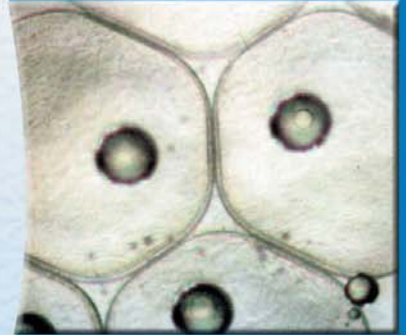


Manual on Hatchery Production of Seabass and Gilthead Seabream

Volume 1



Food
and
Agriculture
Organization
of the
United
Nations

Manual on Hatchery Production of Seabass and Gilthead Seabream Volume 1

by

Alessandro Moretti
STM AQUATRADE Srl
Castelraimondo, Italy

Mario Pedini Fernandez-Criado
FAO Fisheries Department
Rome, Italy

Giancarlo Cittolin
Maricoltura di Rosignano Solvay Srl
Rosignano Solvay, Italy

Ruggero Guidastrì
STM AQUATRADE Srl
Venezia, Italy

PREPARATION OF THIS DOCUMENT

This is the first of two volumes of a Manual on hatchery production of seabass and gilthead seabream. It is part of the programme of publications of the Inland Water Resources and Aquaculture Service. The manual has been written based on the direct experience of technicians and managers of commercial hatcheries operating in the Mediterranean. It is intended to assist both technicians entering this field as well as investors interested in evaluating the complexity of hatchery production of seabass and gilthead seabream.

The manual has been prepared by the authors under the overall coordination of Mario Pedini, Senior Adviser (Aquaculture Development), and with the collaboration of numerous colleagues contributing comments to sections of the manual, ideas, and who assisted in its finalization. The contributions to this volume of Massimo Caggiano (Ittica Ugento Spa), Pepino Candreva (INVE Aquaculture), Béatrice Châtain (IFREMER), Licinio Corbari (Ittica Ugento Spa), Brigitte Loix (STM Aquaculture Srl) and Marlène Dehasque (INVE Technologies) are greatly appreciated. The assistance in the editorial work and final presentation and graphics given by André Coche, Rine Sola, Magda Morales, José Castilla and Emanuela D'Antoni has also been invaluable.

Moretti, A.; Pedini Fernandez-Criado, M.; Cittolin, G.; Guidastrì, R.
Manual on hatchery production of seabass and gilthead seabream. Volume 1.
Rome, FAO. 1999. 194 p.

ABSTRACT

Seabass and gilthead seabream are the two marine fish species, which have characterized the development of marine aquaculture in the Mediterranean basin in the last two decades. The substantial increase in production levels of these two high value species has been possible thanks to the progressive improvement in the technologies involved in the production of fry in hatcheries. As a result of this technological progress more than one hundred hatcheries have been built in the Mediterranean basin, working on these and other similar species. At present the farmed production of these two species that is derived from hatchery produced fry is far greater than the supply coming from the wild.

The development of these techniques, based originally on Japanese hatchery techniques has followed its own evolution and has resulted in what could be called a Mediterranean hatchery technology that is still evolving to provide higher quality animals and to reduce cost of production. This is a dynamic sector but it can be judged that it has reached a level of maturity that merits the production of a manual for hatchery personnel. The preparation of the manual has taken several years, also due to the progress of the sector that led to substantial revisions of sections. This has lengthened its preparation beyond what was originally expected. The manual is not intended to be the final word on hatchery production but rather a publication on how the industry produces in the late nineties. We preferred to include proven procedures rather than orient this publication to research on hatchery produced fry, as there is plenty of academic literature on this subject.

The manual has been divided in two volumes, with this first one divided in three parts. The first part dealing with the historical background which has led to the present status of this practice, and a discussion of the main factors that affect fish seed production. The second main section of the first volume has been devoted to the life history and biology of the species that enter in the production cycle of seabass and gilthead seabream fry. This includes also a short section on microalgae, rotifers and brine shrimp. The third main section of the first volume, which is the longer one, deals with hatchery production procedures, from broodstock management to production of live feed, egg management, larval rearing weaning, fry transport, and diseases.

The second volume will include sections on architecture and design of the hatchery systems, engineering aspects, financial aspects of hatchery operation and will provide some example of real cases of different commercial hatcheries that in recent years have approached hatchery production of these two species.

Key words: marine aquaculture, fry production, Mediterranean aquaculture, seabass, gilthead seabream.

CONTENTS

SUMMARY & INTRODUCTION

Part 1

HISTORICAL BACKGROUND AND PRESENT SITUATION

1.1 - HISTORICAL BACKGROUND	3
The fishery of wild fish fry in the Mediterranean	3
Fish seed demand from controlled reproduction	3
Technological evolution of Mediterranean fish breeding	5
1.2 - PRESENT SITUATION	7
Vertical integration: the hatchery as a part of the “Farming System”	7
Production strategies	8
Multispecific hatcheries	
Monospecific hatcheries	
Multipurpose hatcheries	
1.3 - MAIN FACTORS AFFECTING FISH SEED PRODUCTION	10
Technologies	10
Environmental conditions	11
Marketing	11

Part 2

BIOLOGY AND LIFE HISTORY

2.1 - GILTHEAD SEABREAM	15
Family Description	15
Family Sparidae	
Biology	
Geographic distribution	
Reproduction	
Fishery	
2.2 - THE EUROPEAN SEABASS	18
Family Description	18
Family Moronidae	
Biology	
Feeding	
Geographic distribution	
Reproduction	
Fisheries	

2.3 - LIVE FOOD FOR MARINE FISH LARVAE	20
Microalgae	21
Biology of rotifers	23
Taxonomy	
Morphology	
Life history	
Food	
Mass culture parameters and conditions	
Biology of the brine shrimp, <i>Artemia</i> .	26
Taxonomy	
Morphology and natural history	
Food	
Rearing methods	
<i>Artemia</i> use in aquaculture	
Nutritional value of <i>Artemia</i>	

Part 3

HATCHERY PRODUCTION PROCEDURES

3.1 - BROODSTOCK MANAGEMENT	33
Establishing the broodstock	33
Stock dimensioning	
Origin, capture and handling of broodstock	
Selection and quarantine treatment	
Stocking facilities	
Feeding broodstock	
Maintenance diet	
Breeding period diet	
Egg production	39
Gametogenesis	
Stocking broodstock in the spawning tanks	
Induced spawning	
Stocking facilities for spawning	
Out-of-season spawning	
3.2 - PRODUCTION OF LIVE FEEDS	44
Introduction	44
Mass culture of microalgae	46
Population dynamics	
Mass production systems	
Mass culture facilities for microalgae	
Preparation of the culture medium	
Mechanical filtration	
Enrichment	
Primary stock solutions	
Working solutions	
Culture equipment sterilization	
Enrichment of culture vessels	
Batch culture of microalgae	
Pure strain culture	
Protocol for test tubes replication	

Protocol for purification of algal strains	
Sterilization	
Upscaling culture conditions	
Scaling up protocol	
Monitoring algal populations	
Counting microalgae	
Mass culture of rotifers	61
Population dynamics	
Mass production systems	
Mass culture facilities for rotifers	
Preparation of the culture medium	
Pure strain culture	
Upscaling rotifer cultures	
Mass culture	
Cleaning culture	
Harvest	
High density rotifer culture	
Enrichment	
Monitoring rotifer populations	
Production of the brine shrimp <i>Artemia</i>	75
<i>Artemia</i> cyst strains	
Disinfection and decapsulation of brine shrimp cysts	
Incubation	
Harvesting of nauplii	
Counting and evaluating <i>Artemia</i> nauplii	
Enrichment and storage	
3.3 - FISH EGG MANAGEMENT	83
Gilthead seabream eggs and larvae development	83
Seabass eggs and larvae development	83
Egg harvest	85
Quality controls	
Weighing, disinfecting and counting eggs	
Incubation of eggs	88
Egg incubation in dedicated facilities	
Egg incubation in the larval rearing tanks	
Hatching	90
Viability of newly hatched larvae	
Larval transfer to the rearing facilities	
3.4 - LARVAL REARING	92
Layout of the larval rearing system	93
Preparing the larval rearing system	93
Environmental parameters for larval rearing	94
Photoperiod	
Light	
Aeration	
Water flow	
Dissolved oxygen	
Outlet filters	

Feeding seabass and gilthead seabream post-larvae	98
First feeding	
Transition from live feeds to artificial food	
Feeding protocol	101
Daily distribution of live feed	103
Daily storage of live feed	104
Hygiene in the larval rearing environment	105
Monitoring and controls	106
Quantitative evaluation of feeding performance	
Qualitative evaluation of stress	
Control of swim bladder development	
3.5 - WEANING	110
The rearing system	110
Preparation of the weaning unit	111
Fry culture	112
Rearing parameters	
Transferring fish from larval to weaning section	
Feeding	116
Feeding live-food	
Feeding moist food	
Feeding dry feed	
Feed distribution	
Management of the weaning section	118
Staff	
Daily operations	
Control of environmental and biological parameters	118
Fish behaviour	
Controlling growth and deformity rate	
Fry grading	
Sorting fry with skeletal deformities	
Swim-bladder control	
Cleaning	
Hygiene and sanitary conditions in the rearing environment	
3.6 - FRY TRANSPORT	125
Transport equipment	125
Vehicles	
Tanks	
Oxygenation systems	
Monitoring oxygen	
Water quality	127
Dissolved oxygen	
Salinity	
pH	
Temperature	
Ammonia	
Carbon dioxide	

Turbidity	
Foam	
Stocking density for transport	129
Fry handling	129
Transport conditions	
Loading	
Controls during transport	
Unloading and precautions at point of arrival	
Fry counting	131
Individual counting	
Counting based on sub-samples	
Counting by weight	
Automatic counting	
3.7 - Fry diseases: introduction to their observation, analysis and first treatment	133
Studying lesions at the skin surface	
Observing internal organs of diseased fish	
3.8 - Morphoanatomic and morphometric standards	135
Morphoanatomic performance	
Urinary calculosis	
Swim-bladder development	
Skeletal deformities	
Deformities in newly hatched larvae	
Jaw and opercula deformities	
Backbone deformities	
ANNEXES 1-31	141

SUMMARY & INTRODUCTION

By far and large only two fish species, the gilthead seabream (*Sparus aurata*) and the seabass (*Dicentrarchus labrax*), account for the bulk of marine aquaculture production in the Mediterranean Sea. As a direct consequence, the greatest share of the Mediterranean hatchery output is formed by these two species.

This manual deals with mass production of gilthead seabream and seabass fry for the aquaculture industry. It focuses only on well-established practices that have reached a standardised industrialisation and can be considered as reliable. In some cases, import difficulties, shortage of adequate funding and unavailability of technical assistance and maintenance services, could limit the adoption of the latest and more capital intensive techniques that are described in this manual. These constraints may be overcome by the adoption of less recent technologies in sections of the hatchery, that are simpler and more labour intensive. When available, these methods are also briefly described in this manual. New developments such as genetic manipulations and hybridization with other species are not covered because they have not yet reached a commercial level. The manual has attempted to provide information on what are current practices in commercial hatcheries and the case study section of the second volume is included to show that different commercial hatcheries may establish different protocols for production that suit better the conditions of their sites or the markets they are supplying. The case study section in particular is not supposed to be up to date as the preparation of the manual has taken considerable time, but is included to show different approaches to production organization.

The mentioning of commercial products does not imply an endorsement by the authors. They are mentioned in the text, when they are very common products, only as a matter of information.

