

## **Workshop for Development of Sustainable Practices for Marine Cage Culture Operations in the U.S. Caribbean**

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### **ABSTRACT**

On November 2<sup>nd</sup> and 3<sup>rd</sup>, 2010 the NOAA Aquaculture Program and NOAA Coral Reef Conservation Program, in cooperation with Puerto Rico Sea Grant and the Gulf and Caribbean Fisheries Institute (GCFI), hosted the *Workshop for Development of Sustainable Practices for Marine Cage Culture Operations in the U.S. Caribbean*. This one and a half day invited workshop was convened in conjunction with the 2010 GCFI annual meeting in San Juan, Puerto Rico. The purpose of the workshop was to facilitate exchange of scientific and regulatory information as a first step toward developing environmental guidelines for marine cage culture operations in the U.S. Caribbean. Discussions focused on exchanging scientific information and identifying areas of uncertainty and knowledge gaps for marine cage culture operations. Break-out sessions were held to identify key elements for regional Best Management Practices (BMPs) for marine cage culture operations in territorial waters of the U.S. Caribbean. A second workshop will be held to seek input from additional experts and continue development of the regional BMPs.

KEY WORDS: Marine cage culture, Best Management Practices, U.S. Caribbean

## **Taller Para el Desarrollo de Practicas Sustentables de Acuicultura Marina en Jaulas en el Caribe de los Estados Unidos**

El *Taller Para el Desarrollo de Practicas Sustentables De Acuicultura Marina en Jaulas En El Caribe De Los Estados Unidos* tuvo lugar los días 2 y 3 de Noviembre de 2010 bajo el patrocinio de los Programas de Acuicultura y de Conservacion de Corales de la NOAA en cooperación con *Sea Grant* de Puerto Rico y con el *Gulf and Caribbean Fisheries Institute* (GCFI). El taller, de día y medio de duración, tuvo lugar junto con la reunión anual del GCFI en San Juan, Puerto Rico. Su propósito fue facilitar el intercambio de información científica y regulatoria como un paso hacia el desarrollo de guías ambientales para los cultivos marinos en jaulas en el Caribe de los Estados Unidos. El enfoque de las conferencias fue el intercambio de experiencias científicas y la identificación de áreas de incertidumbre en las operaciones de acuicultura en jaulas. Se tuvieron sesiones especiales para identificar los elementos clave para el desarrollo regional de buenas prácticas de manejo. Se planea ya un segundo taller para refinar el desarrollo de estas prácticas regionales de manejo.

PALABRAS CLAVE: Acuicultura Marina en Jaulas, Buenas prácticas de Manejo, Caribe de los Estados Unidos

## **L'Atelier sur les Pratiques de Développement Durable d'Élevage en Cages en Mer dans les Territoires des Etats Unis dans les Caraïbes**

Entre le 2 et le 3 Novembre 2010, s'est tenu *l'Atelier sur les Pratiques de Développement Durable d'Élevage en cages en Mer dans les territoires des Etats Unis dans les Caraïbes*, a San Juan, Porto Rico. Cet atelier était conjointement organisé par le Programme d'Aquaculture de la NOAA, le Programme de Protection des Récifs Coralliens de la NOAA, le Puerto Rico Sea Grant et l'Institut des Pêches du Golfe et des Caraïbes (GCFI). Cette réunion sur invitation d'un jour et demi était convoquée en conjonction avec la réunion annuelle du GCFI pour l'année 2010, dans la ville de San Juan, Porto Rico. L'objet de cette réunion était de promouvoir, faciliter les échanges d'informations scientifiques et règlementaires comme une première étape vers le développement d'un cadre environnemental pour les cultures marines en cage dans les eaux des Caraïbes sous administration des Etats Unis. Les discussions se sont focalisées sur les échanges d'informations scientifiques et l'identification de zones d'incertitudes ou manques de connaissances sur les opérations de cultures marines en cages. Il s'est tenu des sessions particulières pour identifier les éléments clef des Meilleures Pratiques de Gestion (BMP) dans l'opération de culture marine en cages dans les eaux territoriales des Etats Unis des Caraïbes. Un deuxième atelier sera organisé pour demander des avis supplémentaires d'experts et poursuivre le développement des BMP régionales.

MOTS CLÉS: Cultures marines en cage, Meilleures Pratiques de Gestion, territoriales des Etats Unis des Caraïbes

## INTRODUCTION

With seafood demand on the rise and wild fisheries harvest reaching a plateau, there is strong interest in developing sustainable aquaculture around the world, including in the U.S. Caribbean region. Poorly sited and/or managed aquaculture operations in the U.S. Caribbean have the potential to negatively impact coral reef ecosystems. However, increased aquaculture production could supply local seafood, reduce pressure on reef species and provide economic opportunities for coastal communities. Use of appropriate technologies and management practices may support increased sustainable aquaculture production in the U.S. Caribbean that does not pose a risk to coral reefs and other sensitive ecosystems.

The purpose of this workshop was to examine a wide range of issues regarding marine cage culture operations in the U.S. Caribbean and begin developing Best Management Practices (BMPs) to address potential effects on coral reef ecosystems. The need to develop marine cage culture BMPs specific to coral reef ecosystems was initially highlighted in 1999 by the U.S. Coral Reef Task Force. The NOAA Coral Reef Conservation Program (CRCP) has partnered with the NOAA Aquaculture Program (AQC), as well as Puerto Rico Sea Grant and other local partners, to host a series of workshops aimed at developing formal guidelines for marine cage culture operations in U.S. territorial waters of the Caribbean. This document outlines the first of these workshops which was held during the 63<sup>rd</sup> Annual Gulf and Caribbean Fisheries Institute (GCFI) Meeting in San Juan, Puerto Rico.

## WORKSHOP OBJECTIVES

The workshop was attended by 30 representatives from various federal and state agencies, academic and scientific institutions, and individuals with experience operating marine cage culture systems. Several panels were convened to discuss ecosystem impacts, permitting and regulatory processes and other considerations. A break-out session was held to identify key elements for inclusion in the regional BMPs.

Three major objectives were identified for the workshop, including:

- i) Exchange scientific information to assist in evaluating potential environmental effects of marine cage culture operations on coral reef ecosystems.
- ii) Identify major knowledge gaps that may impede permitting processes for marine cage culture operations and discuss information requirements for permit review.
- iii) Identify the key elements for development of regional BMPs for marine cage culture operations sited near coral reef ecosystems.

## WORKSHOP ACTIVITIES

The workshop began with a brief overview of Puerto Rico's fisheries and aquaculture regulations and economic challenges and opportunities in the region. Information on the potential impacts of marine cage culture operations on coral reef ecosystems, major threats to the health and productivity of coral reef ecosystems (climate change, land-based sources of pollution, and fishing impacts) and the rising U.S. seafood import deficit was also provided.

The first session provided an overview of the status of U.S. marine cage culture operations. Due to continued rise in demand for seafood products, a plateau in landings from capture fisheries and increased land values, marine cage culture operations are becoming more prevalent on a global scale. In the U.S., permitting uncertainty is seen as a roadblock to expansion of the industry and the lack of full-scale demonstration projects make it difficult to validate simulation models which predict potential environmental impacts. Opportunities for expansion of the U.S. aquaculture industry include a growing market for domestic seafood, food security, a large coastline, a well-trained workforce, diversity of aquaculture products and services, and technological advancements.

A panel of industry and academic representatives was convened to discuss ecosystem impacts and insight into the permitting process. Two common themes emerged from this panel, including:

- i) Lengthy and cumbersome regulations and lack of streamlined permitting processes preclude industry expansion in the U.S., and
- ii) Marine cage culture demonstration projects are needed to generate real world data and validate environmental models.

A second panel consisting of representatives from state and federal regulatory agencies discussed agency mandates, regulatory roles, and information needs to facilitate review of applications for marine cage culture operations. Some panelists believed that there is a lack of scientific information in regards to the environmental impact of marine cage culture operations on coral reef ecosystems and that additional studies are needed. Other panelists indicated that data from aquaculture operations around the world provide evidence that properly sited and managed aquaculture operations can have minimal impact on the environment.

## WORKSHOP OUTCOMES

### Discussion Questions

Participants were asked to provide examples of major knowledge gaps that may impede the ability to properly evaluate and manage marine cage culture operations. In general, participants indicated that more information was needed in the following areas:

- i) Potential impacts on coral reef ecosystems;

- ii) Substitutes for fish meal;
- iii) Competition with local fisheries;
- iv) Industry support/infrastructure;
- v) Impacts of escapes;
- vi) Cultural conflicts;
- vii) Ecological carrying capacity;
- viii) Baseline study requirements;
- ix) Siting criteria;
- x) Benthic impacts; and
- xi) Disease issues.

There were also questions regarding how aquaculture fits into marine spatial planning efforts, which species are best suited for cage culture, and the cumulative/synergistic effects of marine cage culture operations.

Next, participants were asked to discuss various management strategies and areas of research which could help to address these knowledge gaps. Responses included:

- i) establish a demonstration project in the U.S. Caribbean;
- ii) Establish standardized monitoring protocols and require 3<sup>rd</sup> party monitoring;
- iii) Standardize *a priori* sampling designs;
- iv) Involve local stakeholders;
- v) Provide permitting guidance;
- vi) Establish water quality standards and threshold nutrient levels;
- vii) Create aquaculture site maps and zoning plans; Exchange information between agencies; and
- viii) Streamline the permitting process.

### Break-out Groups

Participants were presented with a draft BMP list for marine cage culture operations and asked to provide feedback regarding how they would change or modify the list to best address concerns in the U.S. Caribbean. Key elements suggested by workshop participants are included in Table 1. No effort was made to prioritize the suggestions and it is understood that further refinement and input from additional stakeholders is needed prior to finalizing the BMPs.

### CONCLUSION

The objectives of this workshop were successfully met and this was the first step toward developing BMPs for marine cage culture operations in the U.S. Caribbean. At least one more workshop will be held to further develop the regional BMPs and there will be an opportunity for participants to provide their comments and feedback. More information on this workshop can be found at [http://www.ccfhr.noaa.gov/research/marine\\_aquaculture.aspx](http://www.ccfhr.noaa.gov/research/marine_aquaculture.aspx).

### ACKNOWLEDGEMENTS

The NOAA Aquaculture Program and NOAA Coral Reef Conservation Program would like to thank the GCFI for hosting and helping to organize this workshop. We would also like to thank all of the participants for their commitment of time and attention to the goals of the workshop. This initial workshop is the first in a series of invitational workshops funded in part by a National Fish and Wildlife Foundation grant (#10395- 2007), the NOAA Coral Reef Conservation Program and the NOAA Aquaculture Program.

<b>Table 1. Suggested key elements for BMPs.</b>	
<b>BMPs</b>	<b>Action strategies</b>
<b>Community Effects</b>	<ul style="list-style-type: none"> <li>Optimize feeding protocols</li> <li>Implement following procedures</li> <li>Utilize non-lethal predator deterrents</li> <li>Develop comprehensive monitoring plan</li> <li>Establish permanent monitoring stations</li> <li>Develop protocols for dealing with recruitment of other species to cages (e.g., spiny lobsters)</li> <li>Define <i>a priori</i> thresholds for key coral ecosystem parameters</li> <li>Minimize physical disturbance to habitat</li> <li>Employ proper/responsible cage cleaning methods</li> <li>Utilize proper cage design(s) to minimize entanglement (e.g., with marine mammals)</li> <li>Require <i>a priori</i> sediment mapping of lease site and adjacent areas</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Model projected nutrient loads</li> <li>Integrate regular water quality monitoring</li> <li>Remove and properly dispose of dead fish</li> <li>Develop standard monitoring protocols</li> <li>Employ real-time monitoring</li> <li>Conduct baseline survey for water quality conditions</li> <li>Use FDA/USDA approved drugs</li> <li>Establish local nutrient threshold levels</li> <li>Develop dispersion models for site</li> <li>Encourage use of integrated multi-trophic aquaculture</li> <li>Monitor nearby control site to assess changes in water quality</li> <li>Minimize use of anti-fouling chemicals/agents</li> </ul>
<b>Genetic Considerations</b>	<ul style="list-style-type: none"> <li>Require tag or genetic mark on stocked fish</li> <li>Utilize cage design(s) which minimize escapism</li> <li>Use native species</li> <li>Prohibit culture of non-native species</li> <li>Develop broodstock program to maintain genetic diversity</li> <li>Routinely monitor cages/pens for escapement</li> <li>Harvest stock prior to reproductive maturity</li> <li>Stock sterile fish</li> <li>Require risk assessment for non-local genetic strains or species</li> </ul>
<b>Pathogens and Parasites</b>	<ul style="list-style-type: none"> <li>Minimize use of antibiotics</li> <li>Use FDA/USDA approved drugs</li> <li>Develop aggressive biosecurity practices</li> <li>Develop a pathogen and parasite monitoring plan</li> <li>Properly dispose of dead fish</li> <li>Use pathogen free broodstock and fingerlings</li> <li>Report incidence(s) of mortality to permitting agencies</li> <li>Use appropriate stocking densities</li> <li>Develop quarantine protocols</li> <li>Vaccinate fish prior to stocking into cages</li> <li>Monitor local pathology of wild species</li> <li>Attain fish health certification prior to stocking in cages</li> <li>Use fingerlings from a certified disease free facility</li> </ul>

<b>Table 1 (continued).</b> Suggested key elements for BMPs.	
<b>Feed</b>	<p>Encourage use of alternative feed sources and feeds from sustainable sources</p> <p>Develop efficient feeding protocols</p> <p>Document type of feed used and provide justification</p> <p>Optimize feed rate to reduce excess waste</p> <p>Use easily digestible feed</p> <p>Use feed with binders which reduce dust</p> <p>Monitor feeding events to maximize uptake rate of feed</p> <p>Utilize current regimes during feeding events</p> <p>Use feeds that are of the correct buoyancy to reduce sinking rates</p>
<b>Human Dimensions</b>	<p>Public input process prior to permit issuance</p> <p>Conduct economic/market analysis to project local economic effects</p> <p>Identify potential or perceived conflicts with wild harvest</p> <p>Provide educational materials and work on outreach issues with local community</p> <p>Hold informational meetings in local area</p> <p>Meet community needs when possible/practical (e.g., jobs)</p> <p>Train/employ local workforce when possible/practical</p> <p>Consider including tourism and recreational fishing in operations</p> <p>Avoid traditional fishing areas and areas of aesthetic importance</p> <p>Avoid flooding local market(s) with cultured fish</p> <p>Work with local community to market cultured fish when/where possible</p> <p>Complement existing markets with new products</p>
<b>Permitting</b>	<p>Conform with all U.S. state, federal and territory environmental regulations</p> <p>Determine NEPA lead agency for permitting process</p> <p>Adapt existing EISs or EAs for new operations</p> <p>Provide permitting process guidelines</p> <p>Require initial consultation prior to beginning permitting process</p> <p>Provide access to permitting consultant</p> <p>Begin NEPA/Permitting process early in the planning stage</p> <p>Hold regular meetings with permitting agencies</p> <p>Educate permitting agency staff on aquaculture operations</p> <p>Educate industry to ensure compliance</p> <p>Streamline permitting process</p>
<b>Siting</b>	<p>Require baseline assessment</p> <p>Site facilities in areas with sufficient flushing rates</p> <p>Minimize interaction with wild aggregations, migrations, etc.</p> <p>Minimize interactions with critical habitat</p> <p>Develop siting maps for local and downstream environments</p> <p>Site in a manner to avoid/reduce user conflict(s)</p> <p>Develop plan to address storm impacts</p> <p>Conduct benthic surveys</p>
<b>Other</b>	<p>Consider culturing species with efficient food conversion rate</p> <p>Hold local workshop/training courses</p>