

Baltic Coastal Zone No. 2	
(61-66) 1998	Institute of Biology and Environmental Protection University of Education of Słupsk

**POTENTIAL FOR RECULTIVATION AND FOR DEVELOPMENT
OF MARICULTURE IN JAMNO LAKE THROUGH FLUSHING
IT WITH SEA WATERS**

ZBIGNIEW PIESIK

*Department of Ecology and Protection of the Sea,
University of Education of Słupsk,
Arciszewskiego St. 22b, 76-200 Słupsk, Poland*

Freshwater Jamno Lagoon (referred to as a lake) due to its small depth, substantial thickness of organic bottom sediments, high level of eutrophication, and pollution had lost a number of its assets which limited the use of its waters for fisheries and recreation. The recultivation methods that have been hitherto suggested are very costly and the predicted effects are in part disputable. In such situation, another cost-effective recultivation methods of this body of water should be sought that could be implemented in near future.

The present author's idea is to implement a technical-biological method of recultivation of Jamno Lagoon through forced pipeline introduction of the Baltic waters to the western part of the lake. The discharge of the excessive water masses will proceed through a natural canal connecting the lagoon with the sea. To minimize the costs of the water transport from the sea to the lake (and from the lake to the sea at the time of „back water” caused by prevailing strong north winds) it is suggested to supply electricity to the pump system from a wind power station.

Restoring stronger impact of the Baltic Sea on the environment of Jamno Lake through forced influx of the marine waters will cause creation of a brackish body of water with the salinity level of 2-7‰. In the areas where salinity of 4‰ will be maintained (west part of the lake) it is likely that an assemblage of Baltic organisms will develop. This in turn will enrich species biodiversity prompting diversified effects of living organisms on the aquatic environment leading to self-purification. Majority of the organisms of the shallow-water Baltic communities (plankton, benthos, and periphyton) will settle in the lake through introduction of planktonic organisms or pelagic larvae of benthos or periphyton via the pipeline. Fish species of the coastal zone finding there sufficient salinity and abundance of

food will migrate to the lake through the canal connecting the lake with the sea. It concerns, in particular, commercially important species like flounder (*Platichthys flesus*) or spawning schools of herring (*Clupea harengus*) visiting the lake occasionally at the time of seawater influxes. The lake will be settled also by the Baltic species of great importance as the food base for predatory fishes like gobies (*Pomatoschistus minutus*, *P. minutus*), sandeel (*Ammodytes tobianus*), and greater sandeel (*Hyperoplus lanceolatus*). The transformed body of water is likely to be settled by numerous invertebrate species typical for the coastal zone and important as the food base for commercially important fishes: polychaetes (*Nereis*, *Marenzelleria*, *Pygospio*), bivalves (*Macoma*, *Mytilus*), crustaceans - sand shrimp (*Crangon crangon*), prawn (*Palaemon adspersus*), isopods (*Gammarus*, *Pontoporeia*) and others. Sheltered waters of the lake, like the Gulf of Puck (before the ecological catastrophe) provide especially convenient conditions for development of organisms compared to the poor fauna of the coastal zone and the waters of the open sea.

Shaping of the qualitative and quantitative structure of the organisms in the lake under transformation has to be based on the biological methods (additional stocking with selected species, biomanipulation, and using the method of active substrate). Introduction of the specified organisms is aimed at protection of the indigenous species, e.g. stocking with bottom plants poorly developing in the open coastal waters or being on the verge of extinction in the sheltered waters of the Bay of Puck: rockweed (*Phucus vesiculosus*), red alga (*Furcellaria lumbricalis*), sea-grass (*Zoostera marina*) (Żmudziński 1994).

The method of ecological biomanipulation in the lake will consist in artificial stocking with the rainbow trout. Its role as a predator will be to limit the planktophagous fishes (feral fishes), excessively breeding in eutrophicated bodies of water. The planktophagous fishes are undesirable because they reduce numbers of water-filtering zooplankton species (numerous *Copepoda*, cladocerans *Bosmina*, various *Rotatoria*). Maintaining substantial density of water-filtering planktonic crustaceans is aimed at elimination and utilization of excessively developing phytoplankton. The unused phytoplankton causes undesirable physical-chemical changes of water like limitation of water transparency, elevation of pH. In addition, the decomposition of dead phytoplankton causes limitation of life-supporting oxygen levels in the water, which can contribute to oxygen deficiencies, especially at night in the bottom layer even of shallow bodies of water. The selection of the rainbow trout as the predator was justified by its better meat quality over such species as pike or zander and for its very good growth rate in brackish waters (Wawrzyniak et al. 1987). This species has been successful as a fish used for „sea ranching” and it confirms its suitability for Baltic mariculture (Trzebiatowski et al. 1979).

The extensive (at large) culture of the trout in Jamno Lake has to be supplemented with the method of active substrate consisting in introduction of artificial substrate (e.g. steelon nets) on which a reach assemblage of organisms grows. The latter assemblage constitutes a food base and this concerns especially smaller individuals of a given species (Piesik 1992). For instance gammarus (*Gammarus*) abundant on the nets in brackish water are eaten by the trout, which contributes to a

„salmon” coloration of their meat, rising the commercial value and flavor of the trout.

The method of the active substrate (Szlauer 1974, 1979, 1980; Piesik 1974, 1978) can be also used in Jamno Lake as a supplementary cleaning tool reversing eutrophication or as an artificial spawning substrate for certain fish species e.g. herring or roach (Piesik 1978, Wawrzyniak 1987). Assemblage of organisms living in large numbers on an artificial openwork substrate (periphyton) participates in the process of biofiltration, biosedimentation and bioaccumulation of mineral salts (in this number also nutrients) (Szlauer 1979, 1980, Piesik 1978, 1992). Organisms growing on substrates take part in elimination of seston from the pelagial, in this number bacteria and phytoplankton, contributing to creation of the bottom sediments. Elimination, particularly of pathogenic bacteria from the water has a big epidemiological importance. Mass-growing periphyton organisms have effect, depending on the number of substrates, on species biodiversity, accumulation of nutrients, creation an abundant, additional food base for animals (e.g. fishes, waterfowl) in the body of water. For the above reasons it is suggested to use old steelon fisheries nets or other substrate for different purposes - collectors for larvae of sedentary mussels (*Mytilus*), units for supplementary cleaning of water, and artificial spawning substrates (Fig. 1). The most important function in the periphyton assemblage is played by sedimentators and filtrators (*Ciliata*, *Bryozoa*, *Cirripedia* and sedentary mussels) and sedentary predators: *Suctorina*, *Cordylophora*, *Laomedea* (Piesik 1978, 1992). Partial reversal of eutrophication can be achieved by periodical removal of the substrates heavily settled by periphyton and by catching fishes, in this number those feeding on the artificial substrates.

For utilization of the food base of the bottom, in this number muddy areas, it is suggested to stock the waters with sturgeons (sterliad). The latter species can be an attractive item of future catches (Filipiak, personal communication).

The most important problem in the recultivation of the lake can be the sediments accumulated on its bottom. Those in the conditions of small depth and the wave activity can be re-suspended and limit water transparency, not to mention the release of nutrients. It is suggested to remove the sediments with a dredger cutter and transport them to designated dumping sites on land at the time non-colliding with tourist season. A ditch 2-4 m-deep and 50-m-wide should be dredged from the west part of the lake towards the sea-connecting canal. Such ditch could collect sediments from the adjacent shallow areas, preventing their re-suspension. The acquired mud, after drying on the dumping sites can be used in agriculture and they can bring economical effects, compensating the maintenance costs of a small dredger cutter. „Vacuuming” of the sediments from the ditch should be continued for many years. This 4-m-deep ditch will have an additional role as a navigational channel for keel yachts of the draught up to 3 meters. Its maintenance will require also a use of a dredger. The rebuilding of the bridge over the sea-connecting canal and the construction of the navigation channel to the Koszalin Marina on the southern shore of the lake will attract here a number of sail- and motor boats from the southern Baltic.

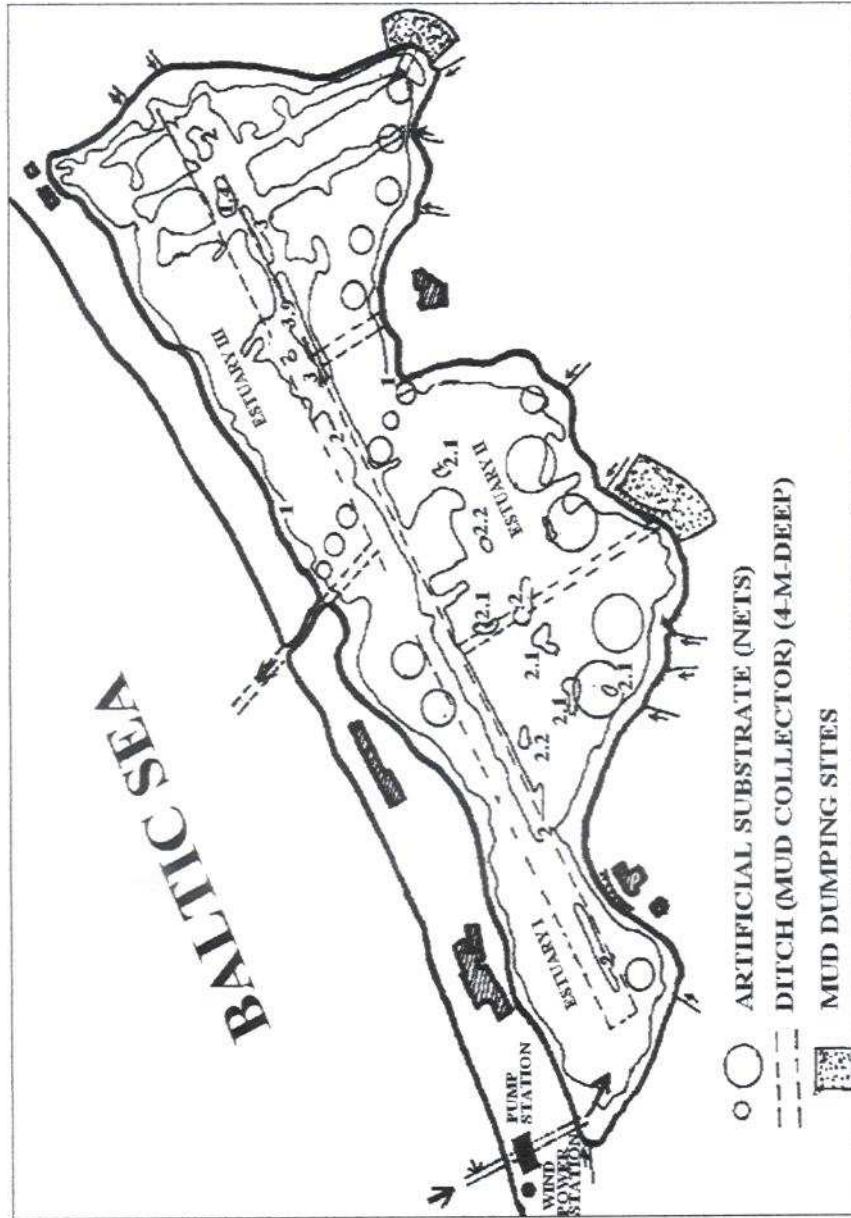


Fig. 1. Localization of the artificial substrate, ditch (mud collector), mud dumping sites, and the pipeline in Jamno Lake

The recultivation changes should be accompanied by administrative changes and the area of Jamno Lake as a part of sheltered marine waters should be administered by the Urząd Morski w Słupsku. In addition a 200-m technical zone on the land should be also included in the jurisdiction of the above authority.

It must be emphasized that the construction of the pipeline and the wind power station would not incur high costs and the recultivation process can be initiated in the near future and supplemented in the subsequent years by consecutive stages (stocking with selected fish species, mariculture).

There are over 500 lakes in the Province of Koszalin thus the conversion of one of them into a real Baltic lagoon would not have a substantial effect on the management of inland water resources and it will bring a number of profits to the maritime economy. Among the profits can be listed: development of fisheries and mariculture, Baltic yachting, development of gastronomic and recreational base, improvement of thermal condition for bathing compared to the beaches on the open sea. Spatial development of the coastal zone of Jamno Lake is discussed in a separate paper by Piesik (1997). Rearrangement of the water-sewage system of the Jamno Lake drainage area constitutes a fundamental condition for achieving positive results of the recultivation efforts.

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