

Nomination of the Center for the Advancement of Population Assessment Methodology (CAPAM) for the American Fisheries Society's William E. Ricker Resource Conservation Award

An effective science-based management system aligns cutting-edge research, operational excellence, and training the next generation of innovators and implementers. The Center for the Advancement of Population Assessment Methodology (CAPAM) has achieved this alignment for the field of fishery stock assessment, the very field pioneered by William E. Ricker, and is highly deserving to be awarded this prestigious award. CAPAM (<http://www.capamresearch.org/>) was formed as a collaboration among researchers at the Inter-American Tropical Tuna Commission (IATTC), the U.S. National Marine Fisheries Service (NMFS) Southwest Fisheries Science Center, and the Scripps Institution of Oceanography (SIO) with the objective of promoting research and development of fishery stock assessment methods. CAPAM's achievements and merits strongly support my nomination of it for the William E. Ricker Award.

I, Richard D. Methot Jr., am NOAA Fisheries' Senior Scientist for Stock Assessments. It gives me great honor and pleasure to have the opportunity to nominate the Center for the Advancement of Population Assessment Methodology for the American Fisheries Society's William E. Ricker Resource Conservation Award. My experience in the field of fishery science is considerable. I am an AFS Fellow, past winner of AFS' "Sully", incoming president of the AFS Marine Fisheries Section, participant in all the CAPAM workshops, and developer of the U.S.' most widely used assessment approach, Stock Synthesis, for marine fisheries. I hold in the highest regard the tremendous contributions that CAPAM has made to the field of fishery stock assessment. These contributions have advanced the state of the science, communicated these advancements through the peer-reviewed literature, facilitated incorporation of these advances in actual stock assessments, facilitated collaboration among researchers, and engaged a new generation of assessment scientists at each step.

BACKGROUND: Stock assessment is the field of quantitative population analysis that guides sustainable management of fisheries. It measures the trade-off between prevention of ecosystem harm and attainment of maximum benefits. Operationally, this is prevention of overfishing versus attainment of high fishery yield and high recreational fishing opportunity. Without accurate stock assessments, the socio-economic benefits from the fishery are at risk. Therefore, improvement of stock assessments and the methods used to conduct stock assessments is an objective of NOAA and any organization mandated to manage fisheries and a priority for the various forms of stakeholders that range from the fishing industry to non-governmental conservation organizations. Stock assessment methods range greatly in their complexity depending on the data available and the important biological and fishing processes that must be accommodated. Stock assessments used for valuable fisheries are typically based on complex mathematical, statistical, and computational concepts. Therefore, professionals with highly-technical skills are needed to conduct stock assessments. Unfortunately, there is a shortage of these professionals as highlighted by numerous organizations including, the U.S. National Academy of Sciences. (<https://www.nap.edu/read/10000/chapter/1>) and the U.S. National Marine Fisheries Service

(http://www.nmfs.noaa.gov/pr/sars/improvement/pdfs/marine_fisheries_saip.pdf). The functioning of fisheries agencies forces this limited pool of professionals to focus on conducting assessments and presenting advice to the detriment of research and improving stock assessment methods. Creation of general stock assessment programs (e.g. Stock Synthesis), which encapsulate the current body of knowledge about stock assessment, has greatly facilitated the development and application of stock assessments, since it is no longer necessary to create a new computer program for each fishery. However, they are still inadequate to fulfill the future needs of stock assessments, as requested by legislation and management bodies, because their complexity still requires expert professionals to use them and our collective understanding of stock assessment is still lacking. Stock assessment methodology is underdeveloped due to the lack of support for directed research. This results in a lack of understanding about the appropriate methods to use for an application, which can be seen as an inconsistency in the methods used among fisheries. What is needed is a well-researched Good Practices Guide (GPG) to Fisheries Stock Assessment. This will improve the current stock assessments and allow more assessments to be conducted as less experienced practitioners can apply the GPG, using a general stock assessment program. The GPG should be predicated on a sound science-based foundation, and its development entails addressing the most influential issues in a structured manner. It should also evolve through focused and coordinated research, and strengthen over time.

WHAT is CAPAM?: The Center for the Advancement of Population Assessment Methodology (CAPAM; <http://www.capamresearch.org/>), a collaboration of the Inter-American Tropical Tuna Commission (IATTC), the U.S. National Marine Fisheries Service (NMFS) Southwest Fisheries Science Center, and the Scripps Institution of Oceanography (SIO), has the objective to promote research and development of fishery stock assessment methods. Toward this goal, CAPAM has developed a Stock Assessment Good Practices Program (GPP). CAPAM also provides training for students and early career scientists through SIO and other research collaborations. At the center of the GPP are workshops on stock assessment methodology (<http://www.capamresearch.org/workshops>), which involve both national and international scientists, and the resulting special issues in the journal Fisheries Research (<http://www.capamresearch.org/publications>), which have been an outstanding success and have been recognized as a model for advancing fisheries science (e.g. <http://ices.dk/news-and-events/asc/ASC2017/Pages/Theme-session-W.aspx>). In each workshop, leaders on the field hold open debate sparked by key questions from CAPAM staff, while students absorb the nuances to advance their deep learning on the topics. Dr. Andre Punt, Director of the School of Aquatic and Fishery Sciences, University of Washington, remarked: "I consider these CAPAM workshops to be my top priority to get students working in population dynamics to attend. The stock assessment-related research that I saw over only two days exceeded what I would expect to see at [national and international conferences]."

CAPAM has conducted five workshops covering the topics: fishery selectivity (over 70 onsite participants), growth (over 100 onsite participants), data weighting (over 50 onsite participants), recruitment (95 onsite participants), and spatio-temporal modelling of CPUE data (75 onsite participants), which were also webcast for those unable to attend in person. Over 20 countries and over 100 students have had participants in the CAPAM workshops. Future workshops are planned for spatial stock assessment models and on natural mortality. The workshops are a continuation of the Inter-

American Tropical Tuna Commission's (IATTC) October stock assessment methodology workshop series that ran for about 10 years. Several CAPAM workshops were funded by NOAA Fisheries as part of its R&D efforts for improving stock assessment methods.

CAPAM's achievements are not derived solely from the output of CAPAM staff members or its visiting scientists, but the synergistic relationship between many researchers resulting in journal special issues and follow-on research. Major concepts on selectivity, growth, data weighting, and general guidelines for stock assessment modeling resulting from the CAPAM workshops have changed the way assessments are conducted both nationally and internationally, and will continue to do so.

To testify to the contributions and importance of CAPAM in improving fisheries stock assessment, management, and conservation, I have obtained 41 support letters from researchers ranging from students to the most well-known stock assessment scientists. These support letters are summarized in the attached document and some highlights are provided below.

A first highlight epitomizes how CAPAM extends from research to operational assessments. Jim Thorson writes, "Dr. Chris Francis published his first paper highlighting the importance of "data weighting" in 2011, but the topic received its first comprehensive, critical evaluation in the 2015 CAPAM workshop and subsequent Fisheries Research special issue. I am proud to have presented an alternative "Dirichlet-multinomial" method that I have subsequently promoted as a way to simplify the increasingly cumbersome and complicated process for conducting stock assessments. I would never have spent the time to discover this alternative data-weighting method without the impetus of speaking at the CAPAM workshop. The Dirichlet-multinomial method is now integrated into the Stock Synthesis assessment software, and was recently approved for use in the 2018 stock assessment for Pacific hake. This rapid transition from problem identification to theory to practice is rarely achieved in a complicated field such as stock assessment, and I believe that CAPAM was instrumental in focusing attention on the issue and encouraging the commitment of institutional resources to solve it."

Clay Porch, now director of NOAA Fisheries' Southeast Fisheries Science Center, writes, "...the research conducted as part of the CAPAM program and its collaborators is at the leading edge of stock assessment modelling. ...substantively influenced the way we do business in the Southeast."

Victor Restrepo, from the International Seafood Sustainability Foundation continues this theme by writing, "CAPAM is the leading provider of cutting edge stock assessment development and continued education through its various activities and good practices guidelines resulting from CAPAM have been taken up by many of the tuna stock assessments worldwide. For this reason, ISSF has supported CAPAM by provided funding for several workshops and visiting scientists."

Steven Cadrin, past president of the AIFRB, writes "As a teacher and practitioner of stock assessment methods, I rely heavily on the good practice guidance developed by CAPAM.I proposed the adoption of the 'CAPAM approach' for more global advancement of stock assessment methods (<http://www.ices.dk/news-and-events/asc/ASC2017/Pages/SISAM.aspx>). I regularly fund my students to participate in CAPAM workshops."

The remarkable contribution that CAPAM has made to fishery science resounds in statements that pervade the support letters. CAPAM “has led a movement in fisheries stock assessment that far surpasses any advances in the past 30 years in multiple ways.” (Trevor Branch). Even Mark Maunder, a leader in the field, stated that he has “learnt more during the few years that CAPAM has been in existence than previously in my entire career”. Similar experiences have been shared by students and early career scientists. For example, student Nicholas Ducharme-Barth attributes “a great deal of [his] academic and professional growth as a scientist over this past year to having been a participant in the CAPAM workshop series.” A group of University of Washington students and postdoctoral researchers commented that the workshops “provide more learning in five days than what could be gained by reading papers for five months.” Therefore, “It’s hard to imagine how the science of fisheries assessment would continue it’s rapid advance without the CAPAM community as a scaffold” (Brice Semmens).

The CAPAM workshops are extremely popular and “are always mentioned as the meetings that everyone wants to attend” and “are the first choice (by far) for ... students who are training to become stock assessment scientists generally” (André E. Punt). “well over 100 students have participated in one [or] more CAPAM facilitated events in the few short years that CAPAM has existed” (Brice Semmens). CAPAM has a global reach as can be seen by the range countries of workshop participant’s and of those who have provided supporting letters. Anyone would be “hard pressed to think of another achievement which has had such deep and far-reaching influence on improving approaches to support the conservation and management of the world’s oceans.” (Éva Plagányi). This acclaim is world-wide. For example, Doug Butterworth stated “Having attended over 400 international scientific meetings (particularly of RFMOs) related to fisheries, ... I must commend CAPAM for the breath of innovative fresh air which they have brought to this field over recent years. The series of workshops ... probably the best of its kind in current operation worldwide.”

The special issues are widely used by a variety of researchers. “The Special Issues of Fisheries Research have consistently been the most cited issues of the journal, with papers in the issues being amongst the most cited papers in the journal.” (André E. Punt)

“The knowledge generated through CAPAM has far-reaching impact, over and above stock assessment, in fields such as ecology and wildlife conservation” (Takis Besbeas). Jay Ver Hoef, a marine mammal statistician, noted that “This [is] one of the best workshops that I have ever attended.”

CAPAM is about a community and “has become the community touchstone for fisheries assessment sciences” (Brice Semmens) and in the process “CAPAM has produced something that is much larger than the sum of its parts.” (Mark Maunder). “Many key discussions in the recent stock-assessment literature were started or got a strong boost of research interest from CAPAM workshops” (James Thorson). The impact is so great that Felipe Carvalho considers the “meeting to be a changing point in [his] career ... During the Selectivity workshop, [he] realized that [he] wanted to dedicate [his] career to providing scientific advice for fisheries management, and to join the dozens of scientists around the world that are committed to improving stock assessment methods.”

With a small amount of funding received by CAPAM the “expectations on how well these funds would yield returns were far exceeded” (James Ianelli). “there has never been an organization like this, with a specific focus on improving the field of fisheries stock assessment, so CAPAM is filling a need that has been felt for some time” (Elizabeth Babcock)

CAPAM’s influence on management and conservation is wide ranging as can be seen from the management agencies mentioned in the support letters that have used CAPAM recommendations in their stock assessments. “CAPAM is just that important for effective fisheries management that supports countless firms, individuals, and coastal communities as well as providing sustainable and healthy protein to consumers and food security throughout the globe.” (Dale Squires)