



# Modernization of artisanal fishing communities on Andros Island, The Bahamas, as a treadmill of production

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## ABSTRACT

Globalization and modernization have driven drastic changes in communities dependent on natural resources. Yet the impacts on resources and local well-being vary widely, with positive outcomes often linked to ecological modernization theory and negative outcomes often linked to treadmill of production theory. We contribute to this literature with a qualitative case study of Bahamian fishing communities which underwent rapid modernization during the latter half of the 20th century. We interviewed 31 fishers on Andros Island, ranging from 49 to 90 years in age, about how they experienced modernization. Participants identified consequences of modernization consistent with treadmill of production theory, including economic system restructuring, introduction of new technologies, increased market demand for natural resources, environmental degradation, and a struggle to maintain quality of life. They identified international tourism, market demands for fish, and employment opportunities outside the island as primary drivers of change and expressed both positive and negative attitudes towards the consequences of modernization. Local fishers described modernization as incorporating elements of world systems theory and telecoupling, including 1) the economic expansion of the country's capital and most densely populated city, Nassau, coming at the environmental and economic expense of Andros, and 2) the introduction of diving as a key fishing method based on practices adapted from international tourists. Participant's accounts of modernization were not consistent with ecological modernization theory but may reflect some elements of this theory in the future in association with the rapid expansion of higher education opportunities on Bahamian "family islands."

## 1. Introduction

The impacts of globalization and modernization have promoted drastic changes in many natural-resource dependent communities across the world. Human migration, international trade, and global market integration have all increased connectedness between previously isolated ecosystems and communities (Adger et al., 2009; Lambin and Meyfroidt, 2011; Raya Rey et al., 2017). Global development and the use of technology have impacted the extent of how both ecological and economic changes can affect various types of communities (Held, 2000; Liu et al., 2013). Key impacts on natural-resource dependent communities include the migration and displacement of people from rural areas to cities, overuse of agricultural land to meet the rising demand for crops, increased social separation between the rich and poor, increased

susceptibility to natural disasters, and reduced availability of social services (Adger et al., 2009; Lambin and Meyfroidt, 2011; Liu et al., 2013; Raya Rey et al., 2017). Some communities are more susceptible to marginalization because they face both economic difficulties associated with transitioning economies, as well as harsh environmental conditions (O'Brien and Leichenko, 2000). For instance, the Mexican agriculture industry faced both severe droughts and increasing temperatures, alongside increased economic competition from imports (O'Brien and Leichenko, 2000).

The environmental and social effects of the forces of modernity are variable and contested by scholarship rooted in different theories of modernization (Fisher and Freudenburg, 2001; Grossman and Krueger, 1995; Schnaiberg, 1980; Spaargaren and Mol, 1992; York et al., 2003). The more favorable perspectives often rely on ecological modernization

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theory. This theoretical perspective suggests modernization and increased technological development promote solutions to environmental problems and encourage adjustment of production processes towards sustainability (Fisher and Freudenburg, 2001; Grossman and Krueger, 1995; Spaargaren and Mol, 1992). Ecological modernization theorists also tend to view changes required to achieve environmental sustainability as economically and politically feasible, if not likely among developed nations (Fisher and Freudenburg, 2001; Longhofer and Jorgenson, 2017). Ecological modernization often includes governments enacting environmental policies, increased awareness of the impacts of consumption, adoption of new environmentally conscious technologies (e.g., solar panels) and social movements to bring public attention to environmental problems (Fisher and Freudenburg, 2001; Longhofer and Jorgenson, 2017; Mol, 2010; Mol and Sonnenfeld, 2000; York et al., 2003). This theory seems most relevant in locations such as the Netherlands and Japan that have emerging policies encouraging environmentally positive actions (Fisher and Freudenburg, 2001). Social stratification within developed and less developed countries and the influence of “world societies” and non-governmental organizations that engage the public by encouraging environmental activism, however, are difficult to account for within ecological modernization theory (Sanderson, 2018). This variability in theoretical fit highlights a need for case studies in new contexts, and larger meta-analyses of multiple nations (Fisher and Freudenburg, 2001; Longhofer and Jorgenson, 2017; Sanderson, 2018).

Less optimistic perspectives of modernization are typically rooted in various political economy approaches, which posit that exploitation of natural resources is a direct result of market economies, institutions of modernity, and the demand for constant growth in the modern capitalist production system (Buttel, 2004; Gould et al., 2004; Roberts and Grimes, 2002; Schnaiberg, 1980; Schnaiberg et al., 2002). Perhaps the best-known perspective, treadmill of production theory, was described by Schnaiberg (1980). This theory, which has both sociological and environmental aspects, states that modern societies are on a ‘treadmill’ requiring ever faster exploitation of the environment to achieve enough economic growth to ensure the same level of well-being for society (Buttel, 2004; Gould et al., 2004; Schnaiberg, 1980). Environmental degradation ultimately hurts the people in these transitioning societies, particularly the communities most reliant on natural resources such as agriculture and fisheries (Gould et al., 2004; Konefal and Mascarenhas, 2005; Longhofer and Jorgenson, 2017). Although globalization and modernization of economies can provide benefits including employment opportunities, modernity can also be detrimental to the ecological well-being that a community may depend upon (Adger et al., 2009; Austin, 2012; Eakin et al., 2009; Schnaiberg, 1980). World systems theory expands upon treadmill of production by asserting “core nations” are the main producers and consumers in the global economy, whereas smaller less developed nations, termed “peripheral nations”, are where the waste of production from core nations is concentrated (Burns et al., 1994; Roberts and Grimes, 2002; Wallerstein, 1974). These two theories are complimentary in that, the negative environmental impacts generated by an economic system under the treadmill of production are concentrated in less developed/developing periphery nations, rather than within the core nations who are more integrated into modernized and pro-environmental society (Longhofer and Jorgenson, 2017).

Case studies evaluating these theoretical models of modernization were criticized for not being representative, and this may highlight another important direction for research. Specifically, there is a need to understand how the people experiencing modernization choose to represent the process in relation to these major theories of social change (Foster, 2005; Longhofer and Jorgenson, 2017; Spaargaren and Mol, 1992; York et al., 2003). Most research in this domain adopts an etic (outside expert; Lincoln and Guba, 1985) perspective (Mol and Sonnenfeld, 2000). This tendency is reasonable since local people transitioning to modernity likely do not share jargon and theory with researchers, and because local people may not view modernity in terms

of ecological footprints and lifecycle analysis. Additional studies adopting an emic (insider viewpoint; Lincoln and Guba, 1985) would be a valuable contribution to current research because they may offer a less paternalistic view on the impacts of modernity, and offer novel insights by prioritizing concepts and concerns less likely to be established a priori by an outsider (Ahmadvand and Karami, 2017). Additionally, emic studies improve the ability to understand, communicate with, and assist locals during development initiatives and programs. Conservation efforts such as Marine Protected Areas (MPAs) are sometimes not widely perceived as beneficial by locals because they are experienced as foreign impositions on local processes that too often do not sufficiently consider locals’ perspectives (Wise, 2014).

In this paper we describe an emic qualitative study of how members of artisanal fishing communities on Andros Island in The Bahamas viewed rapid modernization, and the degree to which their perspectives coincided with prevailing theories of modernization including ecological modernization, treadmill of production, and world systems theory. Andros Island represents a good case study because residents living on the island during this study experienced rapid modernization during their own lifetimes, and livelihoods of the local people were, and are, driven by fisheries (Hayes et al., 2015; Silvy et al., 2017). Although no research we are aware of has addressed modernization in this region, participants from previous studies on illegal harvest of marine resources (Silvy et al., 2017) and ecotourism (Hayes et al., 2015) suggested rapid changes in livelihoods had occurred during the lifetime of many residents. Qualitative research exploring impacts of modernization from insider perspectives in other regions highlight important patterns: individuals alienated from natural resources (Gutiérrez-Montes, 2005; Jones, 2012; Little, 1999; Serenari et al., 2017), rising conflict within and between communities (Little, 1999), declines in subsistence-focused livelihoods such as farming (Holmes, 2013; Little, 1999), and the separation of communities from culturally significant lands (Little, 1999).

## 2. Methods

Residents of Andros experienced a history of colonialism followed by a brief but rapid period of modernization. The Lucayan people first occupied Andros Island in approximately 500 A.D., and relied on marine resources for survival (Keegan, 1985). The Lucayan people were completely eliminated within 25 years of Christopher Columbus’s arrival in 1492 (Craton, 1986). The last Lucayan’s died while being forced to dive for pearls just north of present-day Venezuela. In 1670, the Lord Proprietors of the Carolinas rented the islands which today constitute The Bahamas from King Charles II (Craton and Saunders, 2000) and by 1810, most residents were enslaved Africans (Craton and Saunders, 2000). Although slavery was abolished in 1834, it shaped the dispersal of wealth, resources, and power throughout the archipelago (Craton and Saunders, 2000; Silvy et al., 2017). The Bahamas received independence from Britain in 1973, but that independence did not correspond with local or representative power over governance. The Bahamian government was reorganized as a constitutional parliamentary democracy with three government branches, and based on the Westminster system. The executive branch includes a queen appointed governor-general and a prime minister whose political party controls the majority of the seats in the House of Assembly. The legislative branch consists of the 39-member House of Assembly and 16-member Senate. House of Assembly members are elected and Senate members are appointed by the governor-general with advice from the prime minister and leader of the opposition party. Justices are appointed by the governor-general and jurisprudence is based on English common law. Local government policy is administered by 32 local government districts controlled by the Ministry of Transport and Local Government (Meditz and Hanratty, 1987). This resulted in ‘family islands’ with relatively small tourism industries, including Andros, exerting limited influence over Bahamian politics and associated resource allocation (Craton and Saunders, 2000).

Andros experienced rapid changes in land use designations during the 20th century. In 1959 The Bahamas established the first marine protected area in the Caribbean, The Exuma Cays Land and Sea Park, and have since been rapidly expanding their protected area network. Also in 1959, The Bahamas National Trust (BNT), a non-governmental organization formed by the Bahamian Parliament, was established to manage and develop The Bahamas National Park System. Examples of issues BNT members address include establishing management practices to remedy the degradation of coral reefs, declining fisheries, and wetland destruction within The Bahamas. In addition to the BNT, The Bahamas Department of Marine Resources (DMR) is also tasked with protecting marine ecosystems and is in charge of enforcing all fisheries regulations. The DMR is the primary management agency for a number of marine protected areas throughout The Bahamas. Through the BNT's and DMR's conservation efforts, they have increased the amount of protected marine and terrestrial area throughout The Bahamas, and as of 2019, the total amount of BNT-managed protected areas on Andros and in surrounding waters totaled over 628,000 ha, with an additional 38,620 ha of protected marine and terrestrial area waiting to be assigned a management agency (The Bahamas National Trust et al., 2018).

Residents of Andros experienced modernization in unique ways, but dependence on marine resources was a common theme for diverse groups including landowners, slaves, and descendants of Black Seminoles who escaped US government persecution in Florida by paddling dugout canoes to Andros in 1823 (Craton and Saunders, 2000; Howard, 2006). The latter group adopted local practices of fishing and sponging and persisted on the west coast of Andros for nearly a decade before they were discovered by the British government (Howard, 2006). Other residents on the island were granted freedom and citizenship but were not granted arable land at the same time. Periodic efforts to convert limestone bedrock to 'soil' have been sponsored by the Bahamian government (Young, 2013), but high dependence on fisheries persists.

Mass tourism did not begin in The Bahamas until the 1950's and 1960's. The availability of commercial international flights made The Bahamas a popular destination. Tourism in The Bahamas was further bolstered by cruise ship travel, and by 1990 The Bahamas was receiving over 3.5 million tourists per year with expenditures exceeding \$1.3 billion dollars (Palmer, 1994). The tourism boom of the 1960's pushed expansion of basic infrastructure including water, electricity and telephone services to many islands. This prompted the creation of The Bahamas Telecommunications Corporation, known as BTC since 2002, and resulted in all family islands having access to landline telephone service by 1980, followed by cellular telephone service becoming available in the capital city of Nassau in 1989. In 1997 internet service, known as BaTelNet was introduced to Grand Bahama and New Providence islands via the Bahamas 2 underwater communications cable. In the mid-2000's a new fiber optic cable connecting Andros to other Bahamian islands, facilitated the introduction of DSL internet and GSM cellular service (BTC, 2014). The Bahamas Electricity Corporation supplies electricity to 85% of Bahamian consumers primarily through a system of independent grids supplied by diesel generators, although Nassau has a natural gas turbine power station (Karagiannis et al., 2012).

Changes in government and economic structure had little impact on the population size and density of Andros. Between 1953 and 2010 the population on Andros was stable, only changing from 7,136 individuals to 7,490 individuals, and population density remained consistent at 1.2 people per square kilometer. However, the percent of all Bahamians living on Andros decreased from 8.41% to 2.13%, highlighting the declining political power of Andros. The sex ratio throughout the Bahamas, and on Andros, also changed during this time period. In 1953 Andros had a female-biased sex ratio, with 87 males for every 100 females, but as of 2010 the sex ratio is approximately 50:50, with 101 males for every 100 females. As of 2010, Andros demographics reflected a young population with 56% of residents under the age of 35, and 79% of adults completing at least secondary school (7–13 years of education;

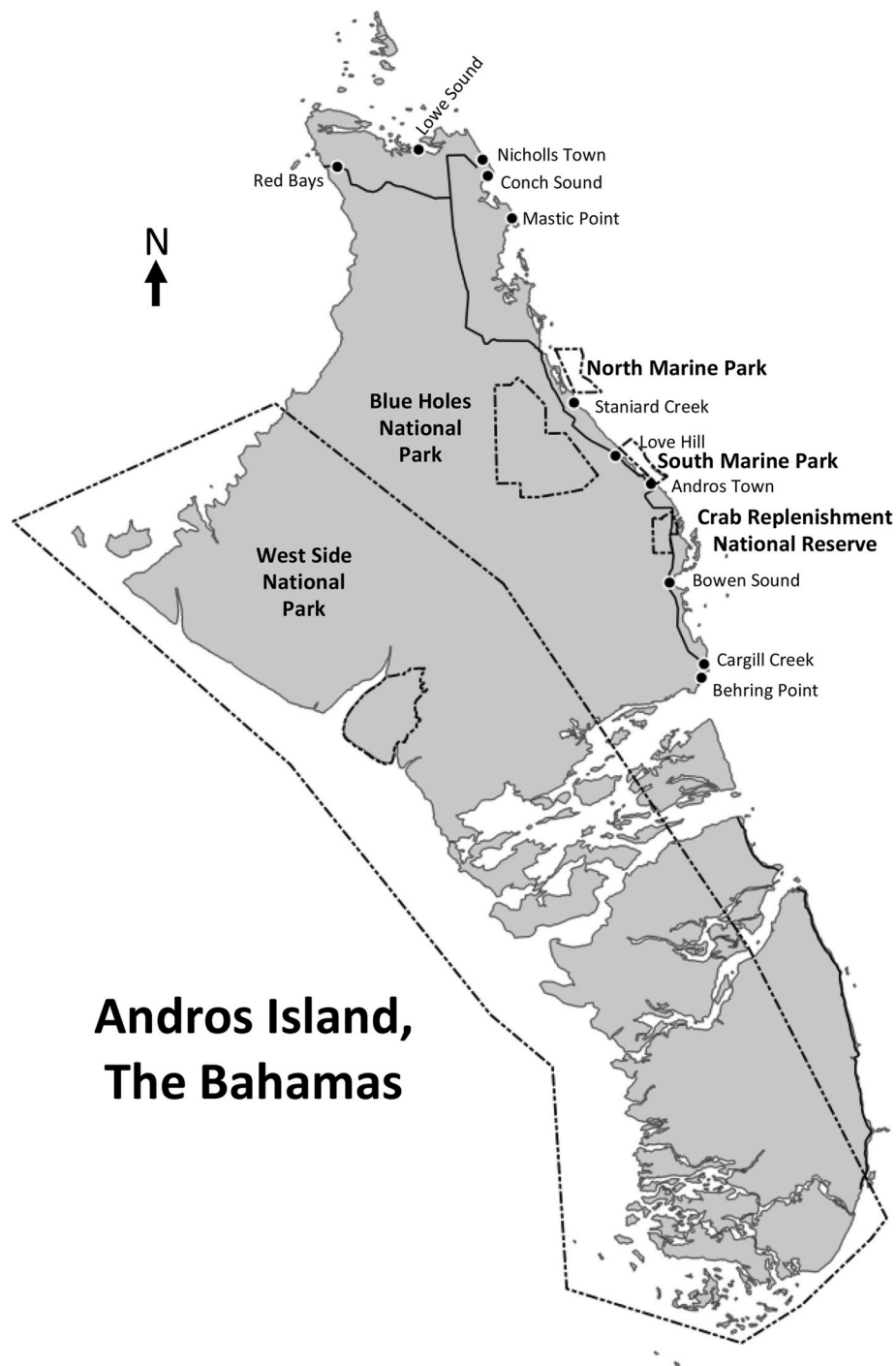
The Commonwealth of The Bahamas, 2012).

### 2.1. Interview methods

We used a qualitative approach to investigate the perceived impacts of modernization on Androsian artisanal fishing communities within the latter half of the 20th century (Lee Jenni et al., 2012; Lincoln and Guba, 1985; Silvy et al., 2017). This approach allowed us to develop an understanding of modernization without accidentally leading participants with pre-specified constructs. We used snowball sampling (Lee Jenni et al., 2012) to find residents in each settlement who had lived there long enough to remember the modernization process on Andros. We began sampling in each settlement by asking participants from previous studies (Silvy et al., 2017) to help us find a community member "old enough to remember what Andros was like when people still used handmade sailboats for fishing." We interviewed 31 local artisanal fishers ranging from 49 to 90 years old from 11 settlements: Bering Point (n = 1), Bowen Sound (n = 3), Cargill Creek (n = 3), Conch Sound (n = 3), Fresh Creek (n = 2), Love Hill (n = 4), Lowe Sound (n = 3), Mastic Point (n = 4), Nichols Town (n = 1), Red Bays (n = 1), and Staniard Creek (n = 7; Fig. 1). This age range reflected the aforementioned snowball sampling approach. All interviews were conducted in May and June 2018. We supplemented interviews with field notes (Silvy et al., 2017).

The semi-structured interviews began with seven open-ended questions that allowed the participants to share their personal accounts and opinions concerning artisanal fishing and how it changed over their lifetime (Table 1). The questions were designed to illicit information about three broad themes: what modernization changes were experienced, drivers of change, and attitudes toward the changes. The interviews lasted between 10 min and 2 h. Interviews were recorded on an audio-recording device and transcribed. Each transcript was then reviewed and coded. We employed an iterative review process as we completed interviews to identify and pursue themes as they emerged among respondents. Subthemes were identified based on repetition within and across interviews. We then systematically organized the data into themes and then subthemes by grouping similar quotations and observations together (Draucker et al., 2007; Shellabarger et al., 2012).

We identified 22 subthemes that were aggregated within the three overarching themes contained within the interview guide: modernization changes, drivers of modernization, and attitudes towards modernization (Table 2). Two researchers coded the interviews separately to facilitate assessing inter-coder reliability. We calculated percent agreement for each subtheme and used Cohen's kappa statistic to test inter-coder reliability across all coding categories (McHugh, 2012). Cohen's kappa values range from 0 to 1, with values above 0 representing varying levels of agreement. Traditionally, values from 0.6 to 0.79 are considered moderate agreement and values 0.80 and above are considered strong agreement; however, these ranges do change based on field of research (McHugh, 2012). Interpretation of intercoder agreement is similar, but it can be calculated with smaller sample sizes than Cohen's kappa. For sections with low intercoder agreement, we only present and explain quotes where both coders were in agreement. Low intercoder agreement was rare, and largely occurred within the Attitudes Towards Change theme due to low sample size for sub-themes and high topic overlap between subthemes (Table 2; e.g., declining fish abundance and increased dependency). Quotations from interviews were labeled and referenced with the initials of the pseudonym used for the participant. Quotations from field notes were labeled with the initials and "Field Notes," and notes from the field notes were referenced as field notes (Silvy et al., 2017). Pseudonyms were used so the identities of the interview participants were not connected with their quotes as required by an Institutional Review Board for research with human subjects (IRB: 12976).



**Fig. 1.** Map of Andros Island, The Bahamas. Settlements, national parks (boundaries denoted in dotted lines) and major roads are displayed.

### 3. Results

Participants described rapid modernization starting in the early 1960s and largely complete by the late 1980s. They described modernization as a transition, shifting from self-sufficiency rooted in fishing and gardening to a system reliant on providing fish to global markets, largely through the tourism industry in Nassau. Gardening was largely eliminated, whereas fishing underwent wholesale changes from use of handmade sail and sculling boats (Fig. 2) to imported motorboats, and from handmade fishing implements deployed from the surface to imported gear often used while diving. Participants had mixed opinions about impacts on well-being ranging from negative (e.g., decreasing

community solidarity, encouraging children to abandon the island) to positive (e.g., providing children opportunities to choose their future livelihoods).

#### 3.1. Modernization changes

Primary fishing methods evolved from harvesting species from the surface using handlines, hooked staves, and nets, to a heavier reliance on diving. Prior to the 1960s and 1970s, Andros fishers typically hooked conch (*Strombus gigas*) from their boats. Sid, a fisherman from North Andros, said, “to get conch, they used a thing with two hook, a staff and grab the conch and hook them and pull them in the boat” (S.B.). When

**Table 1**

Prompts used to interview elder artisanal fishers on Andros Island, The Bahamas between May 22, 2018 and June 4, 2018, and overarching themes typically emerging from each prompt.

Prompt	Theme emerging from prompt
When is the earliest time you remember people fishing here?	Modernization changes
How did people in this community go fishing when you were a child?	Modernization changes
What did people here do with the fish they caught?	Modernization changes
How has fishing changed since you were a child?	Modernization changes
When did people start ___? (answer to previous question)	Drivers of change
Why did ___ change happen?	Drivers of change
Was ___ change good or bad? How so?	Attitudes toward change

asked how conch was harvested today, eight participants said they mainly dive for it now (Table 2). One resident said, “with conch, guys dive for conch ... now they do most of the diving” (A.H.). According to 18 participants, crawfish (*Panulirus argus*) were also harvested from the boat before the transition period, but fishers used two different types of staves instead of one (Table 2). Barry, a man from Nichols Town, said, “They have like a net on a pole. They call it a bully. They have a rod and they tickle it, and they have the crawfish crawl out of its hole. They start with the one without the net and throw it over there and take it out. They didn’t know anything about spearing them” (B.N.). Most of the participants we spoke to said fishers started diving for crawfish after the 1970s, but one resident from Lowe Sound said they also adopted lobster traps during this period. He said, “Oh it’s changed a lot! You find out the guys don’t use the bully no more and the probe no more ... you get special traps, the same traps they use for the stone crab, they use that too for the lobster” (N.L.). There were a number of methods that they used to catch scalefish prior to the transition period. Mary, a shop owner in Staniard Creek, said the main method “was all line fishing. Not with rods but with line. You throw the line and you pull it” (M.S.). They also used different equipment, one participant from Conch Sound recalled, “you fished with a line, at that time you fish with a cotton line. Cotton line, but now these days they got nylon ... and ain’t got no reel or rod” (E.M.). A woman from Bowen Sound mentioned another method similar to persistence hunting where, “we used to run them down ... we used to run them down. Was a lot of young mans here at that time, and we’d go out on the bank, we’d see a school of boxfish, we’d choose which one we’d want to catch, and we’d run him into the shallow water. From there we’d catch him” (P.A.). Another method called chopping was described by a man in Love Hill, who said, “when we don’t wanted to go there with fishing line to fish, we would get a torch out of the forest, we’d snag it and lit it at night, low tide. We would go out in the low waters, the night must be dark. And once you out there with a torch, holding it up, the fish is asleep. You’d have a machete with you, and that’s what you hunt them with. You can just walk, the fish right there and he’s not moving ... Just hit them with a machete” (F.H.). Many of these methods were abandoned after the transition period in favor of diving with a fish spear or fishing with commercially produced hooks and line.

Participants reported a transition from sailing or sculling in handmade wooden boats (Fig. 2) to using imported fiberglass motorboats. One participant from Bowen Sound described the transition, saying, “back in 1965, we go from the sculling boat to the motor boat” (B.P.). Another participant recalled how sculling was a major means of transport, especially for spongers and fishers, “Yeah scull all the way to the reef, that come easy to Andros. That’s all we know about. You know we used to go sponging, in that day you go in the boat you gotta scull, ain’t got no engine or anything like that. And so we used to scull out to the reef, and then we would catch our fish in time to come in. Then we scull back in” (D.S.). Participants also identified sailing as a common means of transportation prior to introduction of motorboats. One participant from

**Table 2**

Themes, subthemes, and their frequency of occurrence, identified through participant quotes. Intercoder reliability is assessed through the agreement percentage between two independent coders and Cohen’s kappa statistic.

Combined Quotes Table			
Themes & Subthemes	Number of Quotes	Number of Participants with Relevant Quotes	Intercoder Agreement
<b>Modernization Changes</b>			
New fishing methods & technologies	146	29	88%
Fewer inshore fish	48	23	65%
Growing dependence on imports	21	9	86%
Individualistic lifestyles	21	12	81%
Higher risk fishing	1	1	-
More alternative livelihoods	10	9	80%
<b>Drivers of Change</b>			
Exposure to diving	50	24	78%
Declining fear of sharks	15	11	66%
Access to alternative jobs and higher education	7	5	100%
Children choosing not to garden and fish	4	3	100%
International poaching	5	2	80%
Market economy	16	12	71%
Growing market demand for fish	22	14	55%
Introduction of motors & fiberglass boats	15	14	93%
Buying groceries & fuel	5	4	60%
<b>Attitudes Toward Change</b>			
Changing Fishing Methods – Positive Perspectives	4	3	67%
Changing Fishing Methods – Negative Perspectives	32	18	81%
Declining Fish Abundance – Negative Perspectives	7	5	15%
More Dependent Lifestyles – Positive Perspectives	1	1	-
More Dependent Lifestyles – Negative Perspectives	4	4	25%
More Individualistic Lifestyles – Negative Perspectives	1	1	-
Alternative occupations – Positive Perspectives	1	1	-
<b>Cohen’s Kappa</b>			
Kappa Value: 0.7659	Std. Error: 0.0198	Lower 95%: 0.7271	Upper 95%: 0.8047

Bowen Sound recalled, “First we put a little sail on it if we going out far, and you sail out until you get where the fish is, then you take your sail and your mast down. Then you use your oars and your scull arms, whatever, until you’re ready to come back in. When you come back in, you put your sail back up and you sail back into the shore” (P.A.). When we asked about the first engines that the locals used, Sid said, “We had a little engine on the boat, the Seagull ... Yeah, we had those we used to use, they ain’t no fast” (S.B.). John, a fisherman from Conch Sound, spoke about later engines, saying, “They put them (Seagulls) on the little small boats. And after that they had some bigger ones that come like made in America, that we call Johnson. You know Johnson have been around for years. And the next one called the Evinrude, they been around for years. And then the men started buying them and putting them on the back of their schooners (handmade wooden boats; Fig. 2). So when the weather’s calm they can still get to Nassau with the conch”



Fig. 2. Two examples of locally made wooden boats that were replaced by imported fiberglass vessels during modernization on Andros.

(J.M.). Participants noted that wooden boats are no longer built or used for fishing, instead imported fiberglass boats have taken their place. One participant from Love Hill said, “All the wood vessel gone, you use motor boat. The boat they making now, Boston Whaler, they don’t sink” (L.H.).

Participants perceived a decline in shallow water fish populations throughout the 1960’s and 1970’s modernization period. Approximately half of the participants described the shallow waters close to shore as previously teeming with scalefish, crawfish, and conch (Table 2). As one resident put it, “you could stand on the edge along the shoreline here, and as far as your eyes could behold you could see crawfish, lobsters by the millions” (S.F.). Participants complained of a general decrease in fish abundance around the island. Herbert stated, “there’s not as much fish as there used to be. I remember that growing up, we go out there, we used to walk out to the beach and get as much crawfish as you can take” (H.F.). This perspective was widespread. A pastor from Bowen Sound said, “the fish was so thick, and there was so many ... you could go anywhere fishing, and catch what you want ... but now the divers have to go to 10, 11 shoal to catch the fish” (P.A.). Seth recalled the drop in grouper (*Epinephelus striatus*) numbers at a nearby cay, saying, “The grouper school, the Nassau grouper, at a big cay called High Cay, you could go over there and see millions in cays like that. Now today you have to close the season because there’s hardly any anymore. They just about depleted” (S.F.). Ralph lamented the loss of conch in shallow waters, saying, “you can’t even find the conch which the people like so much out there. Maybe you’d get 100 if you go down ... but now you can’t find none” (R.W.).

Participants also perceived a shift from growing and catching most food to purchasing imported food items at local grocery stores. Multiple participants noted that, prior to the 1960s and 1970s, families grew most of their food (Table 2). Walter, the owner of a hotel in Staniard Creek, described past gardening, saying, “well basically they just have to buy like can goods because they grow most of their foods ... Most of the other food they just grow” (W.J.). Walter went on to describe some of the crops they grew, saying, “they always had a backyard farming garden ... like tomatoes, carrots, sweet peppers, cassava, eddoe, yam” (W.J.). Andrew, from Cargill Creek, agreed with this notion of self-sufficiency, saying, “You growing everything, you catching the fish, you got your library and your school and, you got everything, the way of life” (A.C.). This practice of sustenance from farming combined with fishing was described as disappearing during the transition period. One resident said, “they get grocery anything they get” (R.R.) and another said, “Now if I need something I have to go buy it” (B.M.).

Many participants were under the impression that the changes in fishing coincided with a change in attitude from a community-focused lifestyle to a more individualistic one. Twelve residents said, prior to the transition period, people frequently gave meals to those that needed

them (Table 2). Walter described how, “we never used to really sell the fish to each other ... if the boats go out when they come back, the neighbors who didn’t have a boat to go, they just send them a meal of fish ... we made sure everybody get fish” (W.J.). Alison, from Bowen Sound, said the community focused lifestyle changed over the years, saying, “He meet you as a friend, then when you see him while he fish, he say ‘Do you want some fish?’ And they’d say ‘Yes, I’d love some fish.’ He just give it to them. But now, the people now then, if they ain’t got the (money; making a hand gesture indicating money) then you don’t get none. So plenty changes, plenty changes” (A.W.). At least one respondent linked this shift to increased pressure to catch enough fish to pay for modern fishing equipment. David, a preacher from Stafford Creek, stated, “Well, now when they go fishing they have to buy gas, oil, and their time. So when they go fishing they gotta sell those fish for them to cover their expense what they paid for gas, etc.” (D.C.).

Participants believed opportunities for livelihoods outside of fishing increased during and after the transition period, but believed those opportunities were elsewhere and drove emigration among the younger generation. Walter said these opportunities started with increased access to education, stating the government “built a tech school on San Salvador and people could go to SS teacher’s college for higher learning and things took off from there” (W.J.). Other opportunities were created in the tourism industry, particularly for fishing guides. Rick, the owner of a fishing lodge in Bering Point, said, “when I first started diving, I left school very early, I left grade school very early and went into trade. I did that for a year, then I learned that they were making \$20 for a 6-day week as a salary. And then I heard that they were training guides and paying them \$31 a week. So I quit doing carpentry and went into guiding. I did that for 6 years, was able to pay my way through school” (R.A.).

### 3.2. Drivers of modernization

Participants believed modernization on Andros during and after the 1960s and 1970s occurred due to new ideas, economic pressures, and technologies spreading from Nassau and international tourism. Most participants described diving for fish as becoming common after foreign tourists introduced locals to diving and associated equipment (Table 2). Participants also believed tourism helped dispel fear of sharks that prevented many fishers from diving prior to that time. Participants believed tourism created strong market pressure to harvest fish, conch, and lobster and the introduction of motors to Andros allowed fishers to reach deeper fishing grounds further away from shore (Table 2). Lastly, as Nassau commercialized, participants viewed the city as a source of alternative jobs, outside of fishing. Many viewed these jobs as easier than fishing and thus, more appealing to the younger generation.

Participants believed declines in fish abundance, particularly in nearshore shallow waters, promoted transitions to diving and motor-boats. Alison said people didn’t dive “because they didn’t have to do that because the fish, they were right at the shore” (A.W.). A participant from Bowen Sound elaborated, stating, “The fish was so thick, and there was so many, they didn’t really need to dive, you could go anywhere fishing, and catch what you want” (P.A.). Participants also believed fear of sharks among older generations limited development of diving-based fishing methods. Sid described how, “It was more like they scared to jump out the boat ... shark, barracuda. They fear their life, so they stay in the boat, they safe” (S.B.). Larry, a resident of Love Hill, gave a possible reason for this fear, saying, “the old generation never used to trust that mistake. They used to be scared of them sharks. They was around here rampant in them days because, every type of vessel was made of wood, the shark turned it over and the shark carried them” (L. H.). The interest in diving among the younger generation was also linked to engagement with American and British tourists during the 1960s and 1970s. When asked how she learned to dive, Alison said, “From the States, everything I learned was from people coming down from the States” (A.W.). Herbert, from Fresh Creek, explained how the younger

generation learned from these tourists, saying, “Well, a lot of tourists that I know, again a lot of tourists came here, and they have some stuff, anchor right up there down the shore, and sometimes they takes the kids with them in their boats you know, and the kids learn how to swim and to dive, that’s where it all started, you know” (H.F.).

Sid stated that, “I dive now I speed it up, I dive down, I throw (conch) up in the air, I come back up, that’s it ... I can get 3–400 conch in a few hours ... back then teachers make \$800 a month, I make that a week” (S. B.). Based on accounts from other fishers, the increase in earnings not only came from the faster harvest, but also from an increase in the price of fish. Eddy, a retired fisherman from Conch Sound, described how, “fish is more expensive now ... you could get anywhere from \$75 to \$160 dollars for one fish. In an hour you can make the amount of money you’d make in the whole week the old man way” (E.M.).

Participants described growing demand for fish from the markets in Nassau as driving the shift from sharing to selling fish and generating pressure to catch larger quantities. Tom from Mastic Point recalled how he “used to go to Nassau, I had a boat I used to fill and go to Nassau and I get paid for everything” (T.S.). Others confirmed that they did the same, saying that, “they do it on the large scale” (A.C.). Demand from Nassau increased during the transition period. Seth believed all the pressure from Nassau was due to “Supply and demand, they can’t get enough of it. People come from all over catching these things” (S.F.). He described this pressure to provide tourists fish on Nassau as the need to “feed the beast” (S.F.).

Participants believed modernization was self-perpetuating in some ways because pressure to pay for goods and new technologies created the need to use the same goods and technology. Sid described the pressure to return with a large catch saying, “you gotta pay your way, you gotta pay” (S.B.). John described the need to cover these new costs, saying, “So when they sell fish they gotta put the price of the fish to cover their expense” (J.M.). This aligns closely with how a participant from Stafford Creek described commodification of the fishing process, “So they have to sell them to cover their expense. Sometimes they don’t sell them to cover their expense, they don’t catch enough fish, so that’s not good ... You have to catch more” (D.C.).

The growth of tourism and increased access to higher education in Nassau were seen as a driving force behind why younger people decided to seek alternative careers outside Andros during this period. One participant recalled how, “during that time there was hardly anything to do, so you had to go fishing. There wasn’t nothing on North Andros during that time” (R.W.). A man from Love Hill said, when he became an adult, “I had 2 choices. Mother told me to go to Nassau, Nassau was the capital. Stay in the capital, find a job. Or, go fishing with the old man, the old man (was) fishing for a living” (L.H.). Walter said tourism boomed during the transition period, saying, “thousand tourists per annum, we had high rise hotels” (W.J.). Beth from Mastic Point said, “Everything change with the children all coming back from school yeah” (B.M.).

### 3.3. Attitudes towards modernization

Participants had mixed opinions about how modernization affected them. They shared both positive and negative opinions regarding changes to fishing methods and the decline of subsistence fishing and farming. Similarly, they viewed higher education and alternative livelihood options as beneficial, whereas they viewed some outcomes of the market economy, especially increased individualism, negatively.

John believed new fishing methods were harmful, he explained how, “they started using bleach and everything to get the crawfish from the hole, they killing the reef and when you kill the reef, the reef is more or less for the fish” (J.M.). The pastor from Bowen Sound agreed with this notion, stating, “we killing ourselves, like I said we kill all the big ones, we kill all the young one” (P.A.). Not everyone viewed the changes negatively however. One participant said, “I think right now it’s better. Because before you couldn’t get what you want, but now you can get

everything you want” (D.M.), explaining that the new fishing methods allow fishers to better target individual fish and specific species. Another participant from Love Hill also viewed the changes positively, saying, “I think in one way, it was good, and it actually increased the production and supply because um, it was easier to get the fish” (H.H.).

There were negative opinions about the transition from subsistence fishing and farming to relying mostly on groceries and imports. David stated, “The new way of life makes everything more complicated” (D. C.). Other respondents considered the loss of gardening as detrimental to neighborhood aesthetics. Walter explained that, “What had happened in the earlier years was there was not a home in this area without a garden. And the people, they were hospitable. And they were very nice people. And they all kept their garden nice and clean. And the community is dirty to compare with those days. Everyone took pride in the way they kept their home and their yard” (W.J.).

The switch from a community to an individually focused lifestyle was largely lamented by participants. Robert said, “Well I guess maybe the generation change and they come up with a different mind. But in those times people were loving, peaceful with each other, and if you ain’t got nothing to cook and I got something to cook, I will share with you. I know about that, share with you, I grew up in that time ... And you don’t hear about it anymore” (R.R.). Beth described how different the community is now, saying, “Mostly it like, nobody love, nobody care. We loved one another. We were all like a family. So when my mom do like the potato bread on Saturdays, everybody get potato bread and soups. Fish stew on Sunday mornings, and stuff like that ... you know it was just like a big family, now ... nobody care about nobody” (B.M.).

Many participants were unhappy with the increased financial risk imposed by the transition to a market economy. John said, “Now they got motor, and gas and oil and they going for 2 or 3 days, that mean they need food, they need water, and all these cost money” (J.M.). David complained about financial risks imposed by modern fishing, saying, “The new way of life makes everything more complicated, and faster, you want fast dollars so you gotta go fast, go far. And you make a good catch today, tomorrow you don’t make a good catch, today you can cover your expense, tomorrow you can’t but you still gotta go” (D.C.).

Most of the older participants we interviewed missed having their children around but were glad new alternative careers to fishing were available for their children in Nassau and abroad. Robert viewed the change as a natural progression of modernity, saying, “the modern world, yeah, the modern that change, the young people change, the modern generation take a different turn with life, you know, they wanna go, they want to do their own thing” (R.R.). Walter spoke of one of the first education reforms, describing how, “one of the first things they began was to educate the people and build schools all over the country” (W.J.). Participants linked establishment of higher education and economic improvements for the younger generation. Walter said, “they all had big homes and big time jobs over there ... we were able to do a whole lot. They created College of the Bahamas” (W.J.).

## 4. Discussion

Qualitative methods provide a unique opportunity to capture accounts of modernization in fishing communities from those experiencing it. Participants described modernization as including increased market demand for natural resources (fish), economic system shift, environmental degradation, and the introduction of new technologies, all of which are characteristic of treadmill of production theory (Gould et al., 2004; Schnaiberg, 1980). Participants most commonly identified the decline in nearshore fisheries as the clearest example of environmental degradation experienced by Andros fishers. While this decline was taking place, a multitude of new technologies and market forces transformed the Andros fishing economy from one focused on subsistence fishing to one driven by external demand. These changes led to the perception of substantial changes in community function. Specifically, as predicted by treadmill of production theory (Schnaiberg et al., 2002),

participants viewed modernization as increasing alternative employment opportunities, outside of fishing and off Andros, without improving the quality of life on Andros. Modernization also encouraged emigration of youth to urban areas, and left the older generation struggling to adapt to a market economy and increasingly dissociated from local natural resources (Bobić and Vesković-Andelković, 2017; Eakin et al., 2009). Although modernization pushed more capital through the Andros economy, this did little to increase the quality of life on the island. Participants believed the costs of living and doing business outpaced increases in personal income locally, also reflecting predictions of treadmill of production theory (Curran, 2017).

Participants highlighted elements of modernization reminiscent of world systems theory, but with a unique perspective where privileged regions within their own nation drove environmental exploitation in peripheral regions. In this case, New Providence, the island where Nassau is located, operated as a “core nation” driving resource exploitation on the family islands like Andros, despite both islands being part of the same nation politically. This modification of world systems theory seems reasonable when regions inside sovereign states operate as core or periphery areas driving and experiencing resource exploitation respectively. Within this framework we see how the benefits of modernity were concentrated in Nassau (e.g., relatively inexpensive seafood and labor) at the expense of Andros (e.g., overexploited fisheries). On Andros fisheries declined, families and communities were disarticulated, and livelihood risks increased. Our findings align with, and add to, a host of other studies suggesting expansion of the market economy leads to environmental exploitation and degradation in peripheral regions without major benefits for human well-being (Austin, 2012; Frey, 2003; Jorgenson and Rice, 2005; Longhofer and Jorgenson, 2017; Rice, 2007; Shandra et al., 2009; Smith and White, 1992).

Tourism may provide a particularly potent form of telecoupling when it shares modalities with local livelihoods. In its simplest form, telecoupling refers to interactions between human and natural systems facilitated by socioeconomic and environmental processes, sometimes across large distances (Liu et al., 2013). The introduction of new technologies and fishing methods (e.g., the boat motor and diving equipment on Andros) can be explained by this phenomenon (Liu et al., 2013; Raya Rey et al., 2017). In the 1960s and 1970s, the tourism industry in many Caribbean countries began to expand (McElroy and De Albuquerque, 1986), and the United States and Britain introduced new practices and technology to Andros. As Raya Rey et al. (2017) described, tourism is a major facilitator in the connection between two systems because it encourages the flow of people to less developed communities while also providing a new source of employment, income and profit. This telecoupling primarily occurred between the US, Britain, and Nassau and impacted Andros by creating a demand for labor and seafood, partially fulfilled by Androsian fishers and young Androsians in search of work. This telecoupling also spurred many changes highlighted by participants. Through telecoupling, tourists created a new demand for seafood in Nassau and at the same time introduced new fishing techniques focused on diving, which ultimately created large changes in Androsian fisheries and for the Androsian economy. In line with these findings, other studies have identified tourism and the transfer of technologies as specific telecoupling interactions through which agricultural, industrial, and technological products move (Liu et al., 2013, 2015). As seen through Andros’s modernization and in other studies, many of the negative socioeconomic and environmental consequences of telecoupling are concentrated in the receiving nation, for example, negative impacts to local fisheries and agricultural productivity and also negative impacts to human well-being (Liu et al., 2013, 2015; Yang et al., 2018).

Inadequate attention to law enforcement may partially explain why modernization on Andros was not experienced as ecological modernization theory would predict. Multiple participants noted declining fish abundance throughout the modernization period, and research supports local perceptions. Culturally and economically significant Bahamian fisheries including the queen conch, spiny lobster, and Nassau grouper

are in decline due to overharvest (Ehrhardt and Deleveaux, 2007; Hayes et al., 2015; Stoner et al., 2009; Stoner and Davis, 2010). During the same time period The Bahamas Department of Marine Resources (DMR), in partnership with The Bahamas National Trust (BNT), established several marine and terrestrial protected areas with the direct goal of protecting marine and terrestrial natural resources. Subsequently, the BNT and the DMR instituted policies that promoted long-term fisheries sustainability and harvest regulations within the marine protected areas; however, these policies were, and continue to be, frequently ignored (Silvy et al., 2017). This highlights a possible weakness of ecological modernization theory, where core regions within modernizing nations establish protected areas in peripheral regions where residents receive limited engagement, face limited enforcement, and exhibit limited compliance.

Although Andros’s past modernization did not align with ecological modernization theory, continued modernization of Andros, including improvements in natural resource enforcement and regulation compliance, may occur in the future. Similarly, ongoing educational modernization on Andros may shift current responses to modernization toward those predicted by ecological modernization theory. The Bahamian government was expanding The Bahamas Agriculture and Marine Science Institute (BASMI) on North Andros during this study. This expansion may increase environmental literacy and serve as a major employer on North Andros. These types of educational investments have the potential to lower exploitation rates of declining fisheries and generate support for marine protected areas among residents in the future (Leisher et al., 2012; Zorrilla-Pujana and Rossi, 2014). They also create a unique avenue for future research, investigating the modernization impacts of higher education systems, policy implementation, and policy enforcement.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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