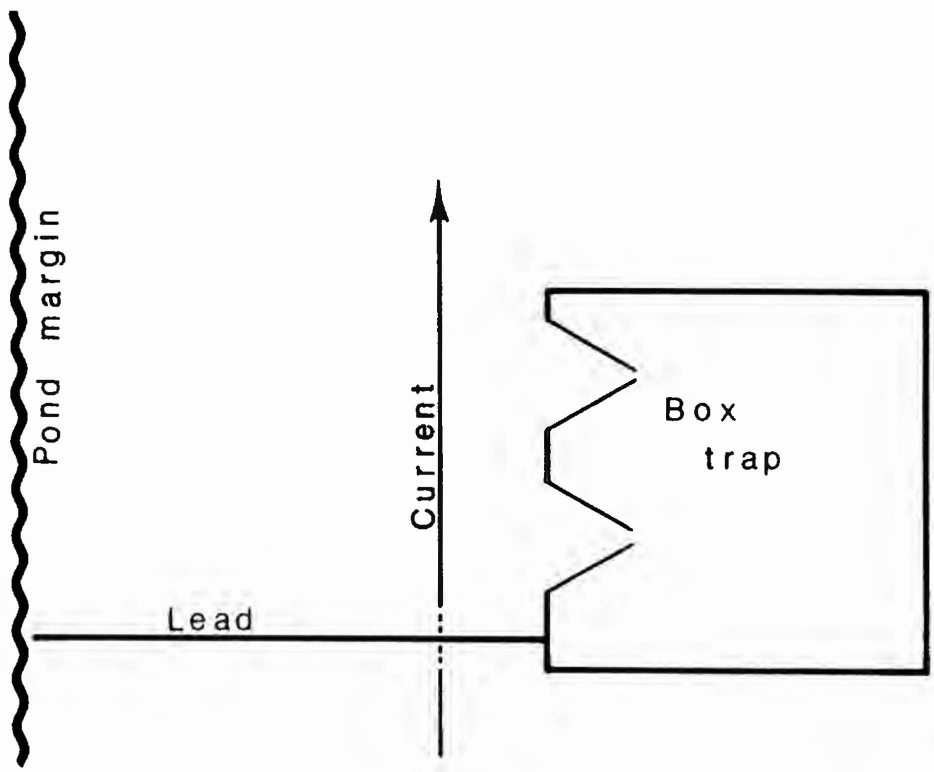

Figure 2.--Diagram of box trap placement in pond for harvesting walleye fingerlings.

A current of water can be used to concentrate fingerlings in any given area of the pond, and then the fish can be seined out. Knotless nylon seines are recommended. Peterson (1973) successfully used nylon seines 150 feet long, 12 feet deep, and of 1/4-inch mesh for harvesting fingerlings; the same mesh size is used in Minnesota (John L. Skrypek, personal communication).

Harvest time is determined by size of fingerlings desired and on available food supply in the pond. Maximum production is usually attained by periodically removing the larger fingerlings that may become cannibalistic. Fingerlings may become cannibalistic at 1 inch in length, if the supply of zooplankton is not adequate; however, with an abundance of zooplankton, fingerlings were 3 to 3.5 inches before switching to a fish diet (Smith and Moyle, 1945). A decision must be made whether greater mortality may occur from cannibalism or from increased handling of the fish during thinning operations.

The production goal should be 6,000 to 10,000 (40 to 50 pounds) 2.5- to 3.0-inch fingerlings per acre.

Drainable ponds

A. Pond construction

Several factors should be considered in locating sites for pond construction.

1. A water supply should be readily available and of high quality.
    a. Water from wells or springs is usually low in dissolved oxygen, low in nutrients, and cold. These waters should be aerated and warmed before being used for rearing walleyes.
    b. Water should be screened to remove unwanted fish fry, when pumped from lakes or streams. The water can be run through a screen box with a mesh of about 16 openings

per inch. In some situations a finer screen may be desirable, but plugging of the screen then becomes a problem.

c. Water seepage from swamps, or from springs, usually leaves the pond bottom wet and soft, so it cannot be worked. Most ponds need some work on the bottom to maintain proper depth and soil fertility.

2. Ponds should be completely drainable so the bottom soil can be worked with farm field equipment.
3. Minimum size of a pond should be 1 acre. Maximum size should be kept to an area that can be efficiently worked and managed.
4. Maximum depth should be about 5 feet, with a very minimum of shallow area less than 3 feet to avoid growth of undesirable vegetation such as cattails.
5. Bottom soils should contain from 4 to 8% organic matter. Organic matter content can be increased by green fallowing.
6. Ponds should be near enough to the lakes to be stocked, so the walleye fingerlings can be transported with minimum mortality.

B. Fertilization

Current information indicates that the best method of fertilization of drainable ponds is green fallowing where a pond is sown to rye and left dry for one season. Rye is planted in early fall, and the vegetation is disked into the soil in late summer or early fall of the next year. In Minnesota, rye was planted at the rate of 75 pounds of seed per acre, and fertilized with 300 pounds of 10-10-10 fertilizer per acre (Dobie, 1956). An application of about 100 pounds per acre of dried sheep manure or hay may be added each year. The organic fertilizer can be either spread, or placed in piles. Spreading the fertilizer over the pond bottom may result in some problems when harvesting with a seine. In Minnesota, organic fertilizer is applied on the frozen pond bottom in the winter. Application of the fertilizer early in the spring has also been successful. Manure or hay adds little to the natural fertility of a body of water, but acts as a catalyst in starting the proper food chain early enough so that zooplankton will be available to walleye fry.

Green fallowing for one year should produce good fish crops for about five years. Terrestrial vegetation is fairly high in nitrogen and low in phosphorus. Release of nutrients when vegetation is disked into the soil is more gradual than when nutrients are added directly to the water.

Four percent of organic matter in bottom soils seems to be the dividing point between productive and unproductive ponds. On occasion, soils may have too much organic matter, and fish losses may occur from summerkill due to high oxygen demand of bacterial decomposition. For a nominal fee (currently $4.00) arrangements can be made through the local County Extension Office to have soils tested for organic content.

C. Ponds during the winter

The easiest procedure is to leave ponds dry over winter. If ponds are filled each spring with lake or stream water that is rich in plankton, a good biological community will develop in a few days. However, some pond managers prefer to keep ponds full of water during the winter to allow more time for natural biological communities to become established.

Nondrainable ponds and natural lakes

A. Size

A minimum of 5 acres with a maximum depth of 6 to 8 feet. A minimum of shallow area less than 3 feet, to discourage growth of vegetation.

B. Bottom types

Bottom soils should contain organic matter, and yet be firm enough to facilitate harvesting by seine or trap. Abundant vegetation and soft bottoms interfere with harvesting operations.

C. Food supply

The food supply should consist of zooplankton and insects. The value of providing forage fish is questioned by some workers. Others maintain that forage fish act as a buffer to control cannibalism. Still others think that forage fish actually enhance cannibalism.

D. Fertilization

Since green fallowing is not possible in nondrainable ponds, addition of nutrients in the form of sheep manure, hay infusion, and/or yeast is necessary. Success has been obtained recently in two relatively unproductive borrow pits in Michigan, with the addition of about 3.5 bales of hay per acre applied in the fall prior to ice cover, and then weekly applications of 30 pounds per acre of Torula yeast beginning 2 weeks before introduction of fry in the spring. After introduction of the fry, yeast was applied bi-weekly (Peterson, 1973). Success in Minnesota was obtained by delaying the application of yeast until June 15, or about 4 weeks after stocking the fry. Probably the delay in applying yeast is advisable in ponds with greater than 4% organic matter in the bottom soils.

Torula Dried Yeast (N.F. XII, Type B) is available from: Lake States Division, St. Regis, 600 West Davenport, Rhinelander, Wisconsin, 54501. The product can be spread manually over the surface of the water.

E. Predator fish

Waters should be chemically treated annually to eliminate competing or predacious species of fish. Complete removal of all fish at harvest time is extremely difficult, and only a small number of yearling fish can be the cause of extreme predation on stocked fry the following year.

Production costs and returns

Production in pond culture varies widely from year to year. Fingerling production in 1968, from 34 ponds in Wisconsin, ranged from 0 (4 ponds) to 200 (2 ponds) pounds per acre, with an average of 42 pounds per acre. Survival rates ranged from 0 to 40.5%, and averaged 7.8% (Klingbiel, 1969). In 1971, field personnel in Michigan planted 715,000 walleye fry in a number of ponds and small natural lakes (Table 1). Production was erratic among these waters, but 72,641 fingerlings were raised, with an average length of 2.8 inches. Survival ranged from 0 (4 ponds) to 24.4%; the average was 9.8%.

Operational costs for the projects listed in Table 1, including surveillance and harvest activities, totaled $2,417, which includes $243 for estimated costs of raising the walleye fry in the hatchery. Cost per fingerling was $0.033, which is comparable to that for northern pike produced in managed marshes in Michigan. No capital costs are included in this analysis, since most ponds were a cooperative effort with lake associations or were natural lakes. However, capital costs for pond development should be similar to costs for northern pike marshes, which range from $73 to $1,000 per acre.

Maintenance stocking with walleye fry has generally met with poor success, except in reclaimed waters. Results from stocking fingerlings have also been variable; however, larger fish generally survive better and contribute more to the fishery. Schneider (1969) reported returns of 7.1%, 0.3%, and 2.3% from three plantings of fingerlings in Bear Lake, Manistee County. The returns could have been as low as 0%, or as high as 28.2%, 6.2%, or 5.2%, depending on the number of native walleyes included in the harvest. Kempinger and Churchill (1972) reported a return of 13.6% from one stocking of 166 fingerlings per acre in Escanaba Lake, Wisconsin.

Survival of walleye fingerlings to age III has been estimated at 10 to 15% (Schneider, 1969; Kempinger and Churchill, 1972). Natural mortality of adult walleyes was estimated at less than 10% per year (Klingbiel, 1969). Exploitation rates vary considerably. A literature search by Schneider

Table 1.--Survival and cost of walleye fingerlings raised in outlying ponds in Michigan, 1971

Lake or pond, and county	Size of ponds (acres)	Number of fry planted	Number of fingerlings produced	Size of fingerlings (inches)	Percent survival	Operational costs ($)
Fife Grand Traverse	1.5	75,000	18,200	2.4	24.3	180
Three ponds Drayton Plains Oakland	20.0	175,000	15,200	3.0	8.6	210
Missaukee Missaukee	0.75	10,000	0	...	0	200
Nordhouse Mason	5.0	75,000	1,000	3.5	1.3	200
Indian Lake	40.0	75,000	0	...	0	200 (est)
Sucker Delta	6.1	75,000	0	...	0	200 (est)
Borrow pit Delta	7.0	150,000	31,567 5,096	2.0 3.0	24.4	784
Four ponds Mackinac	2.3	80,000	1,578	3.0 (est)	1.9	200
Average	...	...	...	2.8	9.8	...
Fry costs (only)	...	...	...	...	...	243
Fingerling costs (only)	...	...	...	...	...	2,174
Totals	82.65	715,000	72,641	...	...	$2,417

(1969) indicated that exploitation rates varied from 6% to 47%. Crowe (1957) estimated an average exploitation rate of 20% for Michigan, with a 13-inch minimum size limit.

Assuming a 6.2% return to the angler, it is estimated that total return to the creel of the 1971 walleye fingerling production in Michigan (Table 1) would be approximately 4,500 adults, of which 80% would be contributed by age groups III through VI. This agrees with the findings of Johnson and Johnson (1971), and Schupp (1972). The estimated catch rate for walleyes taken by anglers is one fish per two angler days. From this it is projected that the 4,500 walleyes creeled will develop an estimated 9,000 angler days. Estimated value of this fishery is $56,700, if an angler day is valued at $6.30 (National Fishing and Hunting Survey, 1970). With a production cost of $2,417, the benefit cost ratio is about 23:1.

Community rearing ponds for fish can serve a useful purpose in improving relationships between local groups and the Department of Natural Resources. Such programs will also provide incentive and direction to citizens' associations and other groups, for improving habitat conditions in their local waters. Any such program is fraught with unforeseen difficulties and confusion, unless a well-planned agreement is complied with by both parties. This agreement should establish ground rules for operation, conditions of compliance to the agreement for both parties, and a stipulation of what use will be made of the fish which are produced.

At present there is no significant hatchery production of walleye fingerlings in Michigan. The new warmwater fish hatchery, proposed for construction in southeast Michigan, is intended to have the capability of producing some 2,000,000 6-inch walleye fingerlings plus an additional 100,000,000 fry. Rearing ponds will have the capability of supplementing the total walleye production in the hatchery, with an intermediate size fingerling for maintenance stocking in selected lakes, and for introductions into chemically rehabilitated waters. If the production goal of 6,000 2- to 3-inch fingerlings per acre is attained, 150 acres of well managed community rearing ponds and selected, small natural and artificial lakes could produce 900,000 fingerlings annually. Based on the 1971 operating cost in Michigan of $26.00 per acre, total annual operating costs would be $3,900, which would represent a good return on investment.

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