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Short communication

Start-up of a tropical marine fish hatchery: Phases and procedures

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ABSTRACT

The importance, main development phases, and start-up procedures for a new marine fish hatchery are presented. General guidelines, start-up preparation phasing, and operations are explained. Specific detailed descriptions are given for equipment conditioning and commissioning of seawater pumping systems including a direct seawater intake and wells with sub-sand pre-filtration extraction systems.

1. Introduction

Detailed information on the design, start-up, and operation procedures of marine fish hatcheries is rarely published. This information is usually given in product manuals that have very limited distribution and are typically included in commercial firm manuals, used for technology transfer to clients (Alvarez-Lajonchère et al., 2007). There are few publications on the design of fish hatcheries with their general operation and maintenance guidelines, as those of Moretti et al. (1999, 2005) for subtropical species, and Alvarez-Lajonchère and Hernández Molejón (2001), Alvarez-Lajonchère et al. (2007), Sim et al. (2005) and Alvarez-Lajonchère and Puello Cruz (2011) for tropical species. However, detailed information on start-up considerations and procedures are scarcer still. General guidelines for this essential aspect regarding aquaculture seawater systems were presented by Huguenin and Colt (2002).

2. General considerations

The procedures follow the concept of a hypothetical hatchery similar to that described by Alvarez-Lajonchère et al. (2007), based on the author's own practical experience during several years in hatcheries in the Mediterranean and Latin American countries.

The initial actions for setting up a new hatchery, or a greatly modified one, are particularly important. This process is called "start-up" and must be performed with great care, following a plan for hatchery system start-up activities given the sensitive steps and risks involved. Before starting-up each system, every factor and component shall be carefully checked by the person in charge of the start-up process. These include, among others, condition of the building structure, safe fixation of devices, possibility of water hammer occurrence, degree of cleanness of water and air distribution systems, safety and initiating position of water/air valves and electric switches (which may need to be full on or off or in a specific position), absence of tools and/or debris on floors, state of effluent systems (channels, sumps, clarifiers, stabilization ponds, etc.), correct specified valve closing times, etc. Special care should be given to life support equipment, electric power supply, safety and performance of the alarm system, etc.

Start-up phases and procedures should be carefully planned in advance, and all persons involved must know the steps, characteristics, critical aspects and control points. Start-up actions shall also be considered as the hatchery's initial operational procedure. Facilities usually start operating before the completion of the building and the equipment is in place (Huguenin and Colt, 2002). A sequential approach, by sections and/or systems, shall be implemented, without trying to start the entire hatchery at the same time.

The person in charge of the start-up process is usually the Chief Engineer (CE), who is assisted by a few technicians and part of the hatchery staff, and is supervised by the Hatchery Manager (HM). The start-up process at the facility, as well as hatchery operations shall be assigned to persons who are knowledgeable in the subject and have practical experience. Ideal personnel do not usually come from the biological science area, but from technical and engineering fields. Often, administrators or bureaucrat authorities lacking knowledge on hatcheries, and, particularly, lacking practical experience, do not understand the importance of including qualified personnel for the start-up, operation and maintenance of these

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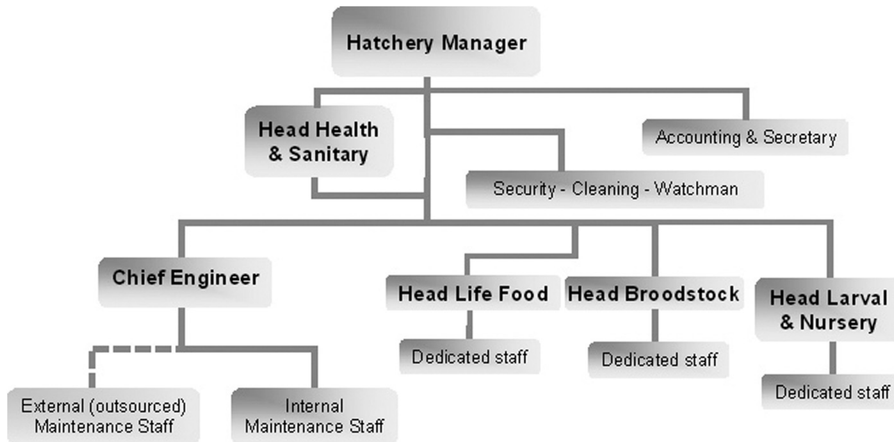

Fig. 1. Tentative organization chart of a typical marine finfish hatchery.

facilities. They are paid lower salaries and are not motivated and as a result, appropriate personnel are not hired for the hatchery. These are specific examples of which the authors are aware of, and, although the salaries for experienced operations personnel should be set by employment opportunities in water treatment, wastewater treatment, petrochemical industries, and industrial processes, this is frequently not the case in poorly managed firms and inexperienced administrative officers in countries where aquaculture is in its early stages, as in many Latin American and Caribbean countries. This underestimation is directly responsible for start-up, operational, maintenance and repair problems, which are as critical as any biological aspects. There are hatcheries where the engineering-related staff is so poorly valued that only mid-level technicians are hired, and are under the supervision of one of the biological area chiefs. There are even times when these essential and specialized activities are sometimes distributed among the technicians of the biological areas and sectors, and are ranked second in importance.

In a properly structured hatchery, operation and maintenance is an organizational unit in itself, with qualified personnel under the supervision of a Chief Engineer in close connection with the Hatchery Manager in order to give these critical activities appropriate hierarchical importance, as part of a typical hatchery organization chart (Fig. 1). This will enable their appropriate prioritization, preventive maintenance programming, and the substitution of equipment parts as required. When specialized personnel is not a part of a hatchery's workforce, the life-maintenance systems (water and air systems, auxiliary electric generators, etc.) are mainly affected due to significant equipment malfunctions and breakdowns, which produce biological contamination, drops in live culture efficiency, high mortality, and even their collapse. The general implication is inefficiency, significant decrease in plant yield, and even complete failure of the hatchery.

The Chief Engineer and Hatchery Manager should have full authority to implement their recommendations on the hatchery start-up process as well as on the operation and maintenance of the hatchery. These must be emphasized to all personnel from the beginning to avoid loss of time and money correcting potential failures.

3. Start-up organization phase

3.1. Facility and equipment conditioning methods

Buildings and facilities must be assembled using components that are directly able to hold biological organisms. Generally speaking, part of the facilities has to be prepared before putting in the organisms that are to be raised. According to Tucker (1998, pp. 142–144) and Huguenin and Colt (2002, pp. 117–127), construction materials can be toxic (especially when new) to cultured organisms, and particularly to larval forms. Even common materials as those specifically used in seawater systems, such as polyethylene and polyvinyl chloride (PVC) and their binding cement, are initially toxic and should be conditioned in flow-through seawater for at least two weeks before using them with marine organisms (Huguenin and Colt, 2002).

Water and air distribution pipes and their accessories, tanks, and any devices that will be in contact with the water or directly with the organisms shall be carefully cleaned and disinfected. Distribution pipe systems and tanks shall be treated (the so-called curing or aging processes) for one or two weeks before being used with live organisms.

Concrete is very alkaline; it is one of the most toxic materials for living organisms and needs to be soaked for a few months (Tucker, 1998). It has been treated with 0.5 ppm of acetic acid (Alvarez-Lajonchère and Hernández Molejón, 2001), or 1 ppm of alum (potassium aluminum sulfate, according to Kungvankij et al., 1985) to neutralize its alkaline nature. This characteristic, together with its rough surface which may cause fish wounds and the consequent infection of pathogenic microorganisms, usually excludes this material, which is not recommended for structures that may be in contact with live organisms. There are a number of coatings for concrete that can greatly improve its surface properties, such as synthetic resins with or without fiberglass, which are usually expensive and need trained staff to apply it properly.

Treatment consists in cleaning the surface of these materials, detaching toxic substances that are attached to the surface or released from the material itself when in contact with water. Cleaning procedures are usually based on strong brushing and washing with pressurized tap water. Sometimes it is advisable to use steam-clean procedures, hot water (especially when grease-type substances are present), lipid solvents, or even neutral detergents, and then washing with a strong brush and tap water. They are then left outdoors under direct sunlight and other weather conditions for at least a week. Repeated filling and draining with tap or seawater is another conditioning method, especially for fiberglass and plastic tanks.

3.2. Other preparatory actions

- Setting-up recirculating systems – biofilter conditioning shall be performed for at least 6 weeks before start-up: it starts with 2 ppm NH_4Cl or $(NH_4)_2SO_4$, which is adjusted on a daily basis