

# Improving *Penaeus monodon* hatchery practices

Manual based on experience in India



**Cover photo:**

*Penaeus monodon* hatchery in Vizag, India. Courtesy Dr. G. Subbarao

# Improving *Penaeus monodon* hatchery practices

Manual based on experience in India

FAO  
FISHERIES  
TECHNICAL  
PAPER

446

Aquaculture Management and Conservation Service  
Fisheries and Aquaculture Management Division  
FAO Fisheries and Aquaculture Department

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

ISBN xxxxxx

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to:

Chief

Electronic Publishing Policy and Support Branch

Communications Division

FAO

Viale delle Terme di Caracalla, 00153 Rome, Italy

or by e-mail to:

[copyright@fao.org](mailto:copyright@fao.org)

© FAO 2007

# Preparation of this document

Responding to a request made by the Government of India, a Technical Cooperation Programme (TCP) project was structured, with the view to improve the capacity of the State of Andhra Pradesh to better manage the shrimp aquaculture sector, with special reference to controlling diseases and managing health. The TCP, besides assisting the Department of Fisheries (DOF) of the State Government of Andhra Pradesh in managing shrimp health, also assisted in creating national capacity for emergency preparedness, empowering rural farmers by providing tools for the self-management of farming systems, improving the quality of hatchery-produced postlarvae and establishing overall better management practices for the shrimp aquaculture sector. It was felt that this multidisciplinary approach is required to obtain positive and permanent results.

This publication, “Improving *Penaeus monodon* hatchery practices. Manual based on experience in India” is one of several outputs of the TCP. It reviews the status of broodstock, hatcheries, postlarval production, health and opportunities for improving hatchery biosecurity and larval quality of tiger shrimp (*Penaeus monodon*). The publication also provides technical protocols and guidelines for improving hatchery biosecurity and larval and postlarval quality.

In preparing Section 3.6 (Broodstock quarantine), we have drawn extensively on material previously published in FAO Fisheries Technical Paper No. 450, *Health management and biosecurity maintenance in white shrimp (Penaeus vannamei) hatcheries in Latin America* (FAO, 2003).

# Abstract

The successful farming of tiger shrimp (*Penaeus monodon*) in India is mainly due to the existence of some 300 hatcheries whose capacity to produce 12 000 million postlarvae (PL) annually has provided an assured supply of seed. However, the sustainability of the sector is still hampered by many problems, foremost among these being a reliance on wild-caught broodstock whose supply is limited both in quantity and in seasonal availability and that are often infected with pathogens. The current low quality of hatchery produced PL due to infection with white spot syndrome virus (WSSV) and other pathogens entering the hatcheries via infected broodstock, contaminated intake water or other sources due to poor hatchery management practices, including inadequate biosecurity, is a major obstacle to achieving sustainable shrimp aquaculture in India and the Asia-Pacific region. Considering the major contribution of the tiger shrimp to global shrimp production and the economic losses resulting from disease outbreaks, it is essential that the shrimp-farming sector invest in good management practices for the production of healthy and quality seed.

This document reviews the current state of the Indian shrimp hatchery industry and provides detailed guidance and protocols for improving the productivity, health management, biosecurity and sustainability of the sector. Following a brief review of shrimp hatchery development in India, the major requirements for hatchery production are discussed under the headings: infrastructure, facility maintenance, inlet water quality and treatment, wastewater treatment, biosecurity, standard operating procedures (SOPS), the Hazard Analysis Critical Control Point (HACCP) approach, chemical use during the hatchery production process and health assessment. Pre-spawning procedures covered include the use of wild, domesticated and specific pathogen free/specific pathogen resistant (SPF/SPR) broodstock; broodstock landing centres and holding techniques; broodstock selection, transport, utilization, quarantine, health screening, maturation, nutrition and spawning; egg hatching; nauplius selection; egg/nauplius disinfection and washing and holding, disease testing and transportation of nauplii. Post-spawning procedures covered include: larval-rearing unit preparation, larval rearing/health management, larval nutrition and feed management, important larval diseases, general assessment of larval condition, quality testing/selection of PL for stocking, PL harvest and transportation, nursery rearing, timing of PL stocking, use of multiple species in shrimp hatcheries, and documentation and record keeping. Information on the use of chemicals in shrimp hatcheries and examples of various forms for hatchery record keeping are included as Annexes.

## FAO.

Improving *Penaeus monodon* hatchery practices. Manual based on experience in India. *FAO Fisheries Technical Paper*. No. 446. Rome, FAO. 2007. 101p.

# Foreword

The rapid development of shrimp farming in India is largely due to the setting up of a large number of hatcheries and the resulting availability of an assured supply of seed. Presently about 300 hatcheries are in operation with an annual capacity to produce about 12 000 million postlarvae (PL). In India wild-caught broodstock is the only source of shrimp seed. Studies indicate that about a quarter of wild-caught shrimp spawners are infected with white spot syndrome virus (WSSV). Furthermore the continuous exploitation of shrimp resources has brought about a scarcity of brooders, and their availability is also not uniform throughout the year. Viral-disease monitoring is an area of growing importance and biosecurity is also a serious concern for hatcheries, and thus protocols to address these concerns are urgently needed. Considering the major contribution of the tiger shrimp (*Penaeus monodon*) to global shrimp production and the economic losses resulting from disease outbreaks, it is essential that the Indian shrimp-farming sector invest in good management practices for the production of healthy and quality seed.

The FAO TCP/IND/2902 (A) project entitled “Health Management of Shrimp Aquaculture in Andhra Pradesh” is a result of a request made by the Government of India for assistance in building capacity to improve health management capabilities in shrimp farming in Andhra Pradesh. The TCP *inter alia* was aimed at providing tools to improve the quality of hatchery-produced PL through better health management and adoption of biosecurity measures at the farm and hatchery levels. The current low quality of hatchery-produced PL is considered a major obstacle to achieving sustainable shrimp aquaculture in the region.

The TCP benefited from close collaboration with other national and regional development agencies active in the field of aquaculture such as the Network of Aquaculture Centres in Asia-Pacific (NACA), the Aquaculture Authority (now Coastal Aquaculture Authority) and the Marine Product Export Development Authority (MPEDA). The TCP activities were conducted in collaboration with members of the private sector involved in hatchery production and the grow out of shrimp in Andhra Pradesh. This collaboration and cooperation between state agencies, regional and international agencies and the private sector not only improved the efficiency of implementation of project activities but also increased and expanded the size of the target groups and beneficiaries of the project.

This publication “Improving *Penaeus monodon* hatchery practices. Manual based on experience in India” is a major output of the TCP, based on strong consultation and collaboration between farmers, hatchery operators, scientists, state extensionists and several key experts in the field of shrimp hatchery production. We believe that this publication will be a milestone reference for shrimp hatchery operators and shrimp farmers in India and anyone interested in tiger shrimp farming globally. We commend and congratulate everyone involved in producing this document.

**Ichiro Nomura**  
Assistant Director-General  
Fisheries and Aquaculture Department  
FAO

**Yugraj Yadava**  
Member Secretary  
Coastal Aquaculture Authority  
India

# Acknowledgements

The production of this manual was made possible thanks to the assistance of many people engaged in shrimp hatchery management and aquaculture (see Annex 1). In particular, major contributions were made by Drs Win Latt, Mathew Briggs and Rohana Subasinghe. Technical editing was done by Dr J. Richard Arthur. Mr José Luis Castilla Civit is acknowledged for layout design.

All other pictures, except cover page pictures are courtesy Dr Win Latt.

Mr P. Krishnaiah, Commissioner of Fisheries, Andhra Pradesh State Government is acknowledged for his leadership in the TCP project, which made this manual possible.

Financial assistance provided by the Government of Norway for publishing this manual, through the multilateral FishCode Trust (MTF/GLO/125/MUL) is gratefully acknowledged.



# Contents

Preparation of this document	iii
Abstract	iv
Foreword	v
Acknowledgements	vi
Abbreviations and acronyms	x
<b>1. INTRODUCTION</b>	<b>1</b>
1.1 Shrimp hatchery development in india	1
<b>2. MAJOR REQUIREMENTS FOR EFFECTIVE HATCHERY PRODUCTION</b>	<b>3</b>
2.1 Infrastructure	3
2.2 Facility maintenance	4
2.2.1 Maintenance of machinery	5
2.2.2 Regular cleaning and disinfection water, aeration and drainage pipelines	5
2.2.3 Maintenance of tanks	6
2.2.4 Maintenance of filters (slow sand, rapid, cartridge, UV/Ozone)	7
2.3 Inlet water quality and treatment	9
2.3.1 Quality of intake water and treatment options	9
2.3.2 Inlet water treatment protocol	10
2.3.3 Seawater intake	11
2.3.4 Sedimentation/sand filtration of inlet water	11
2.3.5 Disinfection of inlet water using chlorine	12
2.4 Wastewater treatment	13
2.5 Biosecurity	15
2.5.1 Personal sanitation and hygiene	16
2.6 Standard operating procedures (Sops)	16
2.7 Hazard analysis critical control point (HACCP) approach	18
2.7.1 Seven steps in applying the HACCP principles	18
2.8 Chemical use during the hatchery production process	19
2.9 Health assessment	20
2.9.1 Level 1 health assessment techniques	21
2.9.2 Level 2 health assessment techniques	21
2.9.3 Level 3 health assessment techniques	21
<b>3. PRE-SPAWNING PROCEDURES</b>	<b>23</b>
3.1 Wild broodstock	23
3.1.1 The broodstock capture fishery	23
3.1.2 Broodstock quality	27
3.1.3 Pollution	28
3.2 Domesticated and SPF/SPR/SPT broodstock	29
3.2.1 Limitations of SPF shrimp	32
3.2.2 Importation of broodstock	33
3.3 Broodstock landing centres and holding techniques	33
3.4 Broodstock selection and transport from landing/auction centres	35

---

3.5	Broodstock utilization	36
3.6	Broodstock quarantine	36
3.7	Broodstock health screening	38
3.8	Broodstock maturation	40
3.9	Broodstock nutrition	42
3.10	Broodstock spawning	43
3.11	Egg hatching	45
3.12	Nauplius selection	45
3.13	Egg/nauplius disinfection and washing	46
3.13.1	Eggs	46
3.13.2	Nauplii	46
3.14	Holding and disease testing of nauplii	47
3.15	Transportation of nauplii	47
<b>4.</b>	<b>POST-SPAWNING PROCEDURES</b>	<b>49</b>
4.1	Larval-rearing unit preparation	49
4.2	Larval rearing/health management	50
4.2.1	Stocking rate	50
4.2.2	Water exchange protocols	51
4.2.3	Siphoning of wastes	52
4.2.4	Aeration	52
4.2.5	Water quality monitoring	52
4.2.6	Chemical/antibiotic use	53
4.2.7	Use of probiotics to replace antibiotics	54
4.2.8	Responsible use of antibiotics	55
4.3	Larval nutrition and feed management	56
4.3.1	Use of live algae	57
4.3.2	Artemia use	59
4.3.3	Artificial feeds	62
4.4	Important larval diseases	62
4.4.1	Monodon baculovirus (MBV)	62
4.4.2	White Spot Syndrome Virus (WSSV)	63
4.4.3	Baculoviral midgut gland necrosis virus (BMNV)	63
4.4.4	Vibriosis	63
4.4.5	Larval mycosis	64
4.4.6	Ciliate infestation	64
4.4.7	Swollen hind gut (SHG)	64
4.4.8	Diseases of unknown aetiology	65
4.5	General assessment of larval condition	65
4.5.1	Level 1 Health assessment observations	66
4.5.2	Level 2 Health assessment observations	68
4.5.3	Level 3 Health assessment techniques	71
4.6	Quality testing/selection of PL for stocking	71
4.7	PL harvest and transportation	73
4.8	Nursery rearing	75
4.9	Timing of PL stocking	76
4.10	Use of multiple species in shrimp hatcheries	76
4.11	Documentation and record keeping	77
<b>5.</b>	<b>REFERENCES</b>	<b>79</b>

---

<b>ANNEXES</b>		<b>81</b>
Annex 1.	Persons responsible for compiling this document	81
Annex 2.	Chemicals and treatments used in shrimp aquaculture in India	88
Annex 3.	List of antibiotics and pharmacologically active substances banned for use in aquaculture in India	93
Annex 4.	Quarantine/maturation tank daily data sheet	94
Annex 5.	Spawning/hatching tank daily data sheet	95
Annex 6.	Larval-rearing tank daily data sheet	96
Annex 7.	Level 1 larval health data sheet	97
Annex 8.	Level 2 larval health data sheet	98
Annex 9.	PL quality testing results sheet	99
Annex 10.	Research and development and extension requirements	100

# Abbreviations and acronyms

ACC	Aquaculture Certification Council Inc.
BAP	Best Aquaculture Practices
BIOTEC	National Centre for Genetic Engineering and Biotechnology (Thailand)
BKC	benzalkonium chloride
BMNV	baculovirus midgut gland necrosis virus
BMP	Better Management Practice
BP	baculovirus penaei
BSCC	Broodstock Collection Centre
CAA	Coastal Aquaculture Authority
CCP	Critical Control Point
CIBA	Central Institute of Brackishwater Aquaculture
CMFRI	Central Marine Fishery Research Institute
COC	Code of Conduct
COP	Code of Practice
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
DOF	Department of Fisheries
EDTA	ethylene diamine tetraacetic acid
FAO	Food and Agriculture Organization of the United Nations
FCR	feed conversion ratio
FRDC	Fisheries Research Development Centre
HACCP	Hazard Analysis Critical Control Point
HH	high health
HPV	Hepatopancreatic parvo-like virus
HUFA	highly unsaturated fatty acid
IHHNV	infectious hypodermal and haematopoietic necrosis virus
LR	laboratory grade reagent
LRT	larval rearing tank
MAF	Ministry of Agriculture and Forestry
MBV	Monodon baculovirus
MPEDA	Marine Product Export Development Authority
NACA	Network of Aquaculture Centres in Asia-Pacific
NSTDA	National Science and Technology Development Agency (Thailand)
OIE	World Organisation for Animal Health
OSSPARC	Orissa Shrimp Seed Production Supply and Research Centre
PCR	polymerase chain reaction
PL	postlarva, postlarvae (plural form) or postlarval

PUFA	polyunsaturated fatty acid
PVC	polyvinyl chloride
SIFT	State Institute of Fishery Technology
SOP	Standard Operating Procedure
SPF	specific pathogen free
SPR	specific pathogen resistant
SPT	specific pathogen tolerant
TASPARC	Andhra Pradesh Shrimp Seed Production and Research Centre
TCBS	thiosulphate citrate bile salts
TSA	trypticase soy agar
TSV	Taura syndrome virus
UV	ultra violet
WSSV	white spot syndrome virus
YHV	yellow head virus