-1 TITLE AND APPROVAL SHEET

QUALITY ASSURANCE PROJECT PLAN (QAPP)
for
Assessment of sea nettle (*Chrysaora quinquecirrha)* polyps in Barnegat Bay, NJ

Department of Biology and Molecular Biology
Montclair State University
1 Normal Ave.
Montclair, NJ 07043
phone: 973-655-4112 fax: 973-655-7047

March 2, 2010

Approved By:

Project Manager: Paul A. X. Bologna _____ 3/15/10
Signature Date

QA Officer: Meiyin Wu _____ 3/17/10
Signature Date

EPA Project Officer: Barbara Spinweber Barbara Spinweber 3/2/2010
Signature Date

EPA QA/QC Manager: _____ Donna Reigel 3/4/2010
Signature Date

2 TABLE OF CONTENTS

3 DISTRIBUTION LIST

Dr. Paul A. X. Bologna
Department of Biology
Montclair State University
1 Normal Ave.
Montclair, NJ 07043
Phone: 973-655-4112; Fax: 973-655-7097
Email: bolognap@mail.montclair.edu

Dr. Meiyin Wu
Department of Biology
Montclair State University
1 Normal Ave.
Montclair, NJ 07043
Phone: 973-655-7800; Fax: 973-655-7097
Email: wum@mail.montclair.edu

Dr. Jack Gaynor
Department of Biology
Montclair State University
1 Normal Ave.
Montclair, NJ 07043
Phone: 973-655-4112; Fax: 973-655-7097
Email: gaynorj@mail.montclair.edu

L. Stanton Hales, Jr., Ph. D.
Program Director
Barnegat Bay National Estuary Program
Ocean County College
1 College Drive, P.O. Box 2001
Toms River, New Jersey 08754-2001
Phone: 732-255-0472, Fax: 732-864-3851
Email: shales@ocean.edu

Barbara Spinweber, Environmental Scientist
U.S. Environmental Protection Agency,
Region 2
Watershed Management Branch
290 Broadway, New York, NY 10007
Phone: 212-637-3812
Email: Spinweber.Barbara@epamail.epa.gov

4 PROJECT/TASK ORGANIZATION

Dr. Paul Bologna, Associate Professor in the Department of Biology, will act as Principal Investigator. He will undertake overall responsibility for the project. He will train and supervise the graduate student to do field monitoring. Dr. Meiyin Wu will act at the QA Manager.

One Master's student (Monica Buesser) will conduct the bulk project work. Ms. Buesser will construct the settling plates, deploy them, retrieve the plates and identify any polyps on the settling plates. She will also take the digital photos of the structures and conduct the photographic interpretation.

5 SPECIAL TRAINING NEEDS/CERTIFICATION

Ms. Buesser will use identification keys to identify the species represented on the settling plates. Review of invertebrates will be conducted in the laboratory with supervision of Dr. Bologna.

6 PROBLEM DEFINITION/BACKGROUND

6.1 Problem Definition

Project Goal: Sea nettle (*Chrysaora quinquecirrha*) polyps in Barnegat Bay, NJ: a pilot assessment

The main focus of this study is to conduct a survey of the polyp population distribution in Barnegat Bay, NJ. Previous researchers in Barnegat Bay have suggested that population surveys are necessary to document the distribution and abundance of sea nettles (*Chrysaora quinquecirrha*). As such, this research will fill a data gap necessary to address the sea nettle problem and potentially develop management strategies. Two investigations will be explored to assess polyp distributions:

1. Experimental settling plates to assess the timing of polyp settlement and their distribution within the bay.
2. Natural surveys of submerged hard structure will be assessed throughout the bay to determine the presence of polyps generating medusa.

6.2 Background

The abundance of jellyfish is increasing in marine ecosystems worldwide including the eastern Bering Sea shelf, the Gulf of Mexico, Sea of Japan, North Sea, German Bight, and the East China Sea. Large populations of jellyfish are detrimental to fisheries because the jellyfish are voracious feeders on zooplankton and ichthyoplankton and are therefore competitors and predators of fish (Brodeur et al., 2008). The trophic interaction between large jellyfish and commercially exploited fish could be enhancing jellyfish blooms. An analysis was done of jellyfish blooms in the East China Sea and researchers found that a possible trophic feedback loop leading to jellyfish blooms was identified (Hong et al. 2008). A Mixed Trophic Impact (MTI) analysis showed strong interactions between large jellyfish, Stromateoidae (butterfish), and small pelagic fish with zooplankton playing a role in mediating the interaction. Without control on this feedback, a jellyfish bloom will occur. Interestingly it was found that an increase in Stromateoidae will have a negative impact on jellyfish, but a positive impact on zooplankton. This unusual situation is defined as beneficial predation (Hong et al. 2008).

In warming coastal waters, the potential exists for species adapted to more tropical and sub-tropical temperatures to become established in more temperate climates. The response of *Chrysaora quinquecirrha* to warming waters in the Chesapeake Bay has been a larger overall population with adults found earlier in the year (Purcell et al., 2007). Warm water temperatures will also increase asexual budding of polyps. This will produce a larger ratio of jellyfish to polyps (Purcell et al., 2007). Sea nettles are now resident in Barnegat Bay and it is important to establish a baseline population count to determine whether the population is continuing to increase to potentially develop a management strategy to address the consequences of the establishment of this species in the bay.

Sea nettles (*Chrysaora quinquecirrha*) have become more abundant in the estuaries of the Mid-Atlantic States. Their ample numbers are an indicator of a disturbed ecosystem. Various

factors have been attributed to the rise in numbers of sea nettles; eutrophication, overfishing, global warming, construction and species introduction. Barnegat Bay is a highly eutrophic system with excess nitrogen and organic carbon arriving in the bay via runoff and watershed waste inputs. Global warming is causing changes in climates worldwide and jellyfish population blooms have been linked to warmer waters in several studies (Brodeur et al., 2008). A survey of sea nettle polyps will help quantify the establishment of sea nettle populations within the bay. The data generated will provide information on polyp distributions and critical life history information and this could be useful in predicting future population fluctuations.

7 PROJECT/TASK DESCRIPTION

Two objectives will be explored to assess polyp distributions:

1. Experimental settling plates to assess the timing of polyp settlement and their distribution within the bay.

2. Natural surveys of submerged hard structure will be assessed throughout the bay to determine the presence of polyps generating medusa.

To assess the timing and distribution of polyps, duplicate settlement plates will be created from flat PVC plates and submerged at three depths within the shallow water column (20, 40, and 80cm from the bottom, Figure 1). The top and bottom of each plate will be assessed to determine if orientation preferences exist for the polyps as well as if there is a settlement depth preference. Settling plates will be deployed at eight to eleven sites within Barnegat Bay. Stations will be established on both east and west sides of the bay and throughout the bay north to south, but concentrating on the northern part of the bay which seems to maintain higher abundances (Figure 2). Given that this is a pilot project, plates will be established in April 2010 and monitored monthly until October 2010. Jellyfish polyps which have attached to the substrate will be identified and counted. Polyps may also form podocysts (cysts with stored reserves of organic compounds produced under the pedal discs of polyps of scyphozoans). Podocysts enable polyps to survive seasonal adverse conditions. When they excyst, the podocysts develop into new polyps capable of strobilation and also creating more podocysts (Arai 2009). This ability of polyps to persevere and reproduce in many ways probably contribute to jellyfish blooms, therefore podocysts will also be counted when possible.

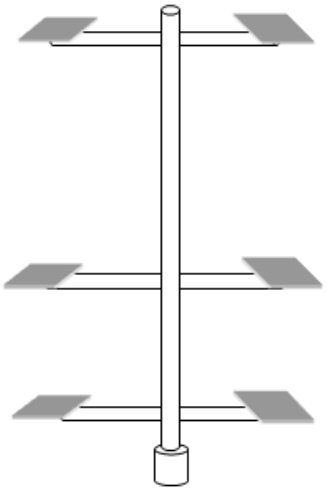


Figure 1. Schematic of Settlement Plate Design

Figure 2. Sites for settling plate placement.

A polyp survey in the summer-fall of 2010 will determine the quantity of polyps currently present on submerged structures in the bay using the adjacent structures associated with the sites that have deployed settling plates. This survey will focus on fixed substrates such as docks and bulkheads. Small photographic quadrats will be taken and visually interpreted in the lab. These images will be compared to the presence seen on settling plates for identification. This survey will be completed by Ms. Buesser during the monthly sampling of settling plates. As this is a pilot project, we are testing to see whether photographs can be used to identify polyps in the field.

PROJECT SCHEDULE

Task	Fall 2009	Winter 2010	Spring 2010	Summer 2010	Fall 2010	Winter 2011	Spring 2011
Create Settling Plates	X						
Deploy Settling Plates	X	X					
Sample Settling Plates	X	X	X	X	X		
Identify Samples		X	X	X	X		
Data Analysis					X	X	
Project Report							X

8 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

8 Field and Lab Biological Assessment

This program of investigation is developed to uphold the requirements for data collection and explicit criteria to ensure quality data is collected. The foundation of this project is to develop a baseline of information regarding the pervasiveness of sea nettle polyps.

8.1 Precision

Replicate settling plates will be removed from each sampling event for each depth. Combined for each site six samples will be collected. These will be compared to the natural hard substrate sampled during the project. Based on these data, we will use the Relative Standard Deviation Method (RSD) to determine the precision of the collected data.

Additionally, Dr. Jack Gaynor at Montclair State University has developed a PCR-based method for the detection of *Chrysaora quinquecirrha* DNA that exploits the 16S rDNA gene from the mitochondrial genome. This is a multiplexed assay that uses universal Cnidarian primers described by Bridge et al. (1992) in conjunction with *C. quinquecirrha* specific primers described by Bayha & Graham (2009). When Cnidarian DNA (but not *C. quinquecirrha*) is present in a water sample we generate a single band of 640 bp. When *C. quinquecirrha* DNA is present in a sample we get both the Cnidarian band (640 bp) and a smaller (208 bp) band which is unique to *C. quinquecirrha*. Dr. Gaynor recently sequenced this amplified fragment and has submitted it to Genbank (Genbank Accession #GU300724). A subset of polyps identified from settling plates will be analyzed using this molecular technique to assess the precision of the identified polyps.

8.2 Bias

As the identification of all samples will be completed by Ms. Buesser, sampler bias will not impact the results. Additionally, natural samples will be collected to determine if the settling plates collect representative fouling organisms.

8.3 Representativeness

As the sampling stations are located throughout Barnegat Bay, we will be compiling a data set which does represent the bay, but as a pilot investigation it coverage is limited. Future investigations will need to create stratified random sampling stations to get a complete picture of the distribution within the bay. Additionally, since we will be collecting in situ samples of hard structure, this will allow us to understand the true distribution of polyps in the bay.

8.4 Comparability

Since this project aims at developing a base line of information on the presence and abundance of sea nettle polyps, future investigations that use our methodology will be comparable. Since no data exist in New Jersey for this species information, settling plate have been used elsewhere and will serve and the comparable experimental design.

8.5 Completeness

The goal of this project is to assess the distribution of the polyps in Barnegat Bay. Representative sites have been chosen and at least 80% of the sites will be sampled to ensure a complete data set for the bay is collected.

8.6 Sensitivity

The goal of this project is to identify sea nettle polyps. In this manner, the sensitivity of samples will be at the species level, while we will use higher taxonomic distinctions for other species present on the settling plates.

9 NON-DIRECT MEASUREMENT (SECONDARY DATA)

No secondary data will be developed or employed for this project.

10 FIELD MONITORING REQUIREMENTS

10.1 Monitoring Process Design

The main focus of this study is to conduct a survey of the polyp population distribution in Barnegat Bay, NJ. Previous researchers in Barnegat Bay have suggested that population surveys are necessary to document the distribution and abundance of sea nettles (*Chrysaora quinquecirrha*). To assess the timing and distribution of polyps, duplicate settlement plates will be created from flat PVC plates and submerged at three depths within the shallow water column (20, 40, and 80cm from the bottom, Figure 1). The top and bottom of each plate will be assessed to determine if orientation preferences exist for the polyps as well as if there is a settlement depth preference. Settling plates will be deployed at eight to eleven sites within Barnegat Bay. Stations will be established on both east and west sides of the bay and throughout the bay north to south, but concentrating on the northern part of the bay which seems to maintain higher abundances (Figure 2). Given that this is a pilot project, plates will be established in April 2010 and monitored monthly until October 2010. Jellyfish polyps which have attached to the substrate will be identified and counted. Polyps may also form podocysts (cysts with stored reserves of organic compounds produced under the pedal discs of polyps of scyphozoans). Podocysts enable polyps to survive seasonal adverse conditions. When they excyst, the podocysts develop into new polyps capable of strobilation and also creating more podocysts (Arai 2009). This ability of polyps to persevere and reproduce in many ways probably contribute to jellyfish blooms, therefore podocysts will also be counted when possible.

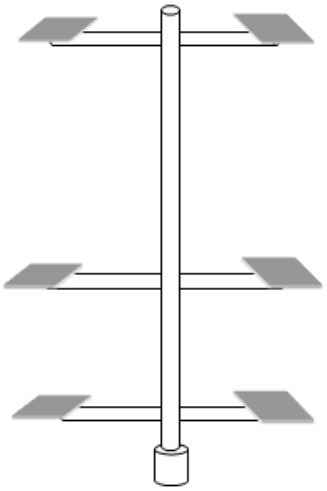


Figure 1. Schematic of Settlement Plate Design

Figure 2. Sites for settling plate placement.

A polyp survey in the summer-fall of 2010 will determine the quantity of polyps currently present on submerged structures in the bay using the adjacent structures associated with the sites that have deployed settling plates. This survey will focus on fixed substrates such as docks and bulkheads. Small photographic quadrats will be taken and visually interpreted in the lab. These images will be compared to the presence seen on settling plates for identification. This survey will be completed by Ms. Buesser during the monthly sampling of settling plates. As this is a pilot project, we are testing to see whether photographs can be used to identify polyps in the field."

10.2 Monitoring Methods

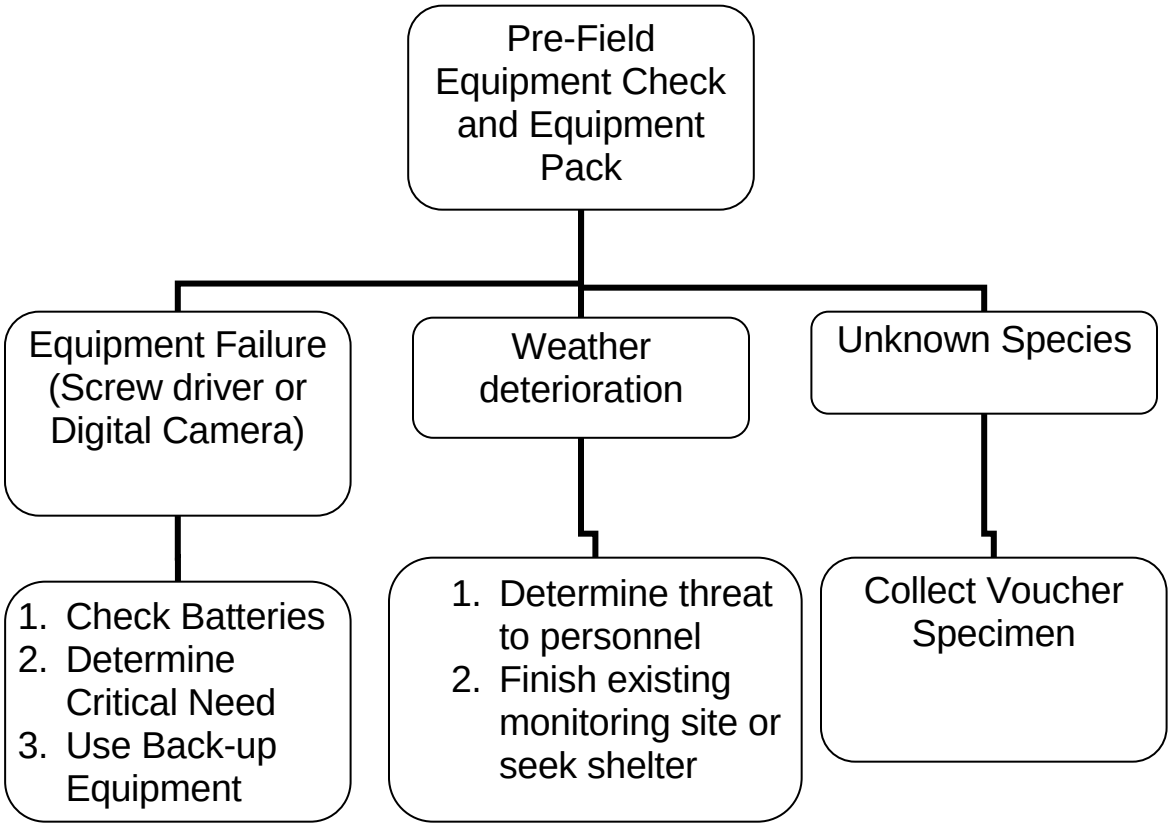
Sampling will be completed as stated above in 10.1.

Monitoring Equipment and Supplies

To complete the field investigation, the following equipment and supplies will be needed

Field Investigation	
Whirlpak for placing samples	Screw driver
Isopropyl alcohol to preserve samples	Digital Camera
Site Collection Data Sheet (Waterproof paper)	Site Collection Identification Tags (Waterproof paper)

Assessment Problem Flow Chart:



10.3 Field Quality Control

Samples will be collected in the field and returned to the laboratory for identification. Bolts and nuts will be taken off and replaced in accordance with their thread direction.

11 ANALYTICAL REQUIREMENTS

There are no analytical requirements for this project.

12 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Samples will be collected by Ms. Buesser. Settlement plates will be unscrewed and placed into new whirlpak bags. Samples will be labeled with waterproof paper and logged on the field data sheet (see below). Samples will be preserved in isopropyl alcohol and returned to the laboratory for identification.

Field Sample Data Sheet

SITE	
DATE	
TIME	
DEPTH OF SAMPLE	
SETTLING PLATE ORIENTATION	
REPLICATE #	

13 TESTING, INSPECTION, MAINTENANCE AND CALIBRATION REQUIREMENTS

13.1 Instrument/Equipment Testing, Inspection and Maintenance

No instruments require testing, inspection, or maintainance.

13.2 Instrument/Equipment Calibration and Frequency

No instruments require calibration.

13.3 Inspection/Acceptance of Supplies and Consumables

The critical supply is isopropyl alcohol. It will be purchased from a reputable company.

14 DATA MANAGEMENT

Data will be transcribed from field data sheets into the computer. All data files will be maintained in Microsoft Excel. Hard copies of the data sheets will be copied and stored. Data entered in the computer will be checked for mistakes by Dr. Bologna. Electronic files will be backed up on external hard drives.

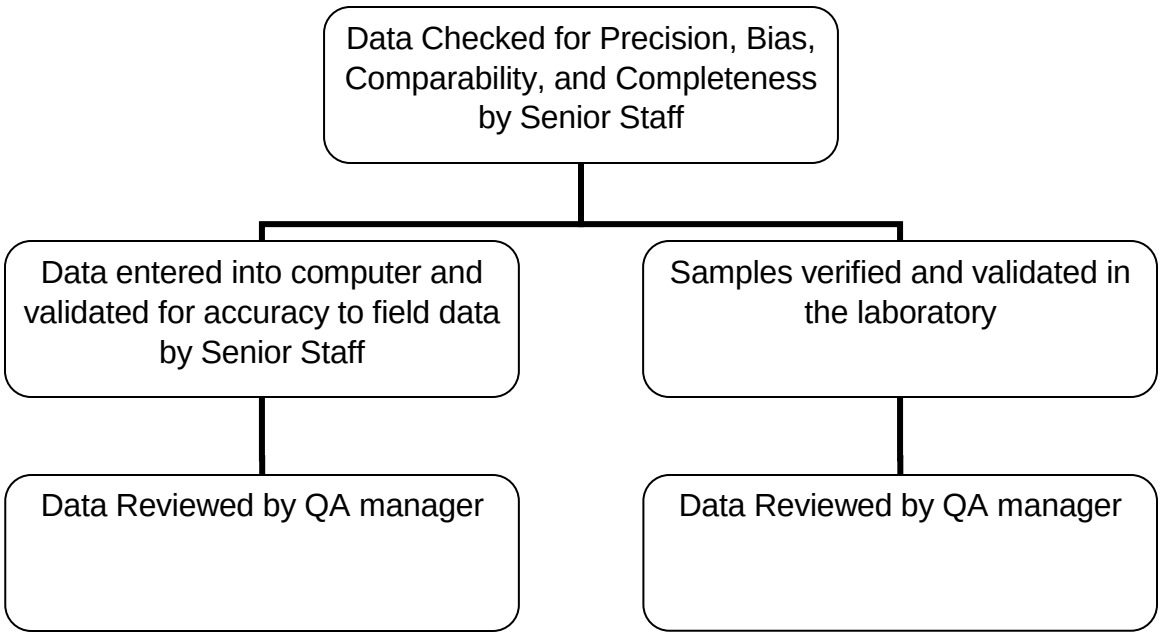
15 ASSESSMENTS/OVERSIGHT

Assessment and oversight will be conducted primarily by the project's QA manager, Dr. Wu. Drs. Wu, Bologna, and Ms. Buesser will meet at least quarterly to review progress on the project, compliance with QA/QC procedures, and identification and resolution of any problems.

If problems are identified, Drs. Wu, Bologna and Ms. Buesser will jointly develop procedures to correct the problems; these procedures will be implemented. Subsequent QA review meetings will assess whether the procedures did indeed correct the problem; if not further corrective procedures will be developed, and more frequently (weekly to monthly) QA review meetings will be held until we confirm that the problem has been solved.

16 DATA REVIEW, VERIFICATION, VALIDATION AND USABILITY

To ensure that the quality criteria for measurement data of all data collected, we propose to use the following procedure:



16.1 Data Review, Verification and Validation

For verification of the collected data, we will follow this protocol: field data sheets copied for duplicate storage, data entered into database, data checked by staff for accuracy, results generated and analyzed, results presented to QA Officer for validation. The QA Officer will then complete the data validation by determining if the collected data meet the requirements of the QAPP. Specifically, the QA Officer will assess whether the data comply with the identified precision, bias, representativeness, comparability, completeness, and sensitivity criteria presented in Section 8 of this document. If data do not meet the expected criteria laid out in the QAPP, the QA Officer will identify problems and direct corrective actions.

16.2 Reconciliation with User Requirements

The project objective of assessing the distribution of sea nettle polyps will necessarily require complete and accurate data. As described above, if these criteria are not met, then accompanying data will be eliminated from the analysis and presentation of the results. The QA Officer will determine if the collected data meet or exceed the minimum acceptable criteria. If they do not, then the data will be re-evaluated and checked for errors again. If no errors are present, but data are unacceptable, they will be removed from the analyses and the database to ensure that the presented results will be comparable to other data sets and other end users of the project.

17 REPORTING, DOCUMENTS AND RECORDS

In accordance with the grant requirements, Montclair State University will complete quarterly progress reports detailing the status of the project, validated results to date, and proposed actions in the coming quarter. Reports will be supplied to all senior project personnel and the EPA Region 2 Project Officer. Reports will include the following: Summary of all field investigations and a Summary of all laboratory investigations.

Project documentation will be established in the following manner. Field collected data will be photocopied to establish a physical back-up of data, notes, and field conditions. Data entered into the computer will be printed and kept as a physical back-up. Copies of the electronic files will be maintained at Montclair State University and provided to the EPA once validated and verified.

18 REFERENCES

Arai, M.N., 2009. The potential importance of podocysts to the formation of scphozoan blooms: a review. Hydrobiologia 616: 241-246

Bayha, K.M. and W. M. Graham. 2009. A new Taqman PCR-based method for the detection and identification of scyphozoan jellyfish polyps. Hydrobiologia (2009) 616:217–228.

Bridge, D., C. W. Cunningham, B. Schierwater, R. Desalle, and L. W. Buss. 1992. Class-level relationships in the phylum Cnidaria - evidence from mitochondrial genome structure. Proc. Natl. Acad. Sci. USA 89:8750-8753.

Brodeur, R., Decker, M., Ciannelli, L., Purcell, J., Bond, N., Stabeno, P., Acuna, E., Hunt, G., 2008. Rise and fall of jellyfish in the eastern Bering Sea in relation to climate regime shifts. Progress in Oceanography 77:103-111

Graham, W., 2001. Numerical increases and distributional shifts of *Chrysaora quinquecirrha* (Desor) and Aurelia aurita (Linne) (Cnidaria: Scyphozoa) in the northern Gulf of Mexico. Hydrobiologia 451:97-111

Hong, J., He-Qin, C., Hai-Gen, X., Arreguin-Sanchez, F., Zetina-Rejon, M., Del Monte Luna, P., LeQuesne, W.,2008. Trophic controls of jellyfish blooms and links with fisheries in the East China Sea. Ecological Modeling 212: 492-503

Purcell, J., Uye, S., Lo, W., 2007. Anthropogenic causes of jellyfish blooms and their direct consequences for humans: a review. Marine Ecology Progress Series 350:153-174

Richardson, A., Bakun, A., Hays, G., Gibbons, M., 2009. The Jellyfish joyride: causes, consequences and management responses to a more gelatinous future. Trends in Ecology and Evolution. 1081 Article in Press

Shoji, J., Kudoh, T., Takatsuji, H., Kawaguchi, O., Kasi, A., 2009. Distribution of moon jellyfish *Aurelia Aurita* in relation to summer hypoxia in Hiroshima Bay, Seto Inland Sea. Estuarine, Coastal and Shelf Science. Xxx 1-6 Article in press

Watanabe, T., H. Ishii, 2001. In situ estimation of ephyrae liberated from polyps of *Aurelia aurita* using settling plates in Tokyo Bay, Japan. Hydrobiologica 451: 247-258