Update Report
Period: 3/1/2014 - 2/28/2015
Project: E/I-21 - NMFS Population Dynamics Sea Grant Graduate Fellowship: Optimizing Bayesian analysis in data-rich stock assessments and management resources in data-limited fisheries. Trevor Branch in support of Cole Monnahan

STUDENTS SUPPORTED
No Students Reported This Period

CONFERENCES / PRESENTATIONS
Monnahan (2014) Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales? National Marine Mammal Laboratory, Alaska Fishery Science Center, Seattle WA., public/profession presentation, 25 attendees, 2014-10-22

Monnahan et al. (2014) An evaluation of alternative binning approaches for composition data in integrated stock assessments. CAPAM Workshop on Growth, La Jolla, CA, November 3-7., public/profession presentation, 50 attendees, 2014-11-05

ADDITIONAL METRICS

P-12 Students Reached:	0	P-12 Educators Trained:	0
Participants in Informal Education Programs:	0	Volunteer Hours:	0
Acres of coastal habitat protected, enhanced or restored:	0	Resource Managers who use Ecosystem-Based Approaches to Management:	0
Annual Clean Marina Program - certifications:	0	HACCP - Number of people with new certifications:	0

ECONOMIC IMPACTS
No Economic Impacts Reported This Period

SEA GRANT PRODUCTS
No Sea Grant Products Reported This Period

HAZARD RESILIENCE IN COASTAL COMMUNITIES
No Communities Reported This Period

ADDITIONAL MEASURES

Number of stakeholders modifying practices:	Sustainable Coastal Development
	# of coastal communities:

PARTNERS

Partner Name: Northwest Fisheries Science Center (US DOC, NOAA, NMFS, NWFSC)

IMPACTS AND ACCOMPLISHMENTS

No Impacts or Accomplishments Reported This Period

PUBLICATIONS

No Publications Reported This Period

OTHER DOCUMENTS

No Documents Reported This Period

LEVERAGED FUNDS

No Leveraged Funds Reported This Period

UPDATE NARRATIVE

Uploaded File: Monnahan_3502_update_n....1.pdf, 379 kb

Project details

Cole Monnahan, monnahc@uw.edu

Project number: E/I-21, award number: NA13OAR4170109

Project title:

Optimizing Bayesian analysis in data-rich stock assessments and management resources in data-limited fisheries

Project update:

My work since June 2014 falls into three categories: (1) a literature review and exploration of advanced Bayesian algorithms; (2) further investigation of how ADMB implements Bayesian methods and learning new software platforms JAGS and TMB; and (3) further learning of Stock Synthesis through a collaborative group project with other UW students and post-docs.

Bayesian Algorithms

I have made substantial progress on my review of algorithms that will be used to optimize Bayesian analysis. In particular I have explored the theoretical basis, and practical implementation of the Hamiltonian family of algorithms. These algorithms are compelling for difficult fisheries models because commonly used software (ADMB and TMB) can now provide fast and accurate gradients via automatic differentiation. Although they are significantly more difficult to understand and tune, they promise increased performance. Figure 1 shows the stochastic nature of the algorithm, while the autocorrelation between different tuning parameters for a simple example model are shown in figure 2.

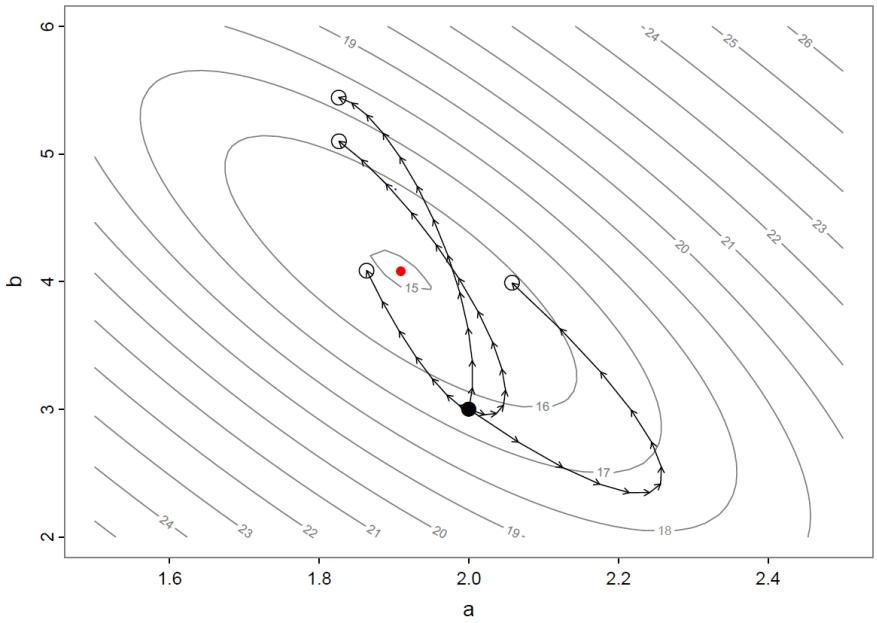

Figure 1. Different proposed parameters (open circles) for Hamiltonian trajectories for the same starting point (filled circle) but for different momentum variables.

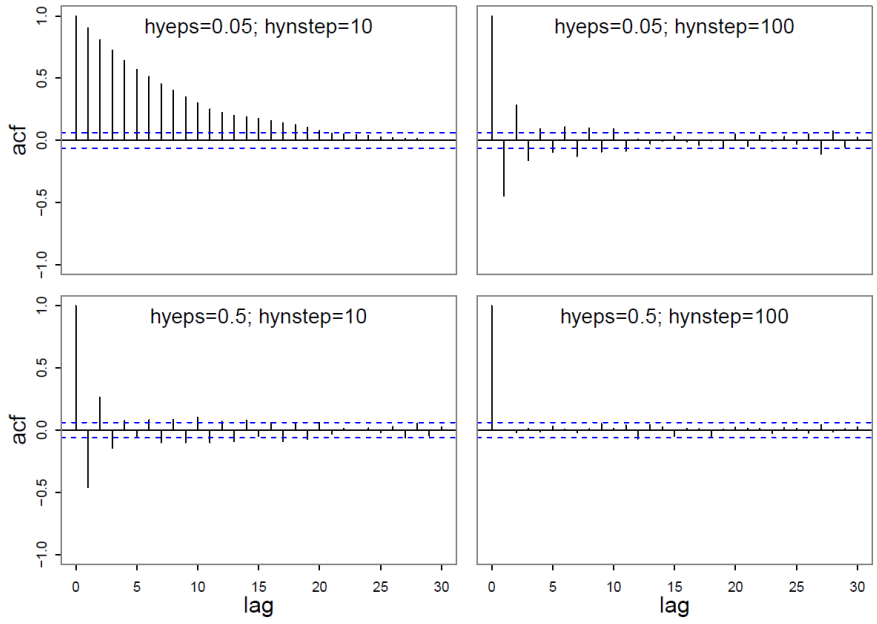

Figure 2. The effect of different combinations of tuning parameters on the autocorrelation of a MCMC chain using the Hamiltonian algorithm.

Software updates

A big part of my research is in surveying the available software tools and learning new pieces that show promise for fisheries science. I have made substantial progress understanding ADMB's version of the Hamiltonian sampler, which was undocumented and not thoroughly tested. Using the ADMB source code I investigated this implementation and documented it and shared it with the ADMB community in a guide. I am also now familiar enough with the ADMB source code that I can modify or extend the current implementation, or perhaps add new variants of the Hamiltonian algorithm that would then be available to all ADMB users. To further facilitate rapid exploration of these algorithms using ADMB I have developed a small R package on github.com which can be used to run ADMB models in the Bayesian framework across a wide variety of settings.

Further, I have learned Template Model Builder (TMB) and am comfortable building models. The advantage of TMB over ADMB is that TMB models work natively in R and thus other available tools, such as advanced MCMC samplers, are available for use without changing the source code. I expect that TMB will be the ideal tool to explore how to optimize runtime for difficult fisheries models. I also spent time learning JAGS, which is widely used, particularly for hierarchical models, but can suffer immensely from slow convergence.

Simulation project

I am also involved in another group project doing simulation testing of Stock Synthesis (SS). As a group we are developing three distinct simulation studies investigating growth: (1) the impact of binning on the estimation of growth and management parameters, (2) the performance of a method of bypassing growth using empirical weight-at-age data, and (3) an exploration of when growth should be estimated internal or external to the model. I am the lead author on the first study, and all three topics were all presented at the CAPAM growth workshop in November.

To facilitate these studies we have updated our R package from last year ('ss3sim') to include new data types and other broad usability updates. I have worked extensively on how to incorporate new data types, such as conditional length-at-age, mean length- and weight-at-age, as well as empirical weight-at-age. Further, I spent substantial amount of time converting existing SS assessment models to be usable by the package. In the process of working on these projects I have gained a deeper understanding of the practical side of SS, but also the statistical properties of the data going into it. This knowledge will be valuable for my work in comparing Bayesian and frequentist differences in estimates of uncertainty.

Summary of progress

I have submitted my PhD dissertation proposal to my committee and am awaiting final feedback. I plan to take my general exams in Spring quarter, and have already made good progress on the readings for that. In all I have the knowledge, tools, and understanding of what needs to be done to accomplish my proposed goals for my fellowship. My next steps are to focus down on the work and begin publishing my chapters.

Since writing my proposal a paper has been published (Carruthers et al. 2014) that is very similar to one of my proposed chapters. Other anecdotal discussions have lead me to believe

that similar work is also currently being done. Therefore I have dropped the chapter on data-poor model performance and have tentatively substituted it with a chapter on commercial catch rate standardization in the Pacific halibut fishery. As I continue with my graduate studies I will monitor the progress on data-limited methods and see if interesting opportunities present themselves for me to further this line of research.