DOCUMENTING CLIMATE CHANGE THROUGH ORAL HISTORIES: PERSP ECTIVES FROM ANGLERS ON 6 CONTINENTS

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Abstract - This paper utilizes the Montana State University Library's Angling Oral History Project and the over 200 interviews conducted with anglers in 40 plus countries around the world. Participants are asked about climate changes they have witnessed and the effects they have had on the waters, fish, and the environments they call home. Participants come from all walks of life and include anglers, politicians, commercial fishermen, aquaculturalists, fisheries biologists, authors, etc. In addition I will review scientific literature, including studies conducted by the Food and Agriculture Organization of the United Nations, in conjunction with the primary source information gathered through the interviews to present an overview of the effects of climate change on angling and what it means to humanity

Index Terms - Climate Change. Fisheries, Oral History, Water Quality

I. INTRODUCTION

According to the Food and AgricultureOrganization of the United Nations over half of the world's population rely on fish for their prime source of protein and nearly 900 million as their sole, or main source, of income [1]. The majority of the world's fisheries, be they in cold, or warm fresh water, or any of the world's oceans or seas, are threatened by human activity. Runoff from agriculture, pollution, micro-plastics, overfishing, habitat degradation, ocean acidification, dams, the spread of invasive species, and a host of other problems put stresses on the ecosystems that hold the fish that billions of people around our planet survive on. Climate change may very well be the proverbial straw that breaks the backs of the world's fisheries.

Our world is covered by water. Over 70% of our planet's surface is covered by oceans and another roughly 1% by freshwater. Climate change effects them all. From the movement and spread of species, bleaching of coral reefs, salination of the world's fresh water held in glaciers and snowpack, and the warming of the earth's cold water systems the waters of the world are changing at a pace species cannot adapt to because of climate change.

The MSU angling oral history project has asked over 200 participants in 40 countries on six continents if they have witnessed climate change and if so what effect on their home waters it has had. Approximately 97% of those interviewed have seen climate change and reported adverse effects on their local fisheries. In my home state of Montana fisheries biologists for the Montana Department of Fish and Game report a record number of river closures and fish kills nearly every year; in New Zealand commercial fishers speak about seeing smaller numbers of large fish and catching species farther south than they have historically been reported; and in Peru guides speak to having to travel deeper into remote rivers to find the trophy size fish destination anglers seek [2]. Not all these changes can be directly tied to climate change; however, it can be argued that the changes had a negative effect and made a bad situation worse.By using these primary source accounts of climate change in conjunction with scientific research we can articulate the global effects on a local level.

II. GENERAL CHANGES

People often confuse climate change with weather patterns. While they do go hand in hand, weather, in the short term, is unpredictable and consistently changing. Climate is formed by consistent weather cycles over thousands of years. Deserts were once seas, colder climates were tropical, and vast areas of dry land once covered in ice. Those are examples of climate change and the dramatic effect it has on life. Weather, I will use my home state of Montana as an example, can give us snow in July or a 60 degree day in January occasionally but it won't snow every July and we don't need to keep our swimsuits close at hand most winters.

For fish, particularly cold water species, weather patterns can be dealt with. There will be occasional algae blooms or fish kills caused by high summer temperatures. It's the frequency of these patterns, and when the patterns point to a larger change that the fish have problems adapting to. A fish kill every 5 or ten years is one thing but one every year or two can decimate a species to a point of no return. This is what concerns anglers on every continent I have conducted oral history interviews on.

Anyone who fishes seriously has a scientific side. We are meteorologists andpay attention to the weather; botanists who watch the plants along the rivers and lakes; entomologists who study the insects in and around the waters; in a sense we study climate and we notice changes in it. Fishing for sport and fishing for sustenance or income, provided it is of a non-commercial nature, and by this I mean fishing

fleets, long liners and the massive fishing vessels prowling the ocean and in many places sweeping it clean of life, are more similar than they are different. Weather fishing for sport, food, or profit if it is an individual trying to out-smart a fish then they are birds of the same feather. Different fish feed at different times on different things and as anglers, if we want to be successful, we need to know in a general sense what's eating what when. Part of the issue with climate change is it changes when insects hatch, when flowers bloom, and when the rains come and this in turn changes the patterns of the fish and other life forms living in or near the waters.

III. SALT WATERS

For the purpose of this paper I will focus largely on issues with fresh water fisheries as more of the world's population can easily access them; they are changing more rapidly due to their proximity to man, and arguably they are more important to our survival as a species. I would like to speak to a few occurrences in salt waters that have been linked directly to climate change. As the oceans warm we see several changes including an increase in hurricanes and cyclones and movements of fish species into new environments. A 2010 study published in Geoscience Nature stated "future projections based on theory and high-resolution dynamical models consistently indicate that greenhouse warming will cause the globally averaged intensity of tropical cyclones to shift towards stronger storms, with intensity increases of 2–11% by 2100." [3] Intense storms like these can damage underwater ecosystems and devastate coastlines where man has replaced the natural barriers with homes and sky rise hotels. Storms can also move fish, transplant seeds and eggs to areas where, due to slight changes in the water temperatures, they can now thrive. Alien or invasive species are increasing at alarming rates and causing significant damage in ocean environments around the world. As early as 2002 scientists were stating that climate change and the spread of invasive species were clearly linked and some of the greatest threats facing the planet [4].

In 2007 it was noted by marine biologists that alien species were invading new habitats at a spectacular rate with only a small increase in temperature [5]. This is happening on a global scale and not simply isolated occurrences. In a 2010 study of the Tasmanian Sea in South-Eastern Australia it noted that "Forty-five species, representing 27 families (about 30% of the inshore fish families occurring in the region), exhibited major distributional shifts thought to be climate related." [6] Polar oceans are the most at risk and in a 2010 study the authors found several changes and stated, "Recent studies indicate that rapidly rising greenhouse gas concentrations are driving ocean systems toward conditions not seen for millions of years, with an associated risk of fundamental and irreversible ecological transformation." [7]

From the bleaching of the coral reefs in Australia and the spread of invasive species globally it is clear that global warming is changing our oceans. While we can guess at the implications of these long term changes and even argue if they are caused by man other threats to the oceans are clear and clearly caused by man. Over fishing and pollution are the two most significant. In 2010 the Census of Marine Life, a decade long survey of marine life involving more than 2,000 scientists in over 80 nations, concluded that 90% of the large fish in our oceans are gone due to overfishing. Once common gamefish like halibut, Atlantic salmon, and blue fin tuna have had their populations decimated. And the lack of large fish is concerning. A healthy population of fish should be a pyramid with the population increasing as size decreases. A lack of large fish indicates that the population as a whole is not flourishing and not surviving in the long term. Anyone who had walked an ocean beach anywhere in the world has likely seen evidence of pollution. I have walked on beaches in Zanzibar, Sri Lanka, Palau, California, Peru, and Croatia to name a few and have never not seen some form of trash washed up on the sands. I recall walking near my house in Palau once and counting over 50 individual plastic sandals in a little over two hours. We know that the majority of the pollutants in our ocean come from the land. They are generated by humans and float down our streams and rivers until they reach the sea. The fertilizers from our farms, human and animal waste, trash, oil, and most of all plastics all find their ways to the water if not properly disposed of or contained. In a 2014 survey it was estimated that there are five trillion pieces of plastic, weighing nearly 269,000 tons, floating in the world's oceans.[8]In some places plastic is six times more common than any other element. The largest mass of garbage on earth known as the Great Pacific Garbage Patch is now three times larger than France.

From oil spills like the recent one in the Gulf of New Mexico to dead zones caused by agricultural runoff the world over the evidence is clear that we are responsible for polluting massive areas of our planets salt waters.

IV. FRESHWATER

Freshwater is located, not counting the icecaps, largely near humans. This has had mostly negative consequences, occasionally followed by positive ones. The majority of the freshwaters have been changed, altered, polluted, stocked directly or indirectly with invasive species, provided drinking water, and used to ferry in goods and carry away waste. It is difficult to find freshwaters untouched by man.

Harnessing the power of rivers to grind grain, move objects, and provide electricity has been a common practice for thousands of years. About 60% of the world's largest rivers are dammed. There are over

84,000 dams in the United States alone and over 54,000 dams 15 meters or higher worldwide. Dams change rivers and everything that lives in them. Migratory fish are blocked from spawning; the flow, shape and speed of a river are altered; and by holding waters the temperatures above and below dams can be drastically altered. It is estimated that 20% of freshwater species worldwide are threatened, endangered or extinct in large part due to dams. [9]

The pollutants in the oceans are carried there by rivers. It is estimated that only 12% of oil pollution comes from spills like the Valdez or BP Horizon. Most comes from the rain washing our streets and flowing eventually to the sea. Rivers are living things are always changing. Heraclitus of Ephesus was quoted by Plato as saying you can never step in the same river twice because he recognized that the river is always moving and the waters passing us by will never be seen again in that place. Freshwaters are changing due to the effects of climate change on many levels. Shifts in precipitation, increasing average temperatures, and the migrating of invasive species are just a few of effects we are witnessing. In a 2015 article in the Journal of Nature the authors argue that because fish are sensitive to even minor temperature changes that climate change will effect breeding success, metabolism, growth, and food consumption in the majority of the world's freshwater fish [10]. Changes in weather patterns are particularly felt by cold water fisheries are formed and fed from seasonal snow melt. Unseasonably warm spring days can mean snowpack that normally takes months to dissipate is done flowing in days or weeks. In Montana this past spring we lost 25% of our snow pack in one week in April. Fish need water and when the majority of the supply is exhausted months earlier than is normal it means the fish have to struggle to survive in warmer waters without ideal oxygen saturation.

V. EVIDENCE FROM ANGLERS

Water is life and as such humans are naturally drawn to it. We built civilizations along the banks of rivers shores of lakes. And of course we have taken advantage of the food sources contained in these waters. There is an unspoken understanding among anglers. Something we know but never really speak of. It's us against the fish but not in a conflict or aggressive way. It's more of an understanding that we will try to trick the fish and occasionally they will submit to our efforts. As mentioned the oral history project this paper is largely based on is global in nature. I have interviewed individuals connected to angling in a variety of ways including sport fishers, professional guides, fish farmers, fisheries biologist, directors of national parks, and celebrity anglers. One common theme has been they have seen evidence of climate change on angling and are concerned about the effects it will have in the future. Rather than quote individual anglers I will summarize responses by continent. I encourage anyone interested to please view the interviews, or the questions related to climate change, in their entirety.

The Angling Oral History project is open source, so available free to anyone with an internet connection and the largest angling oral history project in existence. It was started with the idea of capturing, preserving, and disseminating the history and culture of angling. The project has expanded to include several side projects including collecting information on climate change, the role of national parks in the preservation of native fish, stream access laws in Montana, and documenting minority and female voices in angling.

Africa

I traveled to Africa in 2017 and 2018 and conducted interviews in Kenya, Zambia, South Africa, and Uganda. All of the anglers I spoke with talked about their concerns regarding climate change. In South Africa it was the decrease in rainfall, Kenya the unpredictability of the rains, and in Uganda the increasing average temperatures. In addition they had concerns about overfishing, management of resources, and the introduction on non-native fish.

Asia

I have done interviews in Nepal, India, Sri Lanka, Thailand, Kazakhstan, Japan, and South Korea. In general participants were concerned about climate change and the effects it is having on wild areas and waters. In Nepal they spoke of the concerns with the melting of glaciers and decreased snowpack. In India they spoke of the rivers as living things and again decreased snowpack was a concern as was pollution.

Australia

I traveled to New Zealand and Australia in 2018 and interviewed participants in Te Anau, Dunedin, Auckland, Cairns, and Sydney. In both countries they mainly spoke of climate change as it related to the spread of invasive species. I interviewed several commercial fishermen and all spoke to seeing species in locations where they were not present before.

In New Zealand there was a significant amount of concern amount agricultural runoff and the effect it was having on the lower rivers.

Europe

In 2018, 2017 and 2016 I traveled to Austria, Germany, France, Britain, Ireland, Italy, Slovenia, Poland, Hungary, Spain, and Ukraine. I have interviewed anglers across the continent. Nearly everywhere I went people spoke of the effects of climate change although not all felt they had seen the changes in their lifetimes. Cold water fisheries were the main concern. Atlantic salmon, brown trout, and huchen habitats are threatened by global warming and anglers in Europe are concerned about it. The spread of invasive species and the changes in migration

patterns of species were also mentioned. In Italy they spoke of pelicans that a decade ago were migratory and now stay all year feeding on native brown trout.

North America

I have interviewed participants from Alaska to Panama. Of all the places I have traveled there were more people skeptical about climate change, or at least the cause of climate change than anywhere else I have traveled. While the vast majority of people see its effects and are aware they are at least exacerbated by man's actions there is still a sizeable number of people who simply do not and unfortunately elect politicians who are climate change deniers as well. Those who are concerned are the most concerned about the warming of cold water fisheries and the spread of invasive species.

South America

In 2017 I traveled to Ecuador, Bolivia, Argentina, Chile, Peru, and Columbia. The changing in weather patterns were a concern throughout the continent. The unpredictability of the rains and the general warming of the environments were mentioned by several participants. In Argentina they spoke of vineyards in areas where there were no grapes grown just a decade ago. Overfishing by commercial fleets were also a concern.

CONCLUSION

In conclusion, while climate change is not the only threat to our fisheries it is the most significant and the most difficult to change. If we care about fisheries we need to put that into action by voicing our concerns and electing leaders who believe in climate change and the dangers it presents to the world. According to climatologist there is still time to act and to mitigate the damage done to our world but the window is closing fast and without a concerted effort it may be that angling as we know it will be lost forever. If there are no fish there is no need to go fishing.

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