RMA

The Resource Modeling Association is an international association of scientists working at the intersection of mathematical modeling, environmental sciences, and natural resource management. We formulate and analyze models to understand and inform the management of renewable and exhaustible resources. We are particularly concerned with the sustainable utilization of renewable resources and their vulnerability to anthropogenic and other disturbances.

RMA Newsletter Spring 2020

An overview on WCNRM2020, Valparaiso, Chile,

by the conveners, P. Gajardo and H. Ramirez

In the summer of the South Hemisphere last January, the World Conference on Natural Resource Modeling 2020 was held in Valparaiso, Chile, for the first time in South America. It was hosted by Universidad Técnica Federico Santa María (UTFSM) and sponsored by the Resource Modeling Association (RMA), the Chilean scientific agency (ANID), the Center for Mathematical Modeling (Universidad de Chile-CNRS) and the Department of Mathematics of the host institution UTFSM.

We insisted in organizing this conference in January, in the middle of our summer, instead of May or June 2020, which were the common dates of previous WCNRM editions. This providential decision made possible to avoid dealing with the COVID19 outbreak that has the world currently on hiatus. Furthermore, since October 2019, there had been several social demonstrations in all Chilean cities, adding an important uncertainty to the organization of the conference. This surely implied the absence of some members of the RMA community. Nevertheless, the conference went successfully, we received 63 attendees (30% women, 22% students) coming from 20 countries (60% from Latin America).

The title of the conference was "Decision support methods for natural systems at risk" and the scientific

Table of contents

program included 38 contributed lectures about sustainability, ecology, natural resources management, climate change, epidemiology, among others.
Additionally, it also incorporated 4 outstanding keynote speakers: Prof. Suzanne Lenhart (Mathematics Department, University of Tennessee, US) who spoke about optimal control for management of aquatic population models; Prof. Alejandro Maass (Center for Mathematical Modeling, Universidad of Chile), who delivered a talk about dynamical networks in systems biology, and some important lessons from the Atacama desert; Dr. Eva Plaganyi-Lloyd (CSIRO CMAR, Australia), who presented different methods to model and manage risk in marine natural systems; and Prof. José L. Torero (Department of Civil, Environmental and Geomatic Engineering at University College London, UK) with his insightful talk on modeling fire as a natural resource.

Regarding social activities, the first day we visited the Palacio Rioja, a beautiful palace-museum in Viña del Mar, where the second plenary talk by A. Maass took place. This day ended with a cocktail in its garden, where we enjoyed local music and Chilean wine.

The Gala dinner was organized the second day at the restaurant "Café Turri", a traditional place in Valparaiso facing the bay. During the dinner Hélène Gomes (IFREMER, France) and Luiza Tyminska-Czabanska (University of Agriculture in Krakow, Poland) received the prize for the best PhD student presentation.

On the third day, we enjoyed a Chilean barbecue in the gardens of UTFSM, facing the Pacific Ocean. The final activity was the field trip to bay of Quintay, which is a representative landscape of the central zone of Chile. We visited the old whale slaughtering plant, we did some trekking and discussed with local artisan fishermen. Then we end up in Casablanca valley, located on the coastal plain between Santiago and Valparaiso, and one of the most famous wine regions in Chile, where we lunched and visited a vineyard.

This event would not have been possible without the support, before and during the conference, of the RMA board, in particular from Frank van Langevelde, Luc Doyen and Steve McKelvey. Thank you for your commitment in this annual meeting. We would like to remind that a special issue of the journal Natural Resource Modeling will be edited in relation with this conference (deadline: October 1, 2020).

To end this overview, we would like to thank also to all attendees for their participation. The months before the conference were full of uncertainties in Chile, but your confidence allowed us to organize this WCNRM edition without any major disturbance.

We hope you have enjoyed the conference as much as we do. We hope to meet you again in Chile and at the next WCNRM in Leipzig!!

PRESIDENT'S COLUMN

by Frank VAN LANGEVELDE

Well, these are unprecedented time! I hope that you and your family are all doing fine. Our world has been shaken up by a zoonotic virus that suddenly stops complete economies. The apparent "makeable" society became dependent on a tiny infectious agent that can only replicate inside living cells. It is difficult to pinpoint exactly what the causes are for this pandemic, but we cannot neglect there are hotspots where people and wildlife co-exist that may be sources for these zoonotic diseases. Frequent contact between animals and people not only occurs on wet markets and during hunting for bush meat. Indeed these markets should meet sanitary standards, but this is too easy. These hotspots are more complex. In many areas, such as in US and Europe, habitat of wildlife has been lost and degraded due to human activities, increasing the contact between wildlife, livestock and people, since zoonoses often jump first from wildlife to livestock and then to people.

Several meta-analyses show that increasing animal diversity reduces disease risk. A recent paper (Doughty et al 2020 in Ecography) puts forward a thought-provoking hypothesis by linking the Late Quaternary large mammal extinctions to the emergence of > 100 zoonotic disease outbreaks of the last 60 years. The authors suggest that the concept of group immunity goes beyond human-human interaction and that reduced interaction between people and wildlife during the last 10,000 years reduced our resistance to emerging zoonotic diseases. It is clear that this hypothesis is very difficult to test, but it may lead to contemplating the role of wildlife.

What can we do as Resource Modelling Association? I think that we can play a role in this pandemic. First, RMA members can contribute by modelling the risk of infection in society and how to reduce this risk, by analysing how infection can jump from wildlife to livestock and people, and from livestock to people, by modelling the evolution of several virus families in various hotspots, by predicting potential outbreaks due to resource use, etc. I would like to challenge the RMA community to share ideas on how our association can contribute to prevent or reduce the effects of such pandemic.

Just before the pandemic started, in January 2020, we had our annual World Conference on Natural Resource Modeling in Valparaiso, Chile. The conference was very successful with many presentations from all around the world. Scientists from different disciplines were present and a nice mix of senior and junior scientists came together. The conveners of the WCNRM2020 Pedro Gajardo (Universidad Técnica Federico Santa María) and Héctor Ramírez (Universidad de Chile) did a great job, especially organizing the conference just before the pandemic. I would like to thank Pedro and Héctor and all the supporting staff for organizing this conference! I met many interesting scientists and I hope we meet again during the next conference in Leipzig 2021.

The communication of the RMA through social media such as ResearchGate, LinkedIn and Twitter is doing well. Do not hesitate to use these media to circulate information in line with the objective of the RMA, such as new academic positions, conferences, workshops, books, papers. It would be great if these media can also be used for topics related to the focus of the RMA to be discussed among the members and others. Let's share ideas about research on Covid-19!

The objective of the RMA is to foster research and teaching at the interface of ecology, economics, mathematics and computer sciences and devote to the sustainable management of natural resource and ecosystems. As members of the RMA we have the possibility to promote the global interest in sustainability and environmental issues and help to find solutions. I am convinced that the RMA can help society in these unprecedented times. I hope that the upcoming conference, the RMA journal and social media will help us with this. I want to send my very best wishes to everyone in the RMA community!

Frank van Langevelde
President RMA,
Professor Wildlife Ecology and Conservation
Wageningen University
The Netherlands

Best Phd Student presentation from Valparaiso conference:

Ecosystem scenarios under climate change for the coastal fishery in French Guiana

by Hélène Gomez[1], Luc Doyen[2], Fabian Blanchard[1]

[1]:IFREMER, Universty of French Guyana, Cayenne, France, [2]:CNRS, GREThA, Université de Bordeaux, France

Since 1950 a huge development of fisheries has occurred to ensure food security but also economic security for human population. This development resulted in an increase of about 20% in overfished world's marine stocks between 1975 and 2015 (1). Climate change complicates and exacerbates the issues by inducing new - or intensifying existing- risks, uncertainties and vulnerabilities through e.g. changes in primary production and fish distribution, thus potentially affecting yields.

In that context, designing management tools and public policies that ensure the long-term bioeconomic sustainability of marine fisheries has become a major challenge. In response, many scientists and experts advocate the use of an ecosystem-based fishery management (EBFM). EBFM aims at integrating the ecological and economic complexities of fisheries, instead of focusing on isolated target species. However how to operationalize it remains under debate. A methodological alternative for EBFM is provided by models of intermediate complexity (MICE; (2,3)). MICE are context and question-driven, and aim to limit complexity by restricting the focus to the minimum components needed to address the main effects of the management question under consideration.

The account of species interactions is an important ingredient of EBFM. Recognition that global warming affects the ecological functioning of marine ecosystems and fisheries is increasing. However, the way to integrate it in a model of populations' dynamics stays under debate (4).

In this study we focus on the coastal fishery in French Guiana. It is a non-selective small-scale fishery, exploiting 13 main stocks and operated by four categories of fleet. This fishery plays a major role for the territory, as it provides employment, food security but also population self-sufficiency.Fishing landings and efforts data are provided by the IFREMER Information System, quarterly, from 20016 to 2018 and we focus on two species: Acoupa Weakfish (*Cynoscion acoupa*), and Green Weakfish (*Cynoscion virescens*). This study explores driving ecological and economic processes at play on a medium to long term time scale in the exploited fish populations' dynamics including the impact of the climate change, competition between fish species and fishing efforts of different fleets. For that, a MICE is used.

At each step t, the fish species biomass $B_i(t+1)$, after harvesting, $H_i(t)$, depends on the resource stock $B_{res}(t)$ and the temperature $\theta(t-\tau_i)$ with a time lag τ_i through the relations:

(1) $$B_i(t+1) = B_i(t) * \left(1 - M_i + \gamma_i(\theta(t-\tau_i)) * g_i * a_{res,i} * B_{res}(t)\right) - H_i(t)$$

With fishing catches defined using the Schaefer production function :

(2) $$H_i(t) = \sum_{f=1}^{N_{fleets}} q_{i,f} * E_f(t) * E$$

and thermal impact:

(3) $$\gamma_i(\theta) = \exp\left(\frac{(\theta - \theta_{i,opt})^2}{\kappa_i^2}\right)$$

The equation (3) corresponds to the impact of the climate change. In this equation $\gamma_i(\theta)$ stands for the biological efficiency of the stock i at the temperature θ. It equals 1 when the stock is at his preferred temperature,

denoted by $\theta_{i,opt}$. κ_i^2 is a constant for each stock i, which depends on $\theta_{i,opt}$ and $\theta_{i,10}$, which is the temperature corresponding to $\gamma_i(\theta_{i,10}) = 0.1$. Equation (1) also indicates that the temperature θ does not affect the species dynamics instantly but with a delay denoted by τ_i as in (5).
Another equation is used to represent the population dynamic of the resource, depending on the consumption made by the three stocks. Thus, at each step t, the biomass $B_{res}(t+1)$, depends on biomass of fish stocks $B_i(t)$ through the relation:

$$(4) \quad B_{res}(t+1) = B_{res}(t) * \left(1 - \sum_{i=1}^{N_{stocks}} a_{res,i} * B_i(t)\right) + I(t)$$

where $I(t)$ corresponds to the external input (source) for this resource.
Once the model calibrated through the time series of the Information system, we apply the fishing scenario, business as usual, (it simulates fishing effort based on the idea that every fishery continue its current dynamics) under two IPCC climatic scenarios, which are RCP 2.6, optimistic scenario, and RCP 8.5, pessimistic scenario.
The results and the projected values for the biomass and catches of each stock are represented in the figure 1.

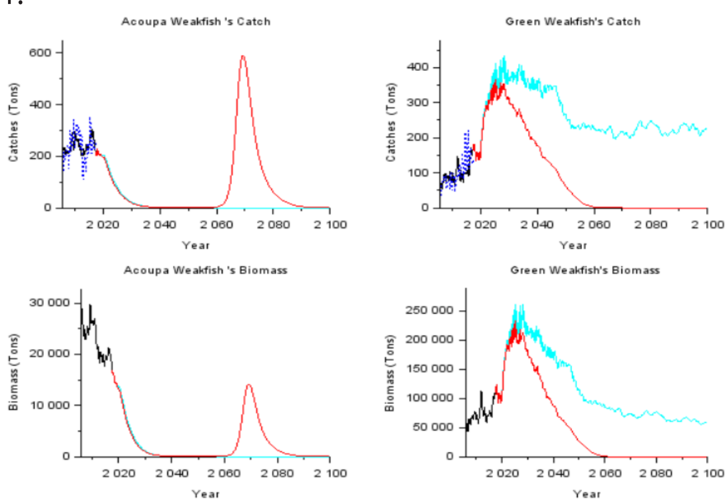


Figure 1: Historical (dark blue points), calibrated (black line) and projected (RCP 8.5 in red lines and RCP 2.6 in blue lines) catches by stocks (first line) and biomass for each stock (second line) under the scenario business as usual.

First it can be observed that the historical (dark blue points) and calibrated (black lines) catches for each stock are close, which validates the model. The projections highlight the impact of the climate change, and the high differences, in terms of catches and biomass, between the two climate scenarios. Thus, in term of species, in the pessimistic case an extinction occurs for both species whereas, in the optimistic case, both stocks are viable. Consequently the loss of biodiversity in the RCP 8.5 is much more severe as compared to RCP 2.6.
Regarding fishing production, the difference between the two extreme climate scenarios is also very important. For the pessimistic scenario, the species extinctions result in a collapse of the whole fishing landings and production whereas, in the optimistic case, the fishery globally persists. Based on these observations it turns out that both dynamics, competition and environment are driving forces in the coastal fishery.

References:

1.FAO, éditeur. The State of World Fisheries and Aquaculture 2018- Meeting the sustainable development goals. Rome; 2018. 210 p. (The state of world fisheries and aquaculture).

2.Plagányi ÉE, Punt AE, Hillary R, Morello EB, Thébaud O, Hutton T, et al. Multispecies fisheries management and conservation: tactical applications using models of intermediate complexity. Fish Fish. mars 2014;15(1):1-22.

3.Doyen L, Béné C, Bertignac M, Blanchard F, Cissé AA, Dichmont C, et al. Ecoviability for ecosystem-based fisheries management. Fish Fish. nov 2017;18(6):1056-72.

4.Cheung W, Lam V, Pauly D. Dynamic bioclimate envelope model to predict climate-induced changes in distribution of marine fishes and invertebrates. Modelling Present and Climate-shifted Distributions of Marine Fishes and Invertebrates. 1 janv 2008;16:5-50.

5.Thompson PM, Ollason JC. Lagged effects of ocean climate change on fulmar population dynamics. Nature. sept 2001;413(6854):417-20.

Hélène Gomez warmly rewarded for her presentation.

Assessing the Economic Tradeoffs Between Prevention and Suppression of Forest Fires

by Betsy Heines, Suzanne Lenhart, Charles Sims,

University of Tennessee, Knoxville, TN, USA

Laureates 2019 of the Lamberson Award

Rapid increases in wildfire suppression expenditures have prompted fire managers, scientists, and policy makers to investigate alternative approaches to managing wildfire. An increasingly popular alternative is fuels management which attempts to reduce wildfire risk and intensity through mechanical, chemical, biological or manual means, or by fire. Our paper examines the economic tradeoffs between fuels management spending and suppression spending using a framework that recognizes how the inability to predict the timing of large fire events influences the riskiness of the two management options. We formulate an optimal prevention and suppression problem with stochastic time of fire and convert it to a deterministic optimal control problem using William Reed's method.

Our goal is to explore the effects of prevention management spending on the value of a forest over a fixed number of years given that a sequence of an unknown number of large fire events may occur within this time. Let this fixed management horizon that we wish to consider a sequence of fires over be Y years long. We are optimizing prevention management spending between each fire event using our optimal control problem. We determine J_Y, the value of the forest over Y years, and consider the trade-offs in total prevention management spending and suppression spending. Because we are sampling the times of the fires, each time we determine J_Y the years in which fires occur will be different.

Thus, we perform a simulation study and perform multiple trials. We then examine some basic descriptive statistics for the value of the forest over Y years, the number of fires over Y years, and the total amount of prevention management spending and suppression spending over Y years. For comparison, we also consider the case without prevention management spending. As our optimal control problem allows for non-constant unburned acres before a fire, it is possible to consider sequences of fires. In essence, we solve our optimal control problem, use the solution to determine the Cumulative Distribution Function of our time of fire random variable, sample for a time of fire, and then solve our optimal control problem again with an updated initial condition for the number of unburned acres in the forest. This new initial condition takes into account the number of acres destroyed in the fire according to the previous solution of the optimal control problem. We continue to do this until the time of the n^{th} fire, n unknown, is beyond a specified amount of time, Y.

The parameter Y represents the the length of the management horizon overwhich we want to consider a sequence of fires. Over the course of the management horizon $[0, Y]$, our optimal control problem will be solved several times. Each time the optimal control problem is solved over the time horizon $[0, T]$.After a fire event, the time of the next sampled fire time τ is in $[0, T]$. The length of the time horizon for our optimal control problem T should be chosen so that our survivor function at T is very small (close to zero) so that we can approximate the CDF for T by its continuous counterpart.

Figure 1 provides one example of the management prevention schedule and number of unburned acres in one simulation where a sequence of fires is considered over $Y = 50$ years. Because we sample for the times of the fires, every fire sequence simulation will be different. The set of parameter values used are based on the values determined for the 2011 Las Conchas Fire.

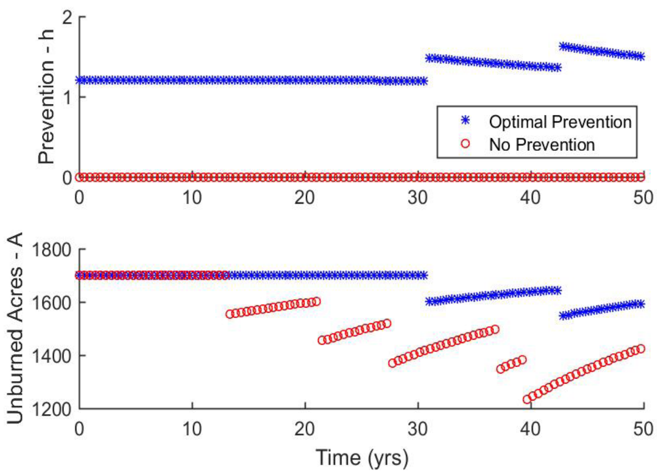


Figure 1: The top plot gives management prevention spending with optimal prevention and without prevention over a management horizon $Y = 50$ years. The bottom plot gives the number of unburned acres. Every jump discontinuity represents a fire event.

These plots also show what the number of unburned acres might look like given no prevention management spending. This simulation is determined separately from the optimal case. The jump discontinuities in the plots correspond to the different fire events. In the particular example in Figure 1 the no prevention management spending case 5 fires occur in 50 years and in the optimal prevention case 2 fires occur.

In order to create a more comprehensive picture concerning the effect of prevention management spending over a fixed management horizon for sequences of fires, we conduct many simulations and calculate statistics concerning the results. For the simulation study, 500 trials are conducted to determine the value of the forest J_Y over 50 years, given that an unknown number fires may occur in this time period for each trial. In addition to calculating value of the forest J_Y using the prevention management schedule found according to the optimal control problems, for comparison, we also calculate the value of the forest given that no money is spent on prevention management.It is important to note that these two cases are determined independently from one another. We also consider total prevention management spending and suppression spending in each case, in addition to the number of fires that occur in the management horizon.

	Number of Fires		Value of Forest - \$ (M)	
Prevention	Optimal	None	Optimal	None
Mean	1.4	5.0	671	536
Median	1	5	677	556
Std.	1.1	2.4	34.0	111.7

Table 1: This table provides statistics concerning the average number of fires and average value of the forest over 50 years for 500 simulations.

Our results reveal that, on average, in the case of optimal prevention management spending there are fewer fires and an increased value of the forest in comparison to the case with no prevention management spending. Furthermore, the standard deviation around the average number of fires and value of the forest is much smaller in the optimal prevention management case in comparison to the no prevention management case.

This suggests that using optimal prevention management spending is a less risky management option when compared to the case without prevention management spending. Additionally, we see that prevention management spending can offset high suppression costs and decrease the total amount of spending overall.

References:

Mercer, D. E., Prestemon, J. P., Butry, D. T., & Pye, J. M. (2007). Evaluating alternative prescribed burning policies to reduce net economic damages from wildfire. American Journal of Agricultural Economics, 89(1), 63–77.

Milne, M., Clayton, H., Dovers, S., & Cary, G. J. (2014). Evaluating benefits and costs of wildland fires: Critical reviewand future applications. Environmental Hazards, 13(2), 114–132.

Minas, J., Hearne, J., & Martell, D. (2015). An integrated optimization model for fuel management and fire suppression preparedness planning. Annals of Operations Research, 232(1), 201–215.

Reed, W. J. (1987). Protecting a forest against fire: Optimal protection patterns and harvest policies. Natural Resource Modeling, 2, 23–54

Reed,W. J., & Heras, H. E. (1992). The conservation and exploitation of vulnerable resources. Bulletin of Mathematical Biology, 54(2/3), 185–207.

What: **#WCNRM2021**

When: 2nd-5th June, 2021

Where: Leipzig, Germany,

The theme of next year's WCNRM conference is "**Tipping ecological-economic systems towards sustainability**". Many natural resources around the world are being overexploited for short term economic benefits, leaving ecosystems on the brink of collapse. This is especially true for marine systems where overfishing is a continuous and globally increasing ecological and economic issue, also resulting in impacts on society and culture. Marine ecosystems are threatened to cross tipping points, leading to abrupt changes in recruitment, biomass, and consequently in catches. The program includes two keynote speakers and two special session keynote speakers.

Dr. Yunne-Jai Shin is a quantitative ecologist and research director at the Research Institute for Development (IRD), France. She is working on marine biodiversity, exploitation and conservation and was one of the lead authors of the IPBES report on biodiversity.Prof. R. Carpenter is Professor at the Department of Integrative Biology at University of Wisconsin-Madison, USA. His research focuses on the interaction of biogeochemistry and food web processes in lakes.Prof. Marie-Catherine Riekhof is Professor of Political Economy and Resource Management at the Faculty of Agricultural and Nutritional Sciences at Kiel University, Germany. She examines the impact of different institutional arrangements in the field of marine and coastal resources.Dr. Camilla Sguotti is an empirical ecologist at the University of Hamburg, Germany. Her research focuses on marine ecosystems and population dynamics under human stressors such as fishing and climate change.

Leipzig is a booming city located about one hour by train south of Berlin. With a population of 600,000 it is the 8th largest city in Germany and it is growing rapidly. Leipzig is well-known for its peaceful mass protests in October 1989 in front of St. Nicholas Church that eventually led to the collapse of the socialist GDR regime and the fall of the Berlin wall. Nowadays, Leipzig is a vibrant city with a cosmopolitan atmosphere and plenty of space for creativity and new ideas. The city is shaped by Gothic, Renaissance, Wilhelminian and modern buildings that tell more than 1000 years of history. The city center offers antique bookshops, art galleries, and legendary pubs such as the Auerbachs Keller from Goethe's Faust. At the same time, the city is extremely green with Germany's oldest botanical garden, large parks, and beautiful woods. In summer, rivers and lakes are invitingly refreshing for relaxation, swimming and canoeing. Leipzig's musical heritage is truly unique with an abundance of great composers, such as Bach, Schumann, Wagner, and Mendelssohn, the famous St. Thomas Boys Choir, founded in 1212 and directed by JS Bach, and the world class Gewandhaus Orchestra.

The conference is hosted by the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, the Helmholtz-Centre for Environmental Research-UFZ and Leipzig University. Both iDiv and UFZ are research centres, where international and interdisciplinary researchers establish the scientific basis for the sustainable management of our planet's biodiversity and natural resources to benefit both mankind and the environment.

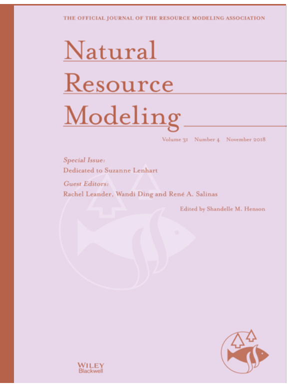
The organizing committee consists of RMA board member Martin Quaas, professor for Biodiversity Economics at the German Center for Integrative Biodiversity Research (iDiv) and Leipzig University, Martin Drechsler, researcher at the UFZ and honorary professor for Ecological-Economic Modelling at Brandenburg University of Technology Cottbus-Senftenberg, Robert Arlinghaus, professor for Integrative Fisheries Management at Humboldt University of Berlin, and Christian Möllmann, professor for Marine Ecosystem and Fishery Science at the University of Hamburg.

We look forward to welcoming you in Leipzig next year.

Editor's Column

Special Issue of Natural Resource Modeling Devoted to WCNRM 2019 Montréal

by Shandelle M. Henson,
Editor-in-Chief



In May 2019 RMA members enjoyed an exciting conference at GERAD, HEC Montréal, Canada, organized by Michèle Breton, Baris Vardar, and Georges Zaccour. The upcoming issue of the Journal (Volume 33, Issue 3, July 2020) is devoted to papers from that conference and is guest edited by Michèle Breton and Georges Zaccour. In this column I give a brief preview of the papers with paraphrased authors' summaries in order to whet your appetite for the special issue.

Three of the papers concern fisheries.

In "Risk sensitivity in Beverton-Holt fishery with multiplicative harvest", Jerzy Filar (a plenary speaker at the conference), Zhihao Qiao, and Sabrina Streipert present a steady-state threshold risk analysis framework for exploited populations.They consider the Beverton-Holt model with constant multiplicative survival, constant carrying capacity, and constant growth rate. They analyze the risk of the steady-state falling below a specified threshold, assum-ing constant harvest and a stochastically distributed proliferation rate. They also consider the case in which a seasonal environment causes 2-periodic forcing of the carrying capacity.

Ngo Van Long, Mabel Tidball, and Georges Zaccour, in "Optimal harvesting and taxation when Accounting for marine environmental quality of the fishery", consider a fishery model with two state variables: stock of fish and marine environmental quality. An index (MEQ) of habitat extent and quality influences the growth rate and the carrying capacity. They study the steady-state solution in two scenarios: a scenario in which the agents realize MEQ is non-constant, and a scenario in which they believe it is constant. The harvest rates differ in the two scenarios and lead to different steady states. The steady-state solution of the planner's problem can be supported by a large number of appropriately designed tax schemes, whereas the approach to the steady state depends on on the implemented tax scheme. The authors address the implications for optimal regulation.

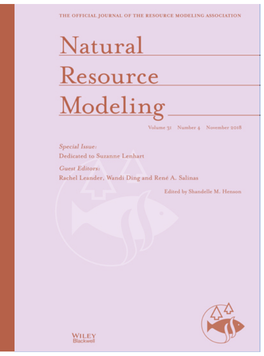
Victor Riquelme, Terrance Quinn II, and Hector Ramírez, in "The role of uncertainty in the design of sustainable and precautionary management strategies for fisheries", use a discrete-time stochastic age-structured model to investigate the long-term behavior of a single-species fishery harvested by several fleets and affected by recruitment variability. They introduce maximum expected, log expected, and harmonic expected sustainable yield and illustrate these concepts with a case study of the Patagonian toothfish fishery in Chile and Argentina. They show that high levels of recruitment variability have a negative effect on all these indicators, and that the deterministic MSY may not be attained, which could lead to a failure of management strategy.

One of the special issue papers addresses a serious and incurable vine disease transmitted by an insect vector. "Disease dispersion as a spatial interaction: The case of Flavescence Dorée", by Jean-Sauveur Ay and Estelle Gozlan, focuses on the spatial diffusion and control of this disease with pesticides. The authors investigate the private strategies of wine producers and the associated socially-optimal regulation, which addresses both the insufficient consideration of collective benefits from controlling the vector, and the failure to take into account environmental damage from pesticide application. The authors consider three assumptions of producers' anticipation: naive, myopic and farseeing.

Two of the special issue papers address more general theoretical issues.

The first, by Luc Doyen and Pedro Gajardo, entitled "Sustainability standards, multi-criteria maximin and viability", deals with sustainability criteria and standards. The authors consider the connections between

Editor's Column



maximin and viability approaches in the context of multi-criteria. A main result is that 'Pareto MSY' can be characterized with viability kernels, making it possible to determine the trade-offs and/or synergies between non-substitutable economic and ecological standards underlying strong sustainability. A second main result is to propose algorithms derived from the viability version of dynamic programming to approximate numerically Pareto maximin values, controls and sustainability standards. The authors given two illustrative examples relying on renewable resource management.

A second theoretical paper is "Geometrical methods for analysing the optimal management of tipping point dynamics (Optimally managing tipping points)", by Florian Wagener, who gave one of the Tutorial addresses at the conference. Wagener notes that resources should not be modeled as infinitely resilient, and that finitely-resilient resources feature tipping points and history dependence. The paper provides a discussion of the mathematical methods needed to understand the optimal management of such resources: viscosity solutions of Hamilton–Jacobi–Bellman equations, the co-state equation and associated canonical equations, exact root counting, and geometrical methods to analyse the geometry of the invariant manifolds of the canonical equations.

I enjoyed working with Michèle Breton and Georges Zaccour, and I thank them for their careful work in pulling this issue together.
I hope you enjoy reading it!

Shandelle M. Henson
Editor-in-Chief, Natural Resource Modeling
Professor of Mathematics
Professor of Ecology
Andrews University
Berrien Springs, Michigan, USA

The editorial team of the RMA newsletter expands:

A warm welcome to Julie Vissaguet , who assists Anne-Sophie with communication tasks.


Anne-Sophie Masure, Julie Vissaguet , Sébastien Lavaud, Luc Doyen.

The official newsletter of the Resource Modeling Association

Editors : Anne-Sophie Masure, Julie Vissaguet, Sébastien Lavaud, Luc Doyen.