

# MERHAB PROPOSAL EVALUATIONS: PANEL SUMMARY 2007

**Proposal Number:** MER07-02

**Proposal Title:** Toxin-Sensor-Based Approach for *In Situ* and Autonomous Monitoring of HAB Toxin Production in Three Regions of the Coastal US

**Institution:** University of North Carolina Wilmington – Center for Marine Science

**Principal Investigator (PI):** Jerome Narr

**Rating:**  Excellent     Very Good     Good     Fair     Poor

## **Brief Description:**

This project proposes to develop assays, sensors, and instruments to identify *in situ* the harmful compounds of three major marine algal toxins (Domoic Acid, Saxitoxin, Brevetoxin), using techniques developed for biomedical research and diagnostics, for use in existing harmful algal bloom monitoring programs.

## **Importance and/or relevance and applicability of proposed project to MERHAB goals**

This project is relevant and applicable to MERHAB program goals. In-situ, real time remote monitoring of toxins complimenting existing technologies and methods of collecting other environmental parameters is extremely important in the HAB monitoring and management arena. The project is highly relevant. The focus could be viewed as a technical rather than regional proposal. While the proposal does suggest the technology should not be expected to result in broad application to state and local level monitoring programs as a result of its completion, the advancement of the science and technology in this field would certainly set the stage for such directions into the future.

## **Technical/scientific merit:**

The proposal blends the technological advances in the medical field for application in the aquatic sciences with HABs applications. Development of field transportable and dockside autonomous instruments fits well with developing, existing and expanding designs of state of the art monitoring frameworks. It is noted that there are sound preliminary results on *K. brevis* and that the toxin measurements correlated well with *K. brevis* densities. The need for such instrumentation is reinforced by common situations among species where strains, population growth phase and environmental conditions among other variables combine in ways not always well understand to affect toxin expression that doesn't correlate with cell counts. This is a significant issue where developing such instrumentation increases its inherent monitoring application value.

## **Overall qualifications of applicant(s):**

The regional team blend of PI's, investigators and collaborators dealing with critical and varied HAB environments and issues, and the diversity scientific disciplines represented is well qualified.

## **Current and Pending Support:**

Not an issue.

## **Project costs:**

Projects costs were determined to be reasonable with the expected advances and efforts.

**Proposal #:** MER07-02

**Broader Impacts (Outreach/education, sustainability)**

This technology will be transferred to stakeholders across three national regions. Data is expected to be available on websites.

**Summary Comments:**

LOC advances in toxin detection methodologies represent a significant contribution to the HAB field. Field transportable and dockside autonomous instruments for measurement of HAB toxins are extremely important to research and management needs. Mail review and panel discussion indicated that the project could divide support for the LOC assay and sensing dimensions developments for some number (one to all of the toxins) as one project and the advances into FTI and DAI instrumentation as a second project award.

## Appendix D4

## PROPOSAL EVALUATION FORM

Please return no later than: December 22, 2006

## A. Proposal Information:

<b>Principal Investigator:</b> Dr. Jerome P. Naar	<b>Reviewer ID:</b> [CSCOR will enter]
<b>Institution:</b> U. of North Carolina Wilmington	<b>Proposal Number:</b> Merhab07-02
<b>Proposal Title:</b> Toxin sensor-based approach for in situ and autonomous monitoring of HAB toxin production in three regions of the coastal United States	

## B. Proposal Evaluation:

For details see "Instructions for Reviewers". Note: boxes will adjust in size as appropriate.

<b>Please evaluate this proposal using the following five criteria.</b>
1. Importance and/or Relevance and applicability of proposed project to the program goals: (30 percent): 25/30%. The proposed work has a very high intrinsic value and relevance to NOAA, federal, regional, state, and local activities. The proposed work seems highly related to the MERHAB program goals, and would represent a significant advance in monitoring activities for HABs. As pointed out by the PI's, the proposed strategy to develop technologies allowing for direct measurement of HAB toxins in natural systems bypasses inherent problems associated with species identification and toxin production variability in natural populations. I believe some variant of the proposed ELISA-based methodology is the most likely to produce an adequately sensitive, precise, and useable system for measuring these toxins in situ. The proposed measurement system could be of great value to scientists and resource managers.
2. Technical/scientific merit (30 percent): 20/30%. The approach seems to be innovative and technically sound. The methods are appropriate and the project goals are clearly stated. However, in my mind, the project may be too ambitious for a single proposed project. I think it may have been more scientifically valid to approach this overall project in the form of two smaller, sequentially submitted proposals: 1) A proposal to develop and validate the antibody - ELISA procedure into a relatively simple method that could be used in the laboratory or on board a ship to quantify HAB toxins in cultures and natural samples using a standard-type microplate reader; and then 2) a proposal to engineer and test the proposed computerized field deployment platforms described here. In this fashion, the validity of the method would be established before investing in the high costs of engineering the micro technology field-platform design.
3. Overall qualifications of applicant (20 percent): 20/20% This is a highly qualified professional group of scientists. This ambitious project would certainly benefit from their experience, education, and training. I imagine if this project were to falter anywhere, it would be somewhere in the design/production of the complex computerized dock autonomous instrument. However these PI's certainly have the ability to succeed in this endeavor wherever possible, and where others might fail. There is a good collaborative mix of biologists, engineers, and resource managers in this project.
4. Project costs (10 percent): 8/10% Most of the project costs seem to understandably go toward the engineering and construction of the miniaturized field instruments. For this reason among others (above), I would have liked to see this work proposed in two separate proposals, 1) validation of the ELISA technique for each HAB toxin group, and 2) design and construction of the field-deployable automatic instruments. That way the cost of the 2 <sup>nd</sup> project would be better justified by the success of the first project.
5. Outreach/education (10 percent): 5/10% This project is quite top-heavy with multiple co-PIs and apparently only a single graduate student. In a project of this magnitude and cost, I would have liked to have seen more student participation/education (especially since the PI's are all associated with academic institutions). However, the PI's have demonstrated clear connections to management/monitoring entities (FMRI, Mote, NOAA) that will use this product. I do have some concerns with the ultimate cost and availability of the proposed technology to other (non-PI) coastal management/monitoring entities and academic researchers, and would have liked to have seen some speculative discussion on this (below).
Additional Comments: I doubt this technology could be used to reliably infer <i>K. brevis</i> (or other HAB species) cell densities during red tide events, as indicated on p. 7, due to inherent variability in toxin production on a cell by cell basis. However that is not the primary intended goal of the product. For reasons stated above, this project may have been better proposed in two separate and sequential project proposals. I am also concerned about how the availability of specific antibodies and purified HAB toxins required in the competitive exclusion assays may cause a prohibitively high cost or otherwise limit the future utility of the proposed products for many potential users. I would have like to see some short discussion in the proposal on this topic of ultimate reagent availability and projected costs for such a technology.

## Appendix D4

However, it is not the responsibility of the PI's to produce a cheap method, but to produce a reliable one. Ultimately, I believe the proposed ELISA-based technology for directly measuring HAB toxins is the best way forward, and this research team has a good chance of success with the proposed project.

Overall Rating: \_\_\_ Excellent     Very Good    \_\_\_ Good    \_\_\_ Fair    \_\_\_ Poor

Verbatim but anonymous copies of reviews, ratings, and associated correspondence will be sent to the principal investigator. Subject to this policy and applicable laws, including the Freedom of Information Act (USC 552), reviewers' comments and identities will be given maximum protection from disclosure.

**Appendix D4****PROPOSAL EVALUATION FORM**

Please return no later than: December 22, 2006

**A. Proposal Information:**

<b>Principal Investigator:</b> Jerome Naar	<b>Reviewer ID:</b> [CSCOR will enter]
<b>Institution:</b> University of North Carolina, Wilmington	<b>Proposal Number:</b> Merhab07-02
<b>Proposal Title:</b> Toxin-sensor-based approach for in situ and autonomous monitoring of HAB toxin production in three regions of the coastal United States	

**B. Proposal Evaluation:**

For details see "Instructions for Reviewers". Note: boxes will adjust in size as appropriate.

<b>Please evaluate this proposal using the following five criteria.</b>
<p>1. Importance and/or Relevance and applicability of proposed project to the program goals: (30 percent): The proposed work is potentially extremely valuable because it addresses the most relevant concern in harmful algal blooms, namely, toxin concentration. While we are all getting better at identifying potentially toxic species and accurately assessing their abundance, this may or may not be related to toxin concentration. The toxic potential of a bloom is ultimately the most critical information related to human and wildlife health concerns. Any progress toward accurate, rapid, deployable toxin screening would be valuable to the research and management community.</p>
<p>2. Technical/scientific merit (30 percent): The elements of the technology development they propose are in place. The researchers have outlined a plan to improve, synthesize, and simplify existing techniques and methods. They present compelling preliminary data that indicates the success of the prototypes for the final testing system. They are probably closest to the final technology development with the brevetoxin assay since this ELISA is well established. I think the domoic acid assay is a very important development because of the variability in toxin production by the <i>Pseudo-nitzschia</i>. Additional species that may produce it (ex. <i>Prorocentrum</i>) would also be detected. The most complicated assay is likely to be the saxitoxin/neosaxitoxin assay for the Alexandrium. Again, other species may bloom and produce these neurotoxins and this would be a useful tool to detect these toxins in many locations. Alternate assessment methods for <i>Karenia brevis</i> are currently available but this would have the potential of detecting toxin in early bloom stages and provide opportunity of research on bloom formation and mitigation.</p>
<p>3. Overall qualifications of applicant (20 percent): The proposal accurately states that the applicants are "well established" HAB researchers. Naar has definitely assembled an "A" team and targeted the most concerning locations for HAB blooms. These researchers and institutions are capable of taking on this challenging project, and it would be a great benefit to all if they were successful.</p>
<p>4. Project costs (10 percent): The development of this technology is expensive, and will require targeted funding to be developed to a level that is useful to managers. The budget appears legitimate and may even be low, because institutions collaborating at no cost will be involved in testing and future application.</p>
<p>5. Outreach/education (10 percent): By choosing the researchers and locations with a long history of harmful blooms, the management community is already engaged in these regions. The transfer of the new technology should be successful since the managers will be integrated into the development of the new sensors.</p>
<p><b>Additional Comments:</b> Not to come off as a pessimist, but even if the final product proposed cannot be completely developed within the proposed time frame, this is the appropriate direction for HAB research and monitoring. It represents an impressive collaboration of researchers from varied geographic locations and agencies. Definitely the way science needs to be done to be effective.</p>

## Appendix D4

Overall Rating:  Excellent     Very Good     Good     Fair     Poor

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**Proposal Number:** MER07-02

**Proposal Title:** Toxin-Sensor-Based Approach for in situ and Autonomous Monitoring of HAB Toxin Production in Three Regions of the Coastal US

**Principal Investigator:** Jerome Narr

**Institution:** University of North Carolina Wilmington – Center for Marine Science

**Please evaluate this proposal using the following five criteria:**

(For details see “Instructions for Reviewers” enclosed.)

**1. Importance and/or relevance and applicability of proposed project to program goals (30%)**

Proposes to develop assays, sensors, and instruments to identify *in situ* the harmful compounds of three major marine algal toxins (Domoic Acid, Saxitoxin, Brevetoxin) using techniques developed for biomedical research and diagnostics for use in existing harmful algal bloom monitoring programs.

This project is relevant and applicable to program goals. (30% out of a possible total of 30%).

**2. Technical/scientific merit (30%)**

Toxin detection in algal cells provides more useful information for resource managers than the current methods (cell counts and/or toxicity accumulated in various animal tissues).

The project has technical/scientific merit (30% out of a possible total of 30%).

**3. Overall qualifications of applicant (20%)**

Overall qualifications of applicant are excellent (20% out of a possible total of 20%).

**4. Project costs (10%)**

Project costs are appropriate. (10% out of a possible total of 10%).

**5. Outreach/education (10%)**

Outreach and education are appropriate. (10% out of a possible total of 10%).

**6. Additional comments**

Funding could be considered for the development of assays, sensors and instruments to identify *in situ* the harmful compounds of a one of the three major marine algal toxins.

**Overall Rating:** Excellent

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**Proposal Number:** MER07-02

**Proposal Title:** Toxin Sensor-Based Approach for In-Situ and Autonomous Monitoring of HAB Toxin Production in Three Regions of the Coastal U.S.

**Principal Investigator:** Naar and McDevitt

**Institution:** University of North Carolina Wilmington – Center for Marine Science

**Please evaluate this proposal using the following five criteria:**

(For details see “Instructions for Reviewers” enclosed.)

### **1. Importance and/or relevance and applicability of proposed project to program goals (30%)**

In-situ, realtime, remote monitoring of toxins complimenting existing technologies and methods of collecting other environmental parameters is one of those ‘Holy Grails’ of HAB monitoring and management arena. The project is highly relevant with long term applicability as well as national and global needs. The proposal does suggest the technology should not be expected to go primetime for broad application to state and local level monitoring programs as a result of its completion, however, the advancement of the science and technology in this field would certainly set the stage for such directions into the future.

### **2. Technical/scientific merit (30%)**

The blending of the technological advances in the medical field for application in the aquatic sciences with HABs applications is a wonderful marriage of efforts. Development of field transportable and dockside autonomous instruments fits well into the state of the art monitoring frameworks but obviously extends them to a highly desirable endpoints and needs when dealing with toxic HABs affecting risk to living resource and human health.

It is encouraging that there are sound preliminary results on *K. brevis*. It is good that the toxin measurements correlated well with *K. brevis* densities in the LOC. However, the need for such instrumentation is perhaps reinforced by common situations among species where strains, population growth phase and environmental conditions among other variables combine in ways not always well understand to affect toxin expression that doesn’t correlate with cell counts. This is where developing such instrumentation increases in value. Will this assay be enhanced to cover a broader range of natural concentrations of this organism (e.g, FWC classification has “medium” concentrations of *K. brevis* as 100K-1million/ml and “high” as  $\geq 1$  million when the preliminary assay results in this work showed a relationship up to 250K cells/ml)?

Question – how stable are the LOCs under expected field conditions and does this effect the ultimate duration of feasible deployment? It is stated that the solid state reagents retain > 95% of their activities after months of storage. Dockside instruments may foul in a couple weeks in certain environments before maintenance and change out of instruments although instrumentation seems to be improving and increasing deployment times. And I see in the Puget Sound dimension of the project the technician is scheduled for approximately biweekly maintenance visits. The use in terms of HIV work in Africa would suggest on the surface to me that the prepared LOCs must already have proven their worth in sufficient shelf life under some extreme conditions for field transportable applications so I am again encouraged. A lot of the later years of the project hinge upon LOC developments but with many molecular approaches already available for multiple species the likelihood of adapting present knowledge to the chip assays seems comfortably high here.

### **3. Overall qualifications of applicant (20%)**

The team blend of PI's, Investigators and collaborators from across the regions dealing with critical and varied HAB environments and issues, and the diversity scientific disciplines represented is well qualified to pursue the project.

### **4. Project costs (10%)**

Projects costs are satisfactory with the expected advances and efforts in this project.

### **5. Outreach/education (10%)**

Displaying cutting edge scientific tools in action and significant results to stakeholders across region garners support for the work. Three regions of application exposes an array of scientists and managers to the developing technologies. Semi-continuous data is expected and websites and press releases highlighting the developments and tracking the applications were not explicitly mentioned but would helpful outreach tools. Lack of a final product that could be expected to be move into broader range of programs seems to be the tradeoff for a significant advancement toward such a future jump-off point.

### **6. Additional comments**

**Overall Rating:** Excellent

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**Appendix D4****PROPOSAL EVALUATION FORM**

Please return no later than: December 22, 2006

**A. Proposal Information:**

<b>Principal Investigator:</b> J. Naar	<b>Reviewer ID:</b> [CSCOR will enter]
<b>Institution:</b> Center for Marine Science UNCW-Wilmington	<b>Proposal #:</b> MERHAB 07-02
<b>Proposal Title:</b> Toxin-sensor based approach for in situ and autonomous monitoring of HAB toxin production	

**B. Proposal Evaluation:**

For details see "Instructions for Reviewers". Note: boxes will adjust in size as appropriate.

<b>Please evaluate this proposal using the following five criteria.</b>
<p>1. Importance and/or Relevance and applicability of proposed project to the program goals: (30 percent): This is a confusing proposal. It is written as a targeted project, i.e. to develop the LOC prototype instrument, but with the timing (5 yr) and budget (\$1.4M) of a regional project. Quite frankly only one of the seven objectives has any type of regional impact, rather the regional choice seems added as an afterthought to provide the budget needed to develop the technology. It is clearly lacking the programmatic requirements (organization and outreach ) needed for a competitive regional proposal. That said, it is of interest to MERHAB as a targeted (albeit expensive) project.</p>
<p>2. Technical/scientific merit (30 percent): The development of the LOC is proceeding well for the brevetoxins. It is worrisome that they do not have antibodies for the saxitoxins, given the difficulty in successfully getting those to work. While this risk is acceptable for a targeted proposal, it could invalidate the entire PSP portion of this work. Unfortunately, most of the future objectives (obj 3,4,and 5) are all predicated on these first objectives working. I think the regional aspects of this project are simply premature at this time. Once they have the technology in hand, they can develop the necessary monitoring protocols to incorporate the LOC into existing monitoring programs.</p>
<p>3. Overall qualifications of applicant (20 percent): The PI's are highly skilled and leaders in their field. That said, a number of highly skilled investigators have been working on antibody based techniques for PSP toxins without success for over two decades. While that is no reason to not fund the proposal, it is a call for caution. It is also not clear who will have overall responsibility for the engineering aspects (obj 3) of this project. Does either Univ. Texas or UNCW have a engineering support section that will work on the electronics and production aspects of these sensors.</p>
<p>4. Project costs (10 percent): Very reasonable priced for a regional project, Very expensive for a targeted project. Maybe MERHAB needs some type of intermediate vehicle for targeted projects that cannot be done under the \$100,000 / year cap.</p>
<p>5. Outreach/education (10 percent): There is no educational component to this project. Neither is there any outreach efforts other than the obvious that come from any standard targeted project. There are no plans provided for the development of continued commitments for the monitoring after the project ends.</p>
<p><b>Additional Comments:</b> This proposal lacks too many of the components to be a regional project. Rather it is a well written and highly targeted project. That project has value, but could easily be funded through the standard MERHAB targeted grant. There is no justification for the higher budget and a weak organizational infrastructure.. The assembled team of collaborating investigators are well qualified but their effort seems almost perfunctory in their scope of work.</p>
<p>Overall Rating: <input type="checkbox"/> Excellent <input type="checkbox"/> Very Good <input type="checkbox"/> Good <input checked="" type="checkbox"/> Fair <input type="checkbox"/> Poor</p>
<p>Verbatim but anonymous copies of reviews, ratings, and associated correspondence will be sent to the principal investigator. Subject to this policy and applicable laws, including the Freedom of Information Act (USC 552), reviewers' comments and identities will be given maximum protection from disclosure.</p>