Did Globalization Hurt the Miskito People?

Using a Quantitative Model to Test a Qualitative Theory from Political Ecology

Abstract

This paper examines how a system dynamics model can be used to represent and test qualitative theories from geography and anthropology studies. I use geographer Bernard Nietschmann's (1979) foundational political ecology analysis of the indigenous Miskito people and their relationship with globalization as a case study. Nietschmann describes a variety of positive feedback loops that result from the over-hunting of green sea turtles due to increased global demand. Resultantly, the Miskito people faced increased emigration, prices, and a decreased ability to fulfill their basic needs. Nietschmann presents a convincing but qualitative story which might be strengthened through the quantification that comes from model analysis and testing. A system dynamics model was implemented using the logic presented in Nietschmann's paper. The results of the model suggest that Nietschmann's model is internally consistent, and coherent even in the context of data gathered from the modern study of sea turtle population dynamics. The model shows that the Miskito could sustainably export a maximum of 3,500 turtles a year. This study suggests that the field of geography may benefit from the use of systems approaches in modeling and evaluating descriptive findings.

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The Miskito people are an indigenous group native to the Eastern coast of Nicaragua. The Miskito have been geographically, economically, and socially insulated from the rest of the world. Despite their isolation, the Miskito have been subjected to intense anthropological study (Noveck, 1988). The Miskito people attracted the attention of international academics due to the interesting dynamics of their civic and political societies (e.g. Helms 1983; Olien, 1983), and their unparalleled skill for hunting green sea turtles (Nietschmann, 1972). Numerous anthropologists, and geographers wrote articles on the Miskito people during the height of this attention, which lasted from the 1970s until the early 1990s (e.g. Helms 1970; Nietschmann, 1979).

Bernard Nietschmann was one of the most prolific geographers to study the Miskito people. Nietschmann's body of work is one of the earliest examples of the field now known as political ecology – the study of the politics of environmental problems. Nietschmann's papers are foundational to the field, and are often discussed in political ecology introductory textbooks (e.g. Robbins, 2011; Neumann, 2005). This project focuses specifically on Nietschmann's (1979) article, "Ecological Change, Inflation, and Migration in the Far Western Caribbean." Nietschmann studied and lived among the Miskito people for 10 years between 1969 and 1979, during which he observed growing economic and social tensions in the community. Nietschmann describes how the growing economic influence of globalization initially led to the over-hunting of green turtles, and then later to the degradation of social cohesion in the Miskito society. As shown in Figure 1, the two important features of this system are a strong positive

feedback loop and less influential negative feedback loop. The positive feedback loop concerns the increasing demand of turtles, which results in a smaller supply of turtles, leading to increased prices. The negative feedback loop concerns the social friction and emigration caused by the increasing price of sea turtles.

When Nietschmann wrote his article in the 1970s, system dynamics modeling was in its infancy. Even in the contemporary study of geography, the use of system dynamics models is almost unheard of. Because geographical systems often produce unexpected, nonlinear behavior (Peterson, 2001), it is nearly impossible to judge the correctness of Nietschmann's conclusions from the article alone. Therefore, I applied systems thinking and modeling tools to this problem to improve our understanding of the dynamics of the Miskito population, their economic system, and globalization's impact on the sea turtle population. Nietschmann's (1979) article was chosen for the purposes of this case study, due to the wealth of numerical data included therein, and the author's pre-existing familiarity with the work. Modern biological data from the Worldwide Fund for Nature (2017) concerning the population dynamics of sea turtles was obtained, and used to supplement the economic and social data presented in Nietschmann's article.

Figure 1.1 –Nietschmann's Mental Model

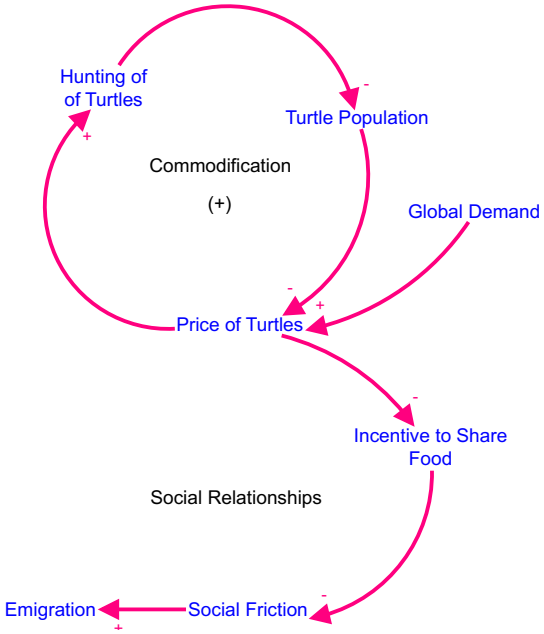

Figure 1.2 Nietschmann's Model with Feedback

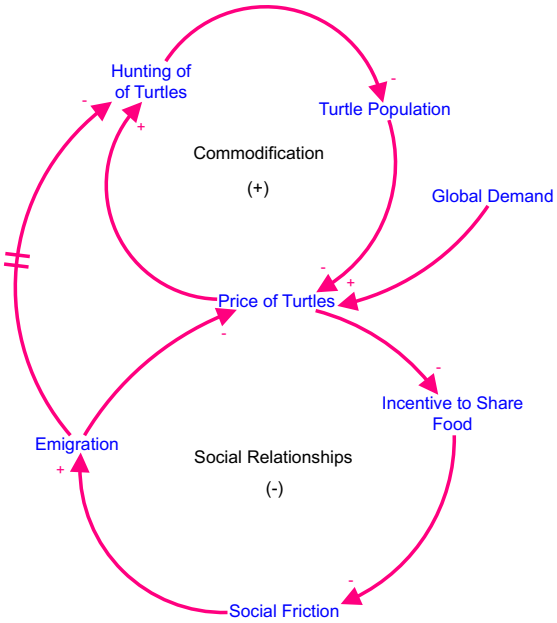

Figure 1 Causal loop diagrams summarizing Nietschmann's mental model.

Figure 1.1 shows the dynamics of the Miskito's hunting of green turtles as described by Nietschmann. The top loop shows the positive feedback of commodification: increased hunting causes the price of turtles to go up. Increased hunting causes the stock of turtles to go down, further increasing the price. The impact of global demand is modeled through an exogenous, positive relationship with prices. In *Figure 1.1*, the bottom loop is not closed, as Nietschmann does not acknowledge the negative feedback loop caused by social friction. *Figure 1.2* shows how the feedback loop should be closed. The bottom, negative feedback loop functions as such: As the price of turtles goes up, the incentive to share food goes down. As the incentive to share food goes down, more Miskito people are disenfranchised, and leave the community. As these residents leave the community, there is less demand for turtles. In addition, fewer turtles can be hunted. As a result, the market price of turtles goes down.

Purpose

This paper attempts to answer two broad questions. The first question revolves around Nietschmann's article specifically, and the second concerns the field of geography more generally:

1. Is the overshoot-and-collapse model described in Nietschmann's (1979) paper correct? If the same connections and feedbacks described in Nietschmann's paper are used, can the described dynamics be obtained? If the described dynamics cannot be reproduced, what needs to be done to produce these dynamics?

2. Due to the complicated nature of geographical systems, geographers have often been limited to describing problems, rather than trying to offer solutions. Can system dynamics models allow geographers to offer solutions to problems that they are confident in? Furthermore, in recent decades, many geographers have eschewed empirical methods in favor of anti-rationalist, postmodern epistemologies (Dear, 1988). Can system dynamics techniques help renew geography's appreciation of empirical approaches and modeling?

Approach

In this paper, a system dynamics model was constructed in Stella Architect version 1.1.2 (isee systems, 2015) in accordance with the specifications of Nietschmann's (1979) mental model. The model was used to perform a post-hoc peer-review of Nietschmann's study of the Miskito people. While this paper is concerned with only one ethnographic study performed in the 1970s, the work shows the potential synergy of combining system dynamics and more humanistic social sciences, such as geography and anthropology. Because geographical systems are often non-linear and too complex to be represented accurately in mental models, more quantitatively rigorous methods can support a richer and testable understanding of these situations.

The final model (Figure 3) consisted of three sections, a Miskito population model, a green turtle population model, and an economic system, where the hunted turtles are either kept as communal goods, or sold on the international market place. At 1,500 turtles exported per year, the model exists at a self-sustaining baseline state. In this state, the turtle population levels off at the ecosystem's carrying capacity of 50,000. The total population, age of sexual maturity, and reproduction rates of the turtles were estimated based upon WWF (2017) numbers. The dynamics of the model remain the same, within a large range of initial turtle population values. The Miskito grows at first, then levels off at around 75,000 people at by 1975. Miskito population growth is driven by an increase in children and retirees, with the population of hunting adults staying relatively stable. The impact of globalization was modeled by using a step function. The initial, steady state value of 1500 turtles demanded per year was stepped up to 6,500 turtles per year in 1965, and to 11,500 turtles per year in 1970.

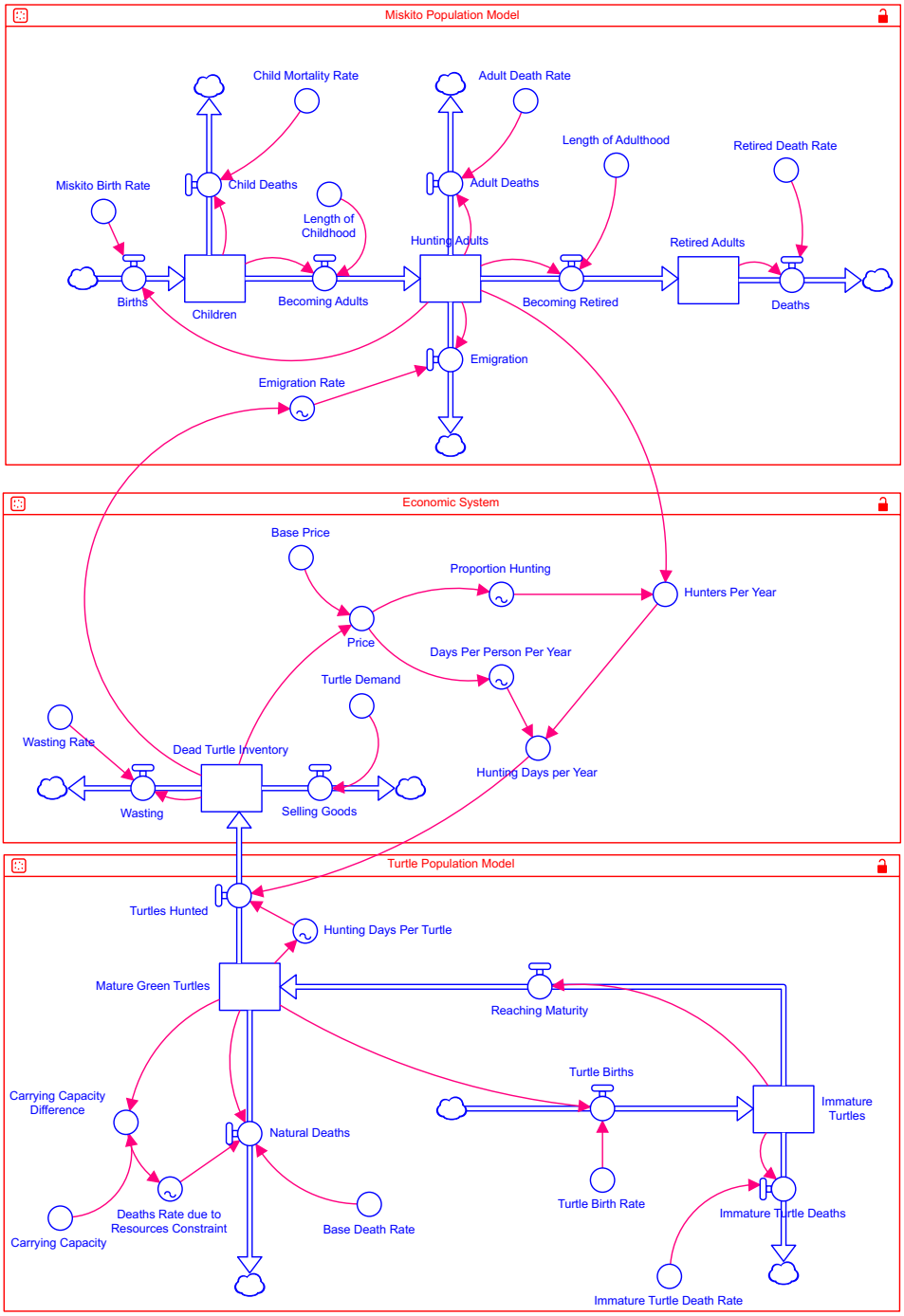

Figure 2 Final Model. This figure shows a screenshot of the complete model of the Miskito society. The model is divided into three main sectors, the Miskito people population model, the green turtle population model, and the economic system that links the two.

Results

Baseline model results capture the dynamics described in Nietschmann's paper. As shown in the set of graphs in Figure 3, introducing an increased global demand of 10,000 turtles between 1965 and 1970 leads to severe effects on the economic and social well-being of the Miskito people. The main dynamic of the model is driven by over-harvesting and the subsequent shortage of communal goods available for public consumption. In 1982, the population of turtles decreases below 2,000. At this point, the Miskito can no longer hunt enough turtles to maintain the steady state number of communal goods.

As the difference between the desired number of communal turtles and the actual stock of communal turtles grows, price rises, and the Miskito exert increasingly more hunting pressure on the coastal turtle population. In the short term, increased hunting moderates turtle supply pressures. However, because increased hunting drives down the stock of mature turtles, births are depressed. As a result, even with higher prices and more hours allocated to hunting, the number of turtles hunted per year can cannot keep the stock of communal goods stable.

By 1983, the population of turtles numbers less than 200, and the price continues to accelerate upwards. The emigration rate closely mimics the rise in price. As the level of communal goods decreases to below the steady state level, the immigration rate also accelerates higher. In the current iteration of the model, the emigration rates and prices reach a ceiling in 1983, that represents an inevitable collapse of the global demand for Miskito hunting of green sea turtles, due to the Miskito's decreased ability to hunt turtles. Because Nietschmann's study ended in 1979, the model is not intended to forecast the future of the Miskito hunting dynamics in through the middle-to-late 1980s.

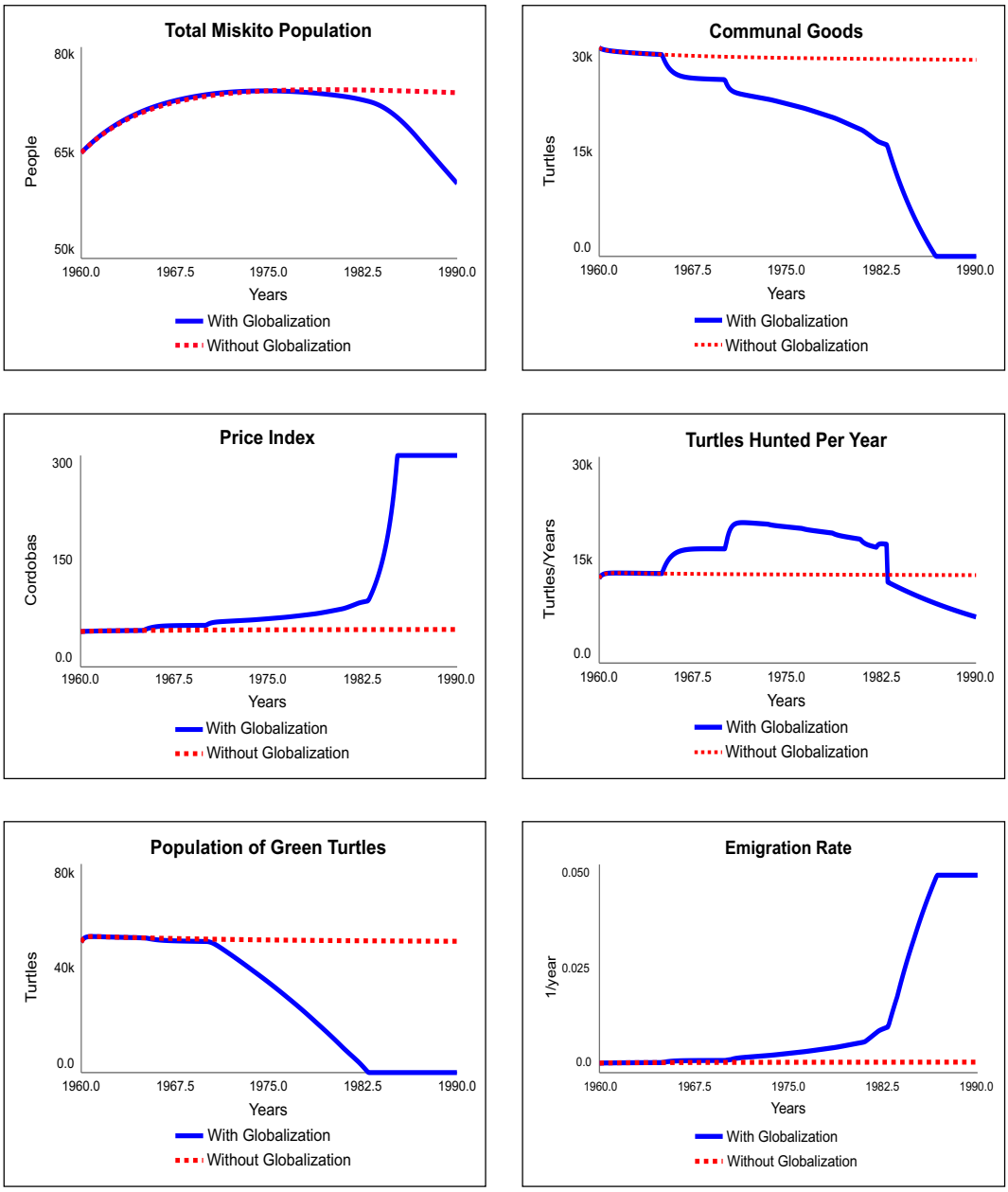

Figure 3 Model Results. This collection of figures displays the results of running the Miskito economic and social model at steady state ("Without Globalization," denoted by red dotted lines, exporting 1,500 turtles per year) in comparison to the model after globalization has occurred ("With Globalization," denoted by blue lines, exporting 15,000 turtles per year).

Conclusion

Implications for the Miskito People

The model, based upon Nietschmann's original description, appears to capture accurately the observed dynamics of the Miskito people and the overhunting of green sea turtles. Consistent with Nietschmann's description, the sea turtles are hunted nearly to extinction, even as the time required to kill each turtle increases three-fold. In addition, the emigration dynamics mirror Nietschmann's reports very closely. Nietschmann reported that 25% of hunting-aged adults left the community during the observed time-period. The model predicted an emigration of around 30% of the hunting-aged population.

Although the model is useful as a tool to validate Nietschmann's description of the dynamics surrounding the Miskito turtle trade, the model enables us to go further. An advantage of applying system dynamics to geography, is that it allows for the creation of counterfactuals. In this case, the model predicts that up to 3,500 turtles could have been exported each year, before the detrimental effects of over-hunting would affect the green turtle population.

At the level of 3,500 turtles per year, emigration hovers near zero, the stock of communal goods stays stable, and the price of sea turtles also stays steady near the pre-globalization price of 50 córdobas per turtle. Exporting more than 3,500 turtles a year means killing turtles at a pace faster than the natural replacement rate. Anytime there are more turtles killed than there are replaced, there is a real risk of entering a reinforcing feedback loop, resulting in the detrimental effects triggered by globalization.

Nevertheless, this model does not suggest that globalization is always a net-negative influence on indigenous communities. The results of this model suggest that the Miskito

people could have harnessed the increased wealth brought upon by global markets, while maintaining the social safety network afforded by the sharing of communal goods. Several policy levers could have curtailed the impact of globalization, such as a tax on turtle hunting or a quota system that limited the export of green turtles to 3,500 per year.

Implications for Geography as an Academic Discipline

The success of recreating Nietschmann's model in system dynamics software showcases the multiple benefits that can be realized through the combination of systems thinking and geography. This combination allows for the testing and evaluation of mental models described in geography papers, many of which were written before computers were widely available. In addition, creating system dynamics models enables geographers to offer solutions to problems, not just descriptions of them. In addition, the benefits of creating geographical systems models comes from creating the model. In the process of turning a mental model into a working system dynamics model, one is forced to more rigorously evaluate the assumptions and feedbacks inherent in the system. Creating working models allows for a deeper understanding than could be gained from describing a situation through words alone. Ultimately, the combination of the descriptive richness of qualitative methods and the rigor of quantitative modeling allows for synergistic benefits that could not be realized by using qualitative or quantitative methods alone.

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