Knowing fish: a cultural case study and portrait of resource understandings in Caspian Eurasia

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Abstract

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Callie Berman

This research seeks to establish the deductive premises of the contemporary sustainability concept by building a cultural case study. Beginning with mainstream resource definitions formulated under the sustainability concept which emphasize market evaluations, this case study explored the limitations of such resource interpretations in Caspian Eurasia. Using Caspian sturgeon as the object of analysis, this research's inductive approach demonstrated how the sustainability concept was mobilized according to certain interpretations of the natural world, knowledge traditions, and a development history specific to western societies. It did so by recording resource meaning-making processes within Caspian cultural life, and how these were reflected in modernized aquaculture production in Azerbaijan, Kazakhstan, and Turkmenistan. The IPBES Framework was tested as a representative tool for current sustainability formulations to assess the extent to which these formulations could explain local forms of sturgeon appreciation. By accounting for Caspian Eurasia's development history, this research demonstrates how the physical geography of the Eurasian steppe conditioned distinct human relations with the environment which continue to inform modern day processes. Accounting for the region's development history and the role sturgeon played as a key food source to support the livestock economy, this research produces alternative resource definitions that more accurately explain Caspian Eurasia's contemporary relationship with sturgeon fish. These resource definitions fill conceptual gaps to update the sustainability framework by incorporating the important modes historically engaging Eurasia's geography and people.

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Acknowledgements

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Chapter 1: Introduction

1.1 Background of the Research

In the context of climate change concerns, sustainability and related resource management issues have been attracting increased research and public policy interest. The most prominent aspect of the climate change issue in academic and public discourse is concern over warming temperatures due to anthropogenic activities, and the diverse effects these temperature increases are predicted to have on a range of human and environmental life processes. Over the last half century, the concept of sustainability increasingly has come to represent an overarching framework for formulating and pursuing climate change mitigation measures. Today, sustainability-based strategies can be found across biodiversity conservation, food system security programs, city and urban resilience projects, to public and human health research.

Despite increased calls for sustainability as a solution set for climate change, the concept itself can be unclear and oftentimes arbitrary. At the time of its formalization at the 1970 Brundtland Commission, over one hundred definitions of sustainability were put forward. With sustainability spanning topics across environmental, social, and economic spheres, and taking place in public and private projects from local to the global levels, identifying what constitutes sustainability becomes problematic.

Review of current sustainability scholarship reveals that sustainability conceptual understandings and outcomes from its stated aims are highly mixed. The majority of sustainability literature discusses climate change mitigation strategies as a technical issue which can be mediated through alterations to industrial processes. Yet a growing body of critical research points to conceptual issues within sustainability's premises. A core feature of the conceptual argument is that sustainability emphasizes certain styles of relating to the environment by framing and narrating the notion of 'resource' in a particular way.

Social science research has made important contributions to the sustainability narration debate. Many of these research efforts began by analysing effects of post-World War II industrial growth processes and outcomes of development activities in pre-industrialized settings. Doing so chronicled the diverse ways in which societies have interacted with their natural surroundings to reveal distinct forms of the human-environment relationship. What many of these social studies

have made evident is that many of the world's people and cultures do not trace their bases of meaning-making nor understandings of 'resource' to those embodied by the sustainability concept.

To supplement and to make technical climate change measures more socially-informed, sustainability research has been soliciting wider account for the ways in which the physical environment is understood and valued cross-culturally. This research makes use of these widening discussions to offer a perspective of resource understandings from Caspian Eurasia, a region that is markedly underrepresented both within western academia and sustainability research.

1.2 Rationale for Analysing Sustainability and Resource Meanings in Caspian Eurasia

The idea of environmental conservation is closely linked with industrial processes. Today, the sustainability concept gives the most visible framework for how the natural environment is, or should be: protected, measured, and addressed. Yet, sustainability represents environmental conservation strategies that operates within economic systems organized around market principles. The centrally-planned economy of the Soviet Union developed its own conservation logic in order to facilitate industrial activities.

The experience of each of these conservation approaches of the Soviet and market economy systems makes Eurasia a unique sight of study. The extensive industrial processes of the Soviet Union left the Caspian with a distinct set of physical infrastructure and institutional capacities for facilitating environmental conservation. Under the current nation-state system, sustainability provides the key overarching concept by which environmental conservation is understood and conducted. Many endowments from the Soviet-era have been leveraged to meet societal challenges associated with ongoing industrialization. The distinct conservation logics arising within each system, yet operating within the same geographic locale, therefore creates a useful contrast for resource analyses.

However, the conservation logics emerging under centrally-planned and market economies represent views and approaches for environmental safeguarding under industrial activities. In essence, both are characterized by a substantial upscaling of physical processes and resource use in order to achieve industrial growth. Moreover, each system represents societies organized under industrialized forms of the human-environment relationship. With human habitation in Eurasia tracing back for a millennia, this history represents its own form of human-environment relation(s).

Although now governed as three independent nation-states, this research takes this extensive collective history and shared development experiences of Eurasian peoples to be more significant in constituting and shaping endogenous resource meanings to provide a distinct layer within the region's resource story. Figure 1 depicts the geographic setting of this case study's fieldwork in Azerbaijan, Kazakhstan and Turkmenistan, along with the other states of primarily Eurasian peoples.

Figure 1: Map of fieldwork sites in Azerbaijan, Kazakhstan, and Turkmenistan (Konstantinovich Leontiev, O. 2019).

This diverse history of human interaction with the natural world embedded in the same socio-physical setting is particularly productive for resource analyses as resources meanings can be qualified and engaged more deeply according to the goals and nature of resource use within each system.

Sturgeon fish are a useful tool for engaging with this range of conservation styles and respective resource understandings as its presence is well-established across pre-, Soviet, and nation-state eras. Caspian sturgeon have retained a highly symbolic and high-market value for centuries. With a

use history dating back to antiquity, both its meat and its roe processed into caviar have been consumed extensively within the region and traded more widely. Appreciation of Caspian sturgeon products, particularly caviar, only increased during Soviet times. In effectively establishing a monopoly on Caspian caviar, it became one of the prominent symbols and source of currency for financing Soviet industrial ambitions. By the time the Soviet Union was dismantled, 90 per cent of the world's caviar was sourced from the Caspian. Additionally, an elaborate system of sturgeon fish hatcheries and research institutes were established under Soviet conservation initiatives for re-stocking declining wild population numbers. While many of these Soviet sturgeon rearing techniques and hatchery systems have been repurposed into Caspian aquaculture ventures today, they give useful insight into the particular strategies of Soviet conservation. Under the current nation-state system, conservation approaches primarily are embodied within the sustainability concept to align with the conditions of a market economy. In particular, the notion of biodiversity orients and informs conservation in terms of Caspian sturgeon.

Provided this historic environmental use backdrop and well-established relevance of sturgeon as an object of study, the notion of resource can be investigated across a range of human development experiences for more comprehensive analyses.

1.3 Justification of the study

Eurasia has supported a historical mix of peoples and societies organized around a range of mobility strategies (nomadic, pastoral, semi-nomadic, semi-pastoral). These lifeways were conditioned by the realities of Eurasia's physical geography which precluded large-scale, irrigation-based and fixed field agriculture. With the primary economy oriented around livestock cultivation, mobility facilitated the accumulation of a distinct history of relations between land, people, and livestock in Eurasia. Having endured for millennia, the capacities for Eurasian peoples to navigate change (social, ecological) inherent to any system demonstrates a distinct understanding of land and land use principles. Although the Soviet era and current nation-state makeup have resulted in two instances of systemic change to the region, the understanding of these land use principles has persisted because of the nature of how these understandings are recorded, transmitted, and sustained. With the repository of these land understandings residing in a diverse range of languages and linguistic traditions, cultural practices, and life habits, Eurasian peoples possess a knowledge archive and development history for existing in a geography that is distinct from the land ethics and strategies arising under sedentary civilizations. This archive has yet to be examined

comprehensively (spatially and temporally) and updated based on the two systemic transitions of the last century.

This research seeks to engage nomadic/pastoral land understandings and land use principles within the Eurasian archive. By analysing from the perspective of the sustainability framework and the Caspian social landscape as it exists today, potential bases for alternative resource understandings can be explored through contrasting features of pre-industrialized and industrialized Soviet/nation-state systems embedded in Eurasia. In this way, the sustainability concept can be updated to represent the resource experiences of mobile peoples or be shown to provide satisfactory explanation of Eurasian resource understandings.

The sustainability concept provides a very clear interpretation of the resource notion. Formalized and most widely known by the Brundtland Commission Report definition, the "ability of future generations to meet their own needs" implies the need for predictive capacities in order to assess, monitor and manage the availabilities and conditions of environmental processes and/or components (WCED, 1987). Based on these predictions and environmental evaluations, threshold limits can be applied in order to meet needs which typically are established within a production-consumption based spectrum. Quantitative measurements for tracking resource flow and evolving use patterns across human populations feature prominently in production-consumption assessments. Second, the idea of biodiversity is of growing prominence in sustainability discourse. Broadly, biodiversity proposes measures of ecological conservation whereby ecosystem qualities and/or species are outlined and monitored such that human use of natural systems can be regulated according to changing conditions. These terms of biodiversity and threshold limits undergird the sustainability concept and reflect a particular style of societal-environmental relations, namely that of industrialized societies with sedentary civilizational histories. Highlighting core aspects of the sustainability logic illuminates the boundaries of the concept's deductive premises. In identifying sustainability's conceptual parameters and important constituting elements, the extent of sustainability's explanatory ability for social phenomena in particular settings can be analysed more accurately.

Caspian sturgeon fish species are an ideal tool for this research's analysis based on several factors:

a) Their presence are well-established within contemporary sustainability measures. This is due to declines in wild population levels which invoked the biodiversity conservation mandate. This is depicted in Figure 2 below.

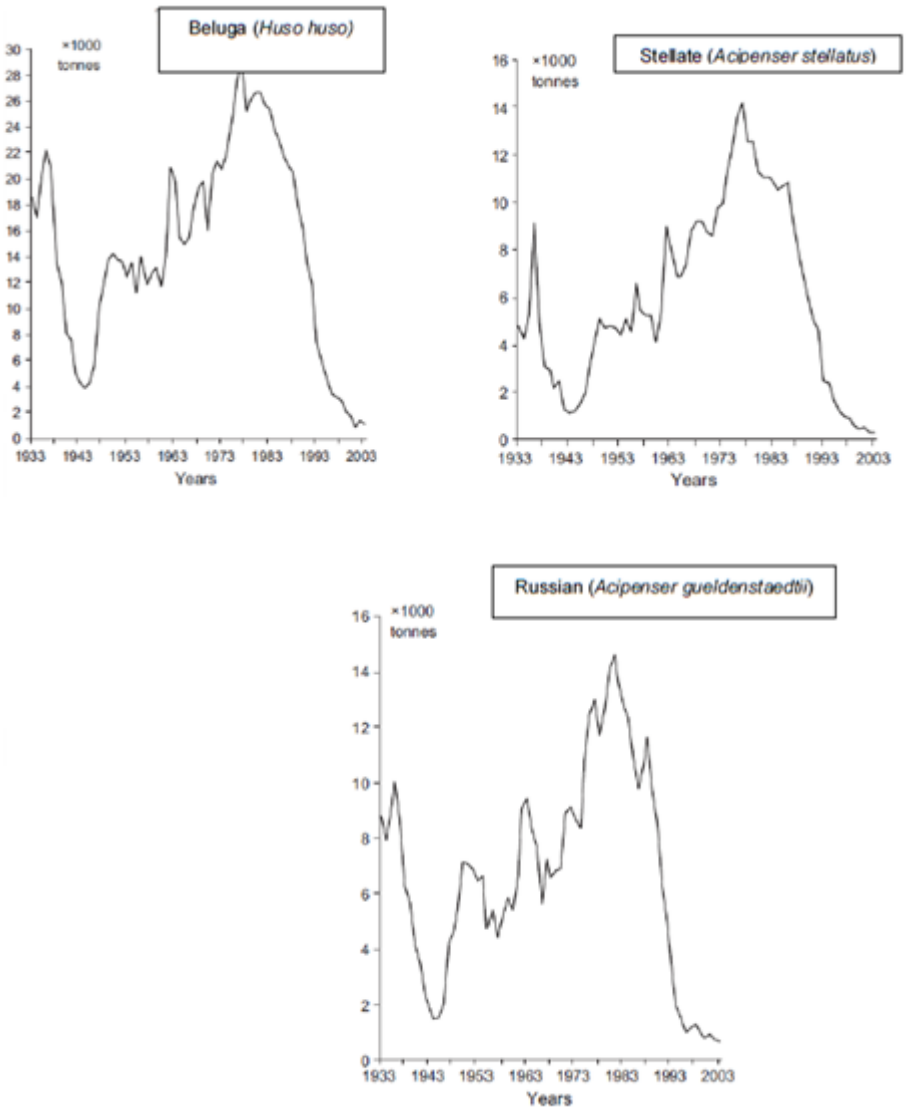

Figure 2: Commercial catches of the three primary Caspian sturgeon species: Beluga, Russian, and Stellate (Ruban, G. I, & Khodorevskaya, R. P., 2011). All sturgeons species are now listed under *Acipeserides* I or II CITES (Convention on International Trade in Endangered Species) with the intention of controlling international trade and promoting the implementation of sustainable management policies (CITES & UNEP, 2017; Raymakers, 2006).

b) With their value and use well-documented under the Soviet system based on the extensive hatchery release program and research institutes, Caspian sturgeon allow for resource comparisons across industrialized centrally-planned and market economic conditions.
c) They have a history of use and form of appreciation in Eurasia which bone isotope analyses date back to the Bronze Age (1200 BC).

The relevance of Caspian sturgeon, past and present, along with the dynamic historical development of Eurasia, make the region a salient and fruitful system for investigating resource meanings and possibilities. The aims of this study described below demonstrate this research's justification rationale.

1.4 Aims and Objectives of this Study

This research seeks to establish the deductive premises of the contemporary sustainability concept by building a cultural case study. It proceeds by taking the abstract sustainability concept and examining its primary structural aspect, the resource notion, through an inductive engagement with a culture's relationship to a particular resource: sturgeon fish. With Caspian sturgeon made the object of analysis, the fieldwork component of this research recorded the resource meaning-making processes in the Caspian cultural setting. It did so by observing the nature of sturgeon use practices in Caspian cultural life, and how these were connected to, or were reflected in, modernized aquaculture production in Azerbaijan, Kazakhstan, and Turkmenistan. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (hereafter 'IPBES') Framework was tested as a representative tool for current sustainability formulations to assess the extent to which these formulations could explain local forms of sturgeon appreciation in the Caspian. The empirical data of sturgeon use and appreciation as a proxy for resources allowed for the deductive premises of the sustainability concept to be qualified.

Rather than focusing on specific outcomes and effects from resource understandings in order to define what a resource is explicitly, this research aimed to examine the processes by which a resource acquires meaning, and the extent to which those processes are embedded in culture. Developing a comprehensive case study of the Caspian's relationship with the sustainability concept in the context of sturgeon aquaculture gives the basis for comparing the distinct ways resource becomes understood from the perspective of culture and current sustainability formulations. The primary data collection method was semi-structured interviews, supplemented with cultural historical assessment and an ethnographic component to compile a holistic case study.

To my knowledge, there is no published work which aims to understand sustainability's interpretations in the cultural context of the Caspian, nor has there been scholarship on Caspian peoples resource understanding as a function of knowledge system endogenous to the region.

1.5 Structure of the Thesis

This thesis consists of three main parts. The first consists of two introductory chapters (Chapters 1 & 2), which sets the research question and reviews the sustainability literature in order to establish the research rationale and design. The second part (Chapter 3 & 4) outlines the cultural and aquaculture industry contexts in which this research was conducted. It also discusses the methodology by which these variables were examined within the design of this research. The importance of the Part II background discussion is in that it establishes the analytic context from which the following chapters proceed. Part III presents the empirical findings from fieldwork collected in Azerbaijan, Kazakhstan and Turkmenistan (Chapter 5) with analyses of the results, connected with contextual factors discussed in Part II, presented in the analysis (Chapter 6).

The particular details addressed in this thesis's chapters are as follows.

Chapter 2 explores the literature on sustainability as a 20th century development phenomenon. This chapter highlights the primary intellectual roots of sustainability as originating within particular knowledge systems and development challenges associated with western societies. Grounding in the conceptual history of sustainability makes salient the motivations and orientations of sustainability, and establishes the resource notion as a key structural element within the sustainability concept. Chapter 3 is organized into two sections. The first discusses the cultural context of this study by taking a historical development perspective. It describes Eurasia's geographic and environmental realities to outline how the region's development history was conditioned in important and distinct ways. This section also substantiates this research's use of the term culture, and how it allows this research to engage Eurasia's development history as a distinct form of human-environment relations which were conditioned by mobility and geography. The second section of Chapter 3 situates the context of the object of analysis, Caspian sturgeon fish species. It provides a brief overview of sturgeon's physiological traits before moving into a discussion of its diverse use and conservation history across pre-modern, Soviet, and post-Soviet times. This section offers a more global account of sturgeon resource use to demonstrate how it has gained value and understanding generally, and to give better grounding of current conservation measures for its protection. A brief discussion of the rapidly growing global aquaculture industry is introduced from the perspective of the Blue Economy framework. Contextualizing the different strategies of sturgeon conservation across industrialized settings allows this research to build an argument for how different resource understandings unfold based on the nature of how sturgeon fish are used. Chapter 4 reviews the design of this research, data collection and empirical analysis procedures, and justifies the methodological approach used. It also presents possible limitations

within the bounds of this research question and how these may be addressed through additional studies.

Part Three begins with Chapter 5. This chapter presents findings and empirical data collected during the fieldwork phase from this research. It is presented in two parts in order to demonstrate the layers by which resource conceptualizations occur as a function of knowledge systems and distinct conservation logics. This first part details findings from aquaculture facilities across the three states of this study. Examples of how sturgeon aquaculture operations have devised distinct strategies for developing viable business models specifically by centring approaches based in market-oriented knowledge within their operations are discussed from each state. These examples also are contextualized by how Soviet-era capacities and fish hatchery infrastructure supplement these market knowledge pursuits to demonstrate distinct forms of conservation logics. The second part of Chapter 5 presents the ethnographic findings and develops an argument for considering the mechanisms by which resource conceptualizations occur, as well as how culture gives the market sturgeon aquaculture production. Archaeological work is presented in order to support how historic fish use practices that have played important roles in the development of Eurasia's life ways and are not discrete nor discontiguous from contemporary food practices because they remain sustained by culture.

Chapter 6 synthesizes fieldwork data and further develops the ideas put forward in Chapter 5. It re-introduces contextual data from Chapter 3 to connect resource understandings with value creation mechanisms which build from the region's historic modes of interacting with the land through livestock cultivation. To develop this argument, the idea of investment structure is used to discuss how culture facilitated and preserved endogenous resource meanings based on the history of interactions between people, livestock, and steppe geography. From this deepened contextual background, new significance of production directions of Caspian sturgeon aquaculture towards meat derivatives rather than caviar can be brought to bear. Chapter 6 concludes with two discussions. First, it reiterates how the findings from this cultural case study offer empirical evidence of Caspian Eurasia resource understandings have roots in pre-industrial interactions with the steppe geography. Mediated by factors of mobility and collective goals of livestock rearing, these interactions created distinct modes by which the environment could acquire meaning and value which remain in lived form in the Caspian region today. Second, because the concept of sustainability is predicated on the notion of resource, this research demonstrates the relevance of accounting for the modes of interpreting and relating to the natural world which predate the

sustainability concept. From this, the chapter closes with suggestions for enhancing the sustainability concept and updating the IPBES Framework based on these findings.

1.6 Diagrammatic Aid

Because this research seeks to integrate insights from across academic disciplines and empirical evidence, a graphic aid will help orient the following discussions. Moving from left to right, each of the components with key terms and considerations from the illustration below will be presented at the beginning of each chapter. The diagram (Figure 3) depicts the workflow of this research and will help establish relevant ideas to be discussed within the scope of each respective chapter.

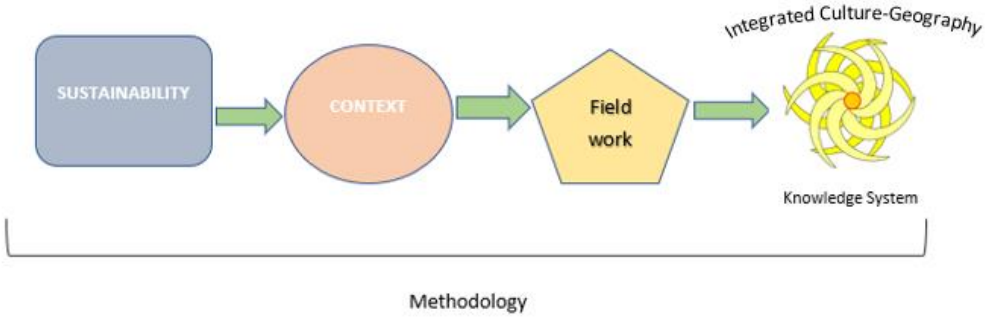

Figure 3: Research Workflow (Berman, C., 2021). In order to orient the reader to the overall research design which produced this case study's findings, each chapter begins with an elaborated component from the above diagram to contextualize the chapter's discussions.

Chapter 2: Literature Review

2.1 Introduction

The second chapter provides a literature review. Figure 4 below provides an illustrative diagram of the key terms constituting the sustainability concept which will be discussed in the pages that follow.

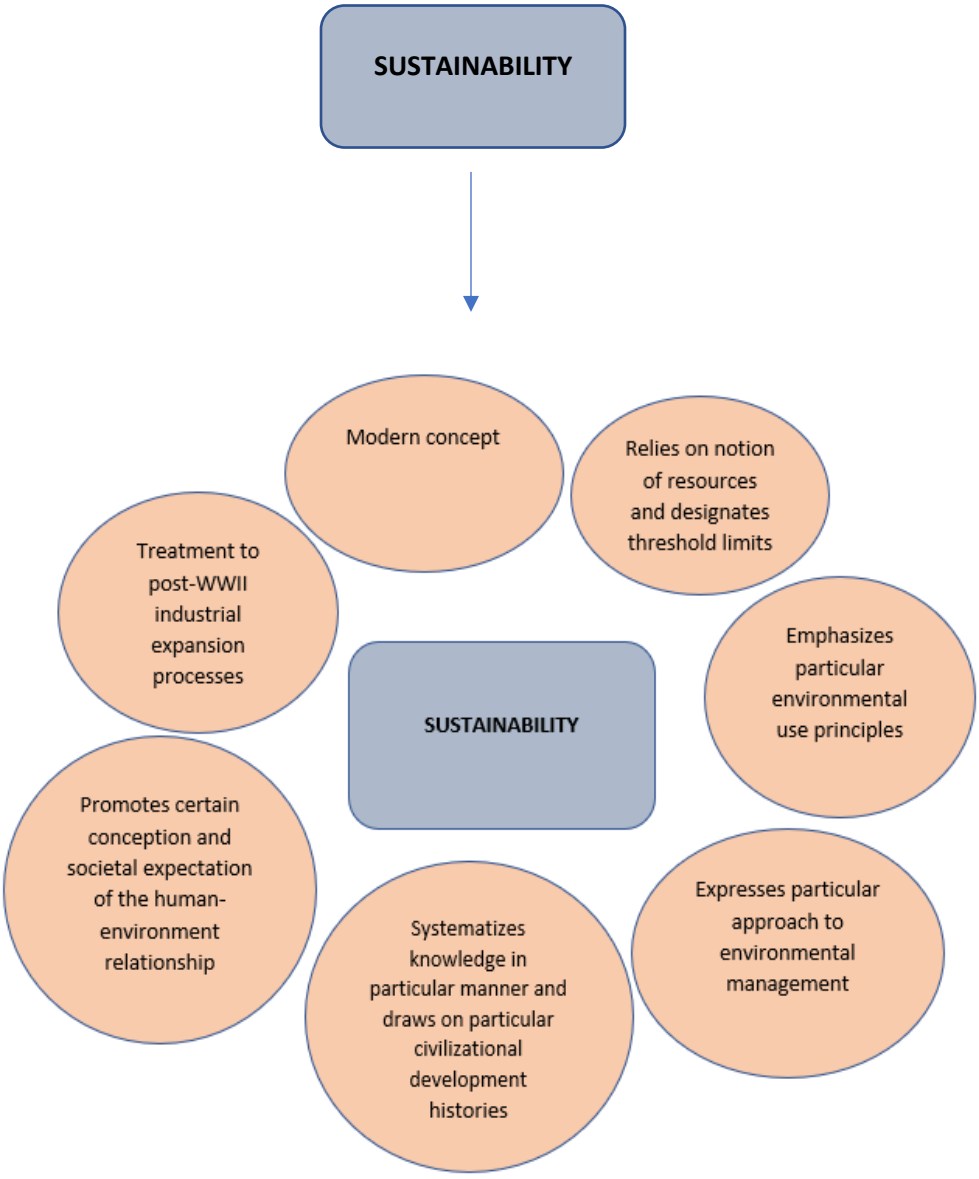

Figure 4: Sustainability concept diagram highlighting the primary constituent elements of the contemporary sustainability term and understandings (Berman, C. 2021).

Chapter 2 starts with a more general discussion of sustainability and common definitions. Next, a historical overview of key features within the 20th century global development process will highlight how they have contributed to sustainability's emergence and current conceptualizations. Within this historical overview, the chapter will present growing evidence and case studies from the social sciences and development literature of the multiplicity of societal values and worldviews overlooked and/or misinterpreted by sustainability's premises and associated initiatives. These brief synopses of critical studies related to sustainability theory and practice, alongside an overview of sustainability's 20th century evolution, will allow this thesis to represent the paradigm of sustainability in terms of a knowledge system. Tracing the post-WWII history of the sustainability regime will demonstrate its genesis to be predominantly within western[1] systems of thought and development histories of sedentary peoples. This allows for a later comparison of how sustainability operates in the Caspian cultural setting.

The chapter will conclude by introducing the IPBES Framework, an important counterpart to the United Nation's Sustainable Development Goal's environmental conservation aspirations. This model provided an important conceptual aid for this research's analysis of resource understandings and mechanisms.

2.2 Definitions

First, to clarify key terms, this research defines knowledge as "inherently dynamic collection of ideas and practices constituting a body of propositions. Knowledge is embodied with relevant actors and in their practices, technologies, and institutions" (Tengö, 2017:17; Diaz et al., 2018a). That is, knowledge exists and locates itself in the socially constructed institutions which organize its production and transfer (Escobar, 2018). A system of knowledge provides resources that are adhered to, formally or informally, and are "routinely used to claim truth" (Tengö, 2017:18). Of

[1] This research will use the definitional understanding of "west", "western", "modernity" and "European" to be terms that equate or are related to western culture or western civilization. Categorically, they apply to countries within the continent of Europe, or whose history is notably defined by European immigration (e.g.: the United States and Australasia). However, the "west" is not only a geographical area but is characterized by a particular model of society and ontological system generally derived from Western European civilizational development experiences (Escobar, 2018). Western culture, civilization and associated values are marked by a strong influence of Christianity and encompass a diverse heritage of customs, values, political systems and artifacts or innovations with some historical relation to Europe, particularly Ancient Greece and Ancient Rome (Duchesne, 2011; Kurth, 2003/4). This research acknowledges sociopolitical, economic and historic variation within the category of "west" (i.e. variation between Germany, Scandinavian countries, the United Kingdom, etc.).

particular relevance for this research is that, although knowledge systems undergo constant evolution, the nature of their change is highly conditioned by the philosophical traditions, worldviews, and physical environments from which they emerge and interact with.

Additionally, this research treats the term sustainability as a *concept.* It is a representation of a particular set of understandings of phenomenon in the natural world and perception of reality.[2] How a society relates to, and comes to construct meanings around these understandings, is a culturally-defined function of that knowledge system.

2.3 Sustainability Literature Review

This research's starting point is in critical studies, post-colonial studies, and political ecology because this is where the bulk of analysis on sustainability has been done. In establishing the intellectual history of sustainability,[3] this research will show where the institutional regime of sustainability is at present, as well as its particular interest in engaging with non-western worldviews and non-utilitarian values of environmental resources. Generally, sustainability is conceptualized around three overlapping spheres depicted in Figure 5.

2 Reality defined and taken to be objective is not inherent to all worldviews and cultures and is fully recognized by this research. Other fundamental aspects of existence, such a temporality, also are not homogenous in form across all thought systems. While beyond the scope of this research question and the literature review of this chapter, this research remained grounded in an awareness of epistemic diversity.

3 Although the history of the ideas constituting sustainability as a sense of balance between resource use and production can be traced to antiquity (Pisani, 2006).

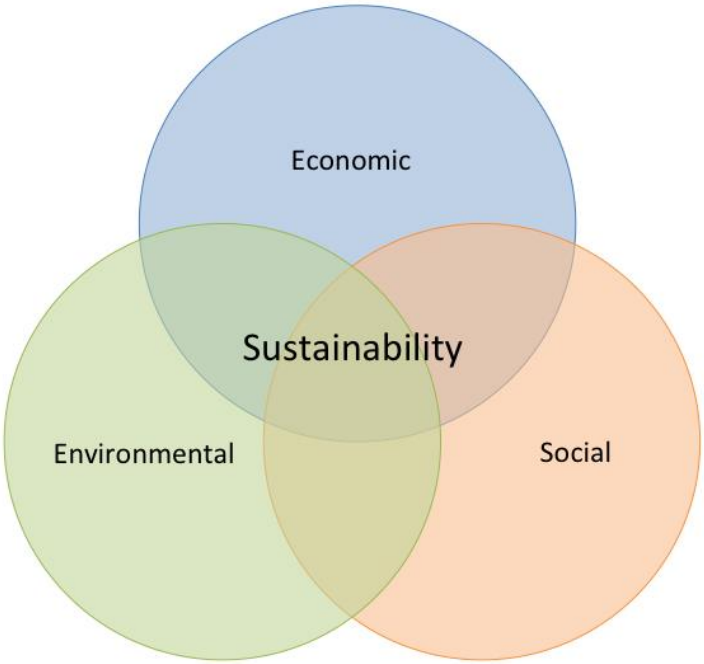

Figure 5: Conventional conceptualizations of sustainability depicting the commonly recognized spheres of sustainability and overlapping dimensions (Curran, J. 2017).

From these interlinked variables, this following section will present how sustainability became implicated in work and policy directions undertaken within a post-war development context. Global development processes emerging in the wake of post-war reconstruction efforts primarily were a political-economic undertaking promulgated by western institutions. They promoted a particular conception of the human-environment relationship based upon the overlapping variables of Figure 4 (Escobar, 2018; Geisinger, A. 1999). Yet, in many respects, sustainability today is finding new import for the social sciences by inquiring into how nature has *contributed* to a people's cultural understanding of themselves *via* ecosystem components or processes (presented with the IPBES Framework Section 2.2).

Sustainability arose as a treatment to undesirable consequences of economic activities owing to the strong economic nature of development's design (Escobar, 2018; Springett, D. and Redclift, M, 2015; Dobson, 1996). Within these development discussions and processes, human interactions with the natural world came to be theorized by select institutions of sustainability which many have argued were not representative (Johnson et. al, 2015; Khalili, 2011). How theoretical gaps and assumptions form when these theories are applied across a globally diverse system of cultures will

be an important theme brought out in this research's case study of the Caspian experience of sustainability.

2.3.1. Development and the Beginning Context for Sustainability

Contextual factors that shaped the beginnings of development work are important to consider as they are implicated in the formation and institutional structures of sustainability as well. Many scholars point to the distinct economic imperatives arising in the post-WWII context and decolonizing processes as birthing the international undertaking known as 'development.'[4] In the post-WWII aftermath, economic concerns - particularly in its early years on the heels of the Marshall Plan – became the guiding logic (Benson, M., and Craig, R. 2014; Coté, 2007). Reconstruction efforts were organized around preoccupations of identifying and expanding benefits of industrialization. This quickly came to include under-developed areas of the world through qualitative improvements in the form of discernible effects in social, economic and political spheres (Escobar, 2018; Currie-Alder, 2016; Edwards, 2010; Esteva, 2010).

As development work became increasingly institutionalized, two major approaches emerged. One approach concerned itself with macro-level structural processes examining the global economy while the other situated itself at the micro-level to devise poverty reduction strategies (Esteva, 2010). Wealth creation strategies broadly were put forth by development as a remedy to poverty concerns. Many development and critical theory scholars link the array of development work to ushering in a grand model of progress built on an array of indicators ranging from literacy rates, weapon development capabilities, judicial-legal capabilities for enforcing rule of law, GDP, life expectancy, level of ICT infrastructure, etc. (Currie-Alder, 2016; Hällström et al., 2006).[5] These benchmarks of progress and their associated projects increasingly became subsumed by national interests and under the purview of government responsibilities in former colonies (Escobar, 1995). Particularly as it was laid out to recently decolonized nation-states, this growth model was purported to provide the necessary drivers for moving towards modernity and poverty alleviation (Hällström et al., 2006). Moreover, in the context of systemically fragile former colonies embarking

[4] The genesis of the 20th century development as a phenomena is generally cited as the inaugural address by American President Harry S Truman on the 20th of January 1949, when he referred to more than half of the world's population coming from 'underdeveloped areas' (Tomalin, 2015; Esteva, 2010; Truman, 1949). This usage of the term 'under development' widely is seen as formally creating the category of development, offering poverty alleviation as its justification (Curry-Alder, 2016).

[5] One of the most salient and universal effects of such initiatives were those for traditionally subsistence communities being redirected towards cash crop production (Banerjee, 2003).

on nation-state building processes, much of development work's appeal lay in its ability to clearly structure projects and outline visions (Khalili, 2011; Edwards, M. 1997; Hettne, 1990).

With economically-derived wealth creation remaining the predominant mode for developing, nation-states sought policy prescriptions to close the development gap (Edwards, 2010). Economically, this led to expanding industrialization and its enabling political-economic structures (Curry-Alder, 2016; Murrell, 2003). From the perspective of sustainability and its broad concern with remediating effects arising out of an economic growth imperative, many contend that development itself accelerated many of the processes sustainability purportedly claimed to address (Hölscher et al., 2018; Escobar, 2018; Adams, 2010).

Many of the social and environmental issues embedded in sustainability and development concerns predate the Second World War and are far from settled. However, this research looks to the notable consolidation of human development policy-making and institutional strategies around particular visions of development which established a paradigm by which human progress increasingly was conceived universally. For the sake of this research's historical overview, the 20th century project of development – while acknowledging its underlying historical links to industrialization - will be taken as the historical setting from which the current sustainability paradigm is derived.

2.3.2. Early Linking of Sustainability and Sustainable Development

The growing presence of the term 'sustainable development' within development discourse highlights the interdependencies, even inseparability, between the two terms (Carrad, N. and Willets, J., 2017; Sundsbø et al., 2014; Pisani, 2006). For some, the terms have risen "to the prominence of mantra—or a shibboleth" (Daly, 1996). Yet the history of sustainability and sustainable development work have been complicated.

There have been periods of varying reception for sustainability initiatives when sustainability was seen as a driver of economic prosperity and/or a strategy for cultural preservation while allowing for modernization (Dernbach, J. C., and Cheever, F, 2015). Despite social science insights which have led to some changes for more informed approaches in sustainability practice, much of sustainability's work and planning remain guided by conventional interpretations predicated in a particular systematization of knowledge and rely heavily on economic interpretations (Escobar, 2018). As a consequence, much of sustainability's interpretations are based on assumptions that elide cultural variation and alternative meanings (Díaz et al., 2018a; Dewey 1985).

The concept of sustainable development itself entered the nexus of mainstream development work following the 1972 United Nations Conference on the Human Environment in Stockholm and "brought the industrialized and developing nations together to delineate the 'rights' of the human family to a healthy and productive environment" (Adams, 1990).[6] The recognition of 'improving' society's connection with the environment led to the establishment of multiple global institutions within the UN system (Edwards, 1997: 582). One of the most important characteristics of these high level developments was how the concept of sustainable development became scaled up to the global level.

The early 20th century debate on sustainability was strongly influenced by the Club of Rome 'Limits to Growth' argument and official circles expressed concern about mass production, technologies and consumption patterns on environment and development in Stockholm (Perez-Carmona, A. 2012). Global conferences reports reiterated the mismatch between development and environment with the 1987 report 'Our Common Future' bringing policies discrepancies to the centre (Currie-Alder, 2016; Edwards, 1997; WCED, 1987; Vitousek et al., 1986). However, the United Nations and most countries data analyses lacked an effective examination of structural forces underlying environmental deterioration (Perez-Carmona, A., 2012). Given limits to growth, as reported by the Club of Rome, redistribution of wealth was viewed favourably in order to integrate environmental protection and social justice. This spirit was captured in the term 'eco development' and in the 1972 Stockholm conference of the human environment (Hulme, 2009).

Proceedings from the 1972 Stockholm Conference fed into the International Union for the Conservation of Nature's 1980 World Conservation Strategy, which produced the 1987 Brundtland Commission Report (Basiago, 1999: 147). According to the Brundtland Commission, sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The WCED definition of sustainable development has been highly instrumental in developing a "global view" with respect to our planet's future (Mebratu, 1998: 494). Although the Brundtland Report is the most commonly cited definition of sustainable development, there are over one hundred known definitions (Palme, 2011). Ensuing international conventions invoking this definition, such as United Nations Conference on Environment and Development in Rio 1992 (the 'Earth Summit') signified the

[6] This included a series of meetings on the rights of people to adequate food, to sound housing, to safe water, to access to means of family planning.

growing uptake of sustainable environmental development as a policy agenda (Springett, D. and Redclift, M., 2015; Unerman, 2003).

Sustainable development emerged in tandem with the neoliberalism in the 1980s to offer guiding principles for sustainability policy (McKenzie, 2012). As some scholars write, sustainability principles became reshaped around the neoliberal ideas of sustainable development in order to fit economic imperatives of growth and ideas of trickle down over wealth redistribution (Sumner, 2006; Serafy, 1991). For many across civil society, academia and policy, the previous framings of environmental issues and possible solutions became watered down as neoliberal growth imperatives were integrated into development thinking. The concept of sustainability then began to figure more prominently as a set of institutional principles to redirect societal progress under development initiatives (Springett, D. and Redclift, M., 2015).

The notion of 'quality of life' became a key means by which development pursuits were justified. Largely drawing on ideas of justice and equality, the premise that every human being has the right to live a decent life became the guiding principle for development and key connecting point with sustainability (Belkaoui 1994: 2; Todaro, 2000:7). With its normative goal of improving people's lives, development aimed to have practical policy relevance around a universal set of living standards. Yet the pressure on development work to demonstrate pragmatic outcomes created a tendency to obscure theory and what actually constitutes development for a peoples (Esteva, 2010). At the same time, the sustainability notion was becoming integrated with development as a strategy for achieving public policy mandates and meeting development-based 'quality of life' measures (Currie-Alder, 2016; Sylvester, 1999). Yet because sustainability presupposes particular relationships and understandings of the environment, the ambiguity around what even constituted development became even more complicated. As Dobson provoked, "what is to be sustained?" (Dobson, 1996: 406). In spite of the principal organizing question of sustainability becoming increasingly arbitrary, it has retained its normative foundations and mandates connecting it with development (Christen, M. and Schmidt, S., 2012).[7]

[7] Such that the realization of the right to good quality of life became sustainability's ultimate goal (Escobar, 2018; Enders, C. and Remig, M. 2015). But this ground the sustainability concept in a normative framework that required it to whereby be substantiated with and proven through a clear conception of quality of life (Colocousis et al., 2017: 275; Ott K. and Voget, L. 2008; Patridge, 1990:41). Ott and Voget discuss how the quality-of-life principle became tied to notion of justice, conceptualized around logic of distributive justice and working towards equitably regulating the distribution of goods (2008).

2.3.3. Development and Knowledge Systems

From the perspective of this research, the term 'development' will be used to refer to these specific historical processes and the overarching institutional project discussed in the preceding section. Concern over the human condition and existence that development claims to contend itself with, however, has been the basis of societal evolution and the changing of life ways since antiquity. How concerns of existence are understood and brought forth, however, is a function of the systems within which they are situated and how knowledge is used in that system (i.e. knowledge system).

Knowledge systems significantly frame the ways in which life considerations can be interpreted and related to by a group (Díaz et al., 2018a; Cornell et al. 2013). What development signifies, therefore, is the presence of a knowledge system within which the material and social processes for conceptualizing and discussing these life concerns are understood in an institutionally cohesive manner. In this respect, this research handles the term development as a reference to a particular knowledge system that reflects the global realities of a distinct social, economic and political and historical era. Following the end of the Second World War, this knowledge system largely was built from a preoccupation with post-war reconstruction needs and challenges emerging from decolonizing newly independent countries. The fundamental work of the post-war development project does not mean that societies previously did not contemplate or strive for ways to improve the life conditions. Instead, development presented itself as a clear set of proposals and approaches for how a good life can and ought to be pursued.

Critical studies scholarship documents the problematic relationship between development and the environment, especially as it became strengthened by neoliberalism (Peluso, N. L., 2012; Fine, 2002; Geisinger, 1999; Marshall, 1995; Sylvester, 1990). Despite progress on some of development's fronts over the 20th century, there was a growing consensus that the overall state of nature was in decline.

2.4 Introducing the IPBES Framework

One of the prevailing assumptions of what in fact constitutes a resource undergirded much of the history of sustainability across development work of the 20th century. As a way of targeting sustainability, the term biodiversity (and biodiversity conservation) has prioritized much of sustainability's work around defined ecosystem characteristics and processes[8] that serve

[8] Often referred to as "ecosystems services," these span from qualities such as clean water, food, forest products, flood control, and natural resources (Millennium Ecosystem Assessment, 2001).

important functions in the climate systems, as well as offer key resources to humans. In 2001, following the declaration of the Millennium Development Goals,[9] the Millennium Ecosystem Assessment offered a review of the condition and trajectories of global environmental change.[10] Yet, many critical studies have demonstrated that the very notion of a resource is premised on conceptual derivations and ideas from knowledge systems that hold little significance in cross cultural settings. A vast body of scholarship illuminates dynamic interrelations between natural and social systems in which categories of economy, society and environment reinforces an unnatural separation between humans and nature.[11] Sometimes described as a metabolic approach describing the 'exchange of energy and matter between social and natural systems' (Ayres and Kneese, 1969; Fischer-Kowalski and Haberl, 2007), others in terms of different cosmologies, this growing literature highlights an integrative principle absent in much of the western-led contemporary decision-making and sustainability logic. Moreover, these categorical distinctions were seen by many as allowing environmental change to be conceptualized with a utilitarian logic that prioritized environmental conservation around safeguarding economic concerns.

In the wake of the Millennium Ecosystem Assessment, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) was established in 2012,[12] as an independent intergovernmental science-policy body open to all member countries of the United Nations for biodiversity and ecosystem service assessment and policy needs. With an aim of contributing to the increasing number of worldwide initiatives that are beginning to focus on the co-construction of integrative knowledge, the IPBES devised a framework through which links between people and nature could be engaged with in more culturally appropriate perspectives. The Framework depicts

[9] For 15 years, the MDGs were to be taken up by national governments and international organizations until the year 2015 in order to address: reducing income poverty, providing much needed access to water and sanitation, driving down child mortality and drastically improving maternal health

[10] Based on the work of 1,360 global experts, the report examined current scientific understandings and brought together new insights in order to offer policy guidance, much like the Intergovernmental Panel on Climate Change (IPCC).

[11] Ontological turn and many related discussions analyse this subject deeply. This research recognizes their important contributions and the role their sustained discussions have had in shifting sustainability discourse, but a more thorough discussion of this literature is beyond the scope of this research.

[12] After a meeting on biodiversity and ecosystem services in June 2010 where States adopted the Busan outcome. IPBES is administratively supported by the UNEP and has a host country agreement with Germany for the presence of the IPBES secretariat in Bonn.

key social and ecological components, and the relationships between them and is set out in Figure 6 below.

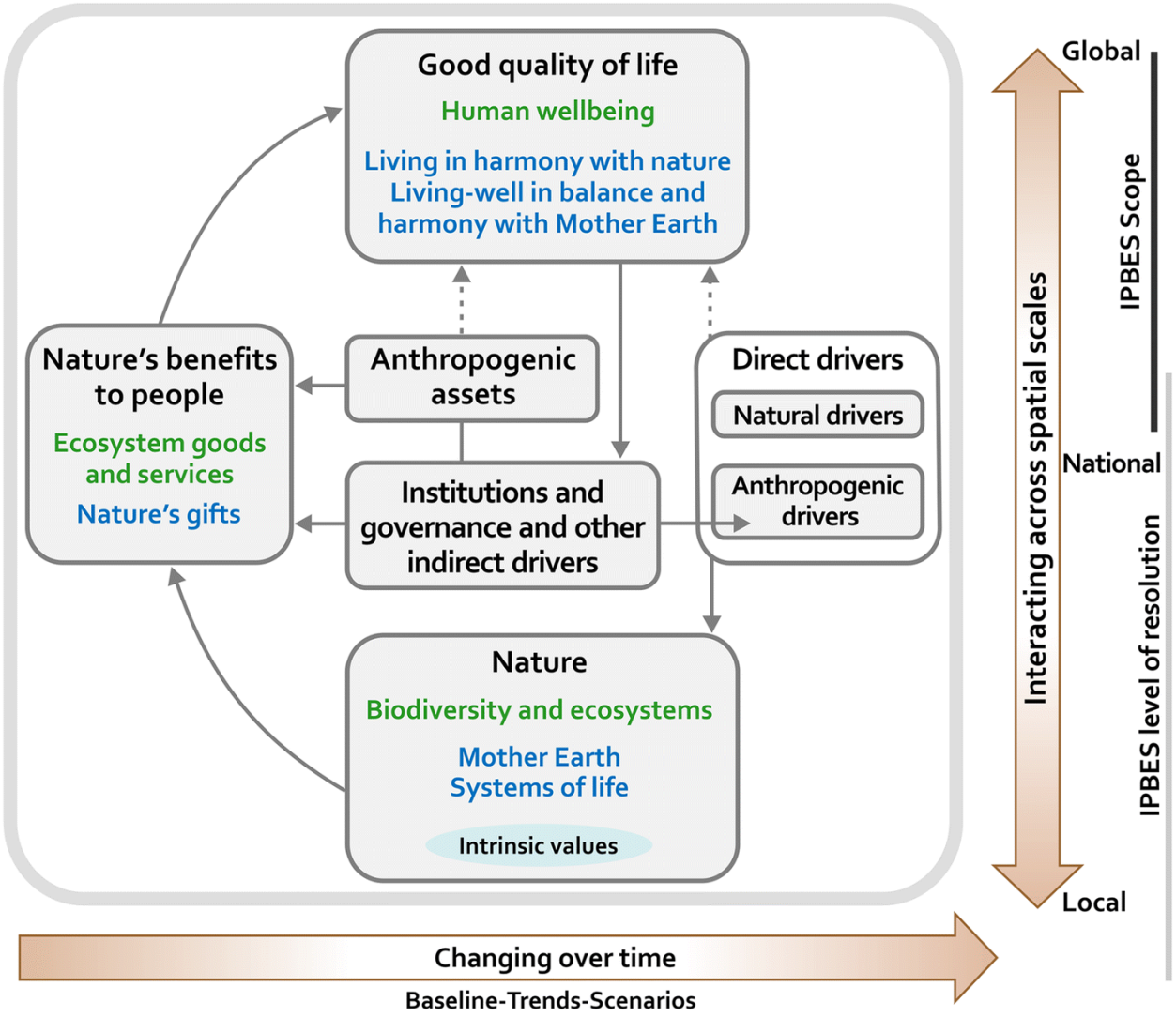

Figure 6: The IPBES Conceptual Framework provides the theoretical backdrop for the prevailing understandings in terms of 'what constitutes a resource' within the sustainability literature (Díaz et al., 2015). The processes and ideas presented within the IPBES Framework guide this case study's comparative analysis of resource meanings and formation processes endogenous to Caspian Eurasia.

The IPBES Framework offers a simplified model of the complex interactions between the natural world and human societies around elements that have been identified and understood as most relevant to the goals of sustainability and biodiversity conservation. It interlinks and emphasizes three inclusive aspects: nature, nature's contribution to people, and a good quality of life with the values ascribed to nature's contributions to people acting as the conduit between nature and a good

quality of life (Díaz et al. 2015). By looking to incorporate diverse disciplinary insights and types of knowledge, the IPBES goes beyond the term ecosystem services to embrace concepts associated with other worldviews on human–nature relations and knowledge systems (e.g. 'nature's gifts' in many indigenous cultures). Using a concept of Nature's Contribution to People (NCP) allows the IPBES to foreground the role of culture in defining links between nature and people (Gorosábel, A. et al., 2020; Díaz et al. 2015). This makes the IPBES Framework a particularly useful and relevant model for this sustainability case study. A key contribution from this case study's findings will update the IPBES Framework for the Eurasian context by highlighting the significance of livestock within the NCP concept. These discussions are presented in Chapter 6 Analysis.

Effectively, the IPBES model shows a reframing of how the human-environment question is being asked: 'what has a resource's contribution been to a people.' This emphasizes cultural context as a cross-cutting factor that does not require it to be immediately amenable to economic concerns and/or attitudes of environmentalism, foregrounding different human perception of nature and good qualities of life instead. While the IPBES Framework builds on a recognition of pluralism, there are limitations in the proposed nature's contributions to people framework. Many different approaches to the way relationships between nature and people can be discussed alongside one another, but they do not have to be all integrated within a single framework. This research aligns with this perspective. Causality cannot always be drawn for every context. Instead, research can unearth rich detail that can in turn be meaningful elsewhere by offering new interpretive bases or concepts.

However, ontological formulations that can be represented in a framework (especially graphically) in one setting may hold little meaning elsewhere. This research acknowledges debates of sustainability's conflictual work in other settings and that other human-environment relationship concepts being formalized today may hold similarly little meaning in Eurasia. As Chapter 3 will show, Eurasian peoples have developed within a unique geography which undergirded distinct life ways of oral societies and favoured mobile-based forms of social organization. There remains relatively little scholarly engagement with the region and, therefore, has led to limited theoretical basis for Eurasia's civilizational development model. Therefore, we do not know if the terms and concepts being formalized in other non-western settings for describing the human-environment relationship and their respective knowledge systems, (i.e. such as those in Latin America) will have

any relevance for understanding historical development qualities or knowledge systems of Eurasia.[13]

While I acknowledge critical theory discussions, I build on them cautiously. For example, the very assumption that there is not a human-nature divide for many societies, as a growing number of scholars contend, may be an entirely irrelevant assumption in the case of Eurasia. Much like the term 'biodiversity' and 'nature', their intrinsic value is appreciated along culturally distinct epistemological lines (this idea will be re-introduced in Chapter 6). Indeed, and oftentimes, these values are not stated explicitly. If claims of a given object of study can be confirmed by the western scientific method, then tentative inferences can help connect processes and entities involved with a reliable identification method. What this research aims to propose, taking the IPBES framework as a starting point, is the pattern of a historic human-environment relationship style can be developed that reflects lived local realities and not to assimilate to one environmental reality or understanding of it. The IPBES model offers an appropriate such framework to these ends because it allows the content this research is concerned with (i.e. the environment and resource) to remain the same. What changes is the ontological line along which the content can be conceptualized. By tracing an object of study – a "resource" – within a distinct cultural setting (the Caspian), the IPBES framework provides the conceptual space to identify areas in which content justifies conceptual refining. The IPBES can act as a conceptual aid by making visible the distinct nexuses that arise within a knowledge system. Bringing out and making suggestions in the direction of what some of these distinctly interlinked processes and entities could be in the context of Eurasian knowledge systems is what justifies this research's use of the IPBES Framework.

Extending the IPBES framing question of 'how has a resource contributed to the development of a people's culture and history', the institutional understandings of a resource (as a concept) are embedded in the regime of sustainability. Sustainability itself then, can be taken as a process. Cultural tellings of how, where, and for what, a 'resource' occurs serves a twin purpose: illuminating how a thing functions in a particular socio-cultural context, as well as how sustainability gets made. Together, these insights are expressions of the human-environment relationship. The IPBES framework's treatment of the terms: 'resource' and 'biodiversity' within a

[13] Many of these interpret environmental relations according to animist framework.

larger network of human interactions, this research was able to make sturgeon fish (and caviar as an important by-product) an effective tool for analysis.[14]

Sustainability, as an institutional outgrowth of 20th century societal change processes, has developed in tandem with these wider processes. However deep or wide the scale of change may have been of the last century, ideas and life ways preceding it were not displaced. At its core, sustainability is a modern-day construct asking the design question of what the human-environment relationship ought to, or can look like? Global dialogue of this sustainability institutional construct in recent decades reveals that the meaning-making processes of what constitutes the environment, human's biological place within it, and the principles by which a people relate to it, are highly varied across cultures and geographies.

This brief overview provides a glimpse into some of the overarching 20th century historical factors and seeks to situate the program of sustainability emerging in the post-WWII context as having been mobilized in a context of a distinct set of resources, disciplines, practices, and research traditions that were embedded in a particular system of knowledge. More specifically, these factors were contingent to western European (and particularly American) preoccupations at the time. Yet these development processes are not discrete and importantly build from the prevailing philosophical and intellectual traditions. Those informing western European and American thought systems are from the former Greco-Roman world. The particular thought traditions and schools emerging from the particular Greco-Roman civilizational history, frame the conceptual landscape to which conditions of the human life are placed. Most of the world's cultures, however, do not find their origins within this western system of thought. What this research documents and will elaborate on in future chapters, is the problematic nature of contextualizing the sustainability experiences of one civilizational development history and anticipating components and dynamics of this system to be readily identifiable when recontextualized in another. In order to highlight the shortcomings of such analytic assumptions, the notion of knowledge systems allows this research to trace and to make sense of effects from the interactions between different civilizational stories within the sphere of sustainability. To this end, what the *methodologies* of knowing are (or are not) within the institutional regime of modern-day sustainability, crystallizes through the IPBES question, "what is a resource to you?" This brief literature overview of sustainability is offered as an anthropology of sustainability itself, as a domain of thought and practice operating under a

[14] How subsequent responses come to be integrated and applied to sustainability practice, however, is a function of the value system sustainability locates itself

conceptual framework that has come to be referred to as sustainability. It is this area in which this research aims to contribute.

As will be explained in the course of this dissertation, this research's style of engagement with knowledge and knowledge systems does not entail explicitly asking respondents to state what knowledge is from their perspective. Rather, and as will be elaborated on in the Methodology and Findings Chapters, this research's fieldwork used the concepts of knowledge and knowledge systems to map Caspian sturgeon as a representation of resource understandings. The idea of knowledge then, gave this research a grounding tool for listening to *how* sturgeon (and sturgeon by-products) were used and a framework by which to trace the values associated with those use patterns. This justified the ethnographic component of this research and looked to the phenomenology of sturgeon and caviar within the Caspian landscape. This became an indispensable mode for conceptualizing sustainability within the IPBES framework.

Part II

Chapter 3 – Contextual Background

3.1 Introduction

Introduces ideas in order to substantiate geography as the methodology - The environment is not the object of inquiry; it gives the method.

This chapter offers a historical background in which fieldwork can be contextualized in Chapter 5 and is analysed in Chapter 6. The chapter is organized into two parts so that each aspect of the case study can be sufficiently situated. First, because this research investigates a cultural relationship to the notion of sustainability, the modes and physical realities in which that culture has developed its human-environment relationship must be clarified for analyses. In order to develop a sustainability case study, sturgeon – a 'resource' – was used to trace the Caspian's understanding of sustainability in the modern-day framework of the nation-state. To this end, the second part of this background chapter reviews the history of sturgeon fishing and conservation, as well as relevant environmental management practices in the Caspian.

Figure 7 below illustrates the aim of contextualizing the Eurasian geographic landscape as well as Caspian sturgeon use in order to establish an appropriate analytic background such that a comprehensive case study can be presented.

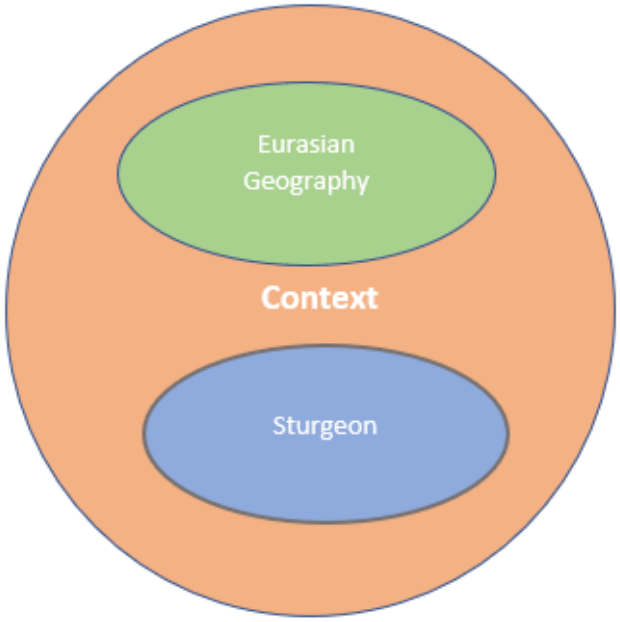

Figure 7: Research Context Background Diagram (Berman, C. 2021). Depicts how this chapter will discuss sturgeon fish and the Eurasian Steppe geography as the two primary contextual aspects grounding this case study.

Part 1 of Chapter 3 – Geography as Culture

3.2 Eurasian Civilizational Development

This first part of Chapter 3 discusses the first inner sphere of the context graphic above: Eurasian geography. It introduces the idea that because environmental geography unequivocally shaped the historic relations between Eurasian Steppe and peoples, it conditions the nature of resource meanings and sustainability-conservation practice in the Caspian today. It will demonstrate this historic relationship first by outlining the prevailing environmental features of the Eurasian steppe geography. These environmental characteristics then will be contextualized in a discussion of pastoral nomadic practices to demonstrate the *co-conditioning* processes between human and environmental development in the region. While this research focuses on the human development end of these relations, the prefix '*co*' is used to emphasize the non-deterministic nature of these interactions. Pastoral and nomadic studies substantiate how unique life ways were developed given

the region's biophysical and geological factors. That is, from looking to the physical geographic factors, the respective biological and physiological requirements of livestock species provide important insight into the nature of nomadic community organization. To give better shape to these considerations, the following depiction orients the information that will be presented within this Part 1.

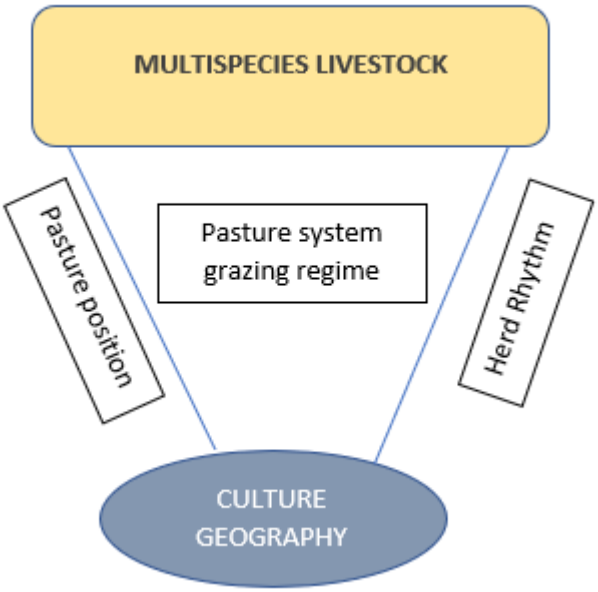

Figure 8: Factors Unifying Eurasian Peoples, Landscape and Livestock (Berman, C. 2021). Interactions between the Eurasian Steppe environment and multi-species livestock herds create distinct requirements and set of conditions for livestock production. The relationships between these elements constitutes Eurasia's culture-geography nexus through the resulting style of land utilization.

The environmental geography-culture discussions introduced in the context of this background chapter allows for better situating modern day food practices with Caspian sturgeon. These ideas will be re-introduced in Chapter 6 Analysis in order to demonstrate the fundamental persistence of cultural resource understandings. The following sections will substantiate the research design of the dissertation whereby the environment does not act as the object of inquiry but gives the *method* for analysis. From this methodological base, fieldwork findings will be contextualized to demonstrate connections between modern day resource uses with an enduring food system that arises from these particular physical geographical realities.

Moreover, because this research is an analysis of the concept of sustainability and resource understandings, this contextual chapter is necessary as it will allow this thesis to show how the particular civilizational premises and narratives in which the sustainability concept are predicated – namely in that of sedentary peoples. The development histories of sedentary peoples introduce assumptions that do not apply to Eurasia's development path. Yet there is a notable lack of theoretical models to follow for explaining Eurasia's historical development. While this research looks to ethnographic studies and academic work in the field of pastoral studies to establish an analytic base, it remains mindful of early translations and classical interpretations which, despite having been re-read or discredited, often can be located in contemporary studies of Eurasia.[15]

Several notable 20th-century anthropological studies helped replace prevailing myths and misplaced theories of nomadic peoples (Sneath, 2007, Khasanov, 1984).[16] Placing emphasis on the ecology within which nomadism and pastoralism occurred, economic and social strategies of mobile peoples could be conceptualized as viable alternatives for resource sourcing in geographies that were not conducive to intensive crop cultivation (Linseele, 2010: 45; Schlee, 2005; Christian, 1990; Krader 1955; Lattimore 1940; Dahl and Hjort 1976; Spooner 1973). From these investigations, livestock could be represented as the "means by which non-productive regions became productive through their conversion of arid land vegetation into meat, dairy and secondary sources" (Honeychurch, 2014: 279; Chang and Koster 1986).

Although many pastoral peoples, past and present, cultivated crops such as millet, barley, and wheat, doing so did not lead to sedentism or fixed agriculture. Crops remained second and

[15] Almost a century of systematic research on nomadic and pastoral societies amounted to ample theory and data developed for the purpose of enhancing administrative objectives and foreign interests. Many theories appealed to an evolutionist worldview and according to the classical canons of an idealized human historical path - from pre-capitalist, feudal, agrarian, state (Sneath, 2003; Scott; 2013). Most saliently, standard representations emphasized nomads as barbaric with economies primed for war-making and environmentally determined, simple political structures (Sneath, 2021). Also, social phenomena of nomadic societies often was explained in terms of 'tribes' and 'clans,' when there was in fact no correlative term (Bauer et al., 2007; Sneath, 2007). The notion of 'clans', generally presumed to link together to form 'tribes', holds little meaning in explaining social relations in pastoral and nomadic societies (*Ibid*).

[16] This research uses the terms nomadic and pastoral to imply *mobility-based* modes of community life. The categorical differences and boundaries between nomadism, nomadic-pastoralism, and pastoralism have sustained a wide array of scholarly discussions (see Frachetti, 2009; Boyle et al., 2002). Providing an overview of this debate is not relevant for the purposes of this research as future arguments rely on the existence of these life ways, not the essentialized differences between them. The use of the term 'pastoralism' or 'nomadism' in this writing reflects their use within the secondary sources.

supplementary to the livestock-based system (Scott; 2017; Honeychurch, 2014; Spengler, R. et al., 2013; Khazanov, 1984).[17]

This broader model of pastoralism as a highly integrated social-ecological system has been applied successfully to case studies of mobile peoples across a range of spatiotemporal contexts (i.e. from Greater Mesopotamia to South Asia), and can account for the variation in nomadic practices related to different livestock herd types as well as environment and climate regimes shaping resource availability (Manzano et al., 2021: 659). This idea will be elaborated further in Chapter 6 Analysis. For the purpose of this background chapter, the reason that the environmental-social co-conditioning model offers a high degree of explanatory power is because it gives greater emphasis to dynamic processes for providing the structure of nomadic and pastoral systems, rather than the elements themselves. With this in mind, the detailed discussion of the historic Eurasian nomadic system based on secondary sources that follows is not to be able to discuss the various components in detail. Instead, they are to bring greater texture to the system's functions that arise out of the connections, rather than the parts alone (i.e. not looking exclusively at the physical characteristics of the steppe geography but the processes by which land and people have engaged in Eurasia). Centring these qualities of the Eurasian system through this contextual background chapter will allow Chapter 6 Analysis to show how and from where Eurasia produced its own resource meanings.

Lastly, this research does not adhere to a geography defined by nation-state borders. The loose groupings of peoples, tribes, religions, and lifeways grouped mechanically into nation-state entities often misrepresent historical realities and create problematic bases for analyses.[18] Particularly in the case of Eurasia where nation-statehood is a phenomenon arriving less than thirty years ago, nation-state borders impose abstract concepts that often convey more difference than exists in

[17] Nomadic groups that cultivated crops travelled around their pastures while growing spring-sown crops. After the reaping, they processed the harvest, took part of it and put the rest in the soil until the next season (Spengler et al., 2013: 68). A review of ethnographic and archaeological evidence for steppe nomadic communities suggests that nomads did not require large amounts of agricultural products to survive (Di Cosmo, 1994).

[18] Empires such as the Mongols, Scythians or Russians offer convenient units, but only for limited historical periods (Christian, 1994: 173).

reality. Moreover, the sudden arrival of a nation-state existence for Caspian peoples, and the subsequent need for narrating new national histories from a political perspective, would have complicated the nation state as a unit of study for this research (Ferret, 2016).

3.2.1. Environmental Overview

This section explains the dominant environmental factors of the Eurasian region and how, given their relative continuity (in geologic terms) since the last Little Ice Age, they can be treated as constant.[19]

This research borrows from geographic delimitations of the Eurasian landmass established by numerous scholars (Di Cosmo, 2009; Hanks and Linduff, 2009; Boyle et al., 2002; Christian, 1994; Taafe, 1990). Totalling a territory of eight million square miles,[20] Eurasia comprises the world's largest flatlands area (Taafe, 1990: 19). Moving from north to south, coniferous forests of the taiga transition to mixed and deciduous forests before eventually converging with steppe grassland (Shahgedanova, 2003: 3). In the drier borderlands of the steppe, tall grasslands are gradually replaced by more sparse semi-desert, or desert-steppe areas (Christian, 1994: 174; Taafe, 1990: 20). To the west, mixed deciduous forests extending into Hungary provide the region's border with Europe with the Pacific defining its westernmost reaches (Christian, 1994).[21] The snow-capped Kopetdag Mountains designate the region's southern boundary (Christian, 1994; Taafe, 1990). However, despite considerable variety in the terrain of the geography, viewing the Eurasian landmass longitudinally reveals a considerable continuity. Spanning from the Black Sea to the plains of Manchuria and eastern Mongolian prairies, the virtually continuous cover of grasses is the most distinguishing manifestation of this uniformity (Okladnikov, A., and Crookenden, J., 1990;

[19] Although human societal activities inevitably shape the landscapes in which they occur – be it through forest clearing or altering hydrologic regimes for crop agriculture – Inner Asia's ecologies notably have retained their original character since the Little Ice Age (Taafe, 1990). This provides a useful constancy with which features of the Caspian's human-environment relationship across time can be identified.

[20] about one-seventh of the land area of the world

[21] The Ural Mountains of western Russia and northwest Kazakhstan constituting the conventional border between Europe and Eurasia elides historical exchange of goods and peoples to the extent that this boundary is not seen as useful (Christian, 1994).

Taafe, 1990: 19). The immense size of the region's prevailing grassland ecologies effectively overcomes terrain diversity (Christian, 1994).[22]

A useful approach to understand Eurasia's bio-physical system is in terms of distinctive zones, or large-scale ecological complexes arranged along latitude (Binney et al., 2017). Yet transitions between these zones are gradual and remain integrated by climate, and soil and water regimes (*Ibid*; Taafe,1990). The main distinguishing difference between these zones is their predominant types of vegetation. To be sure, internal variations occur within all the natural zones. Yet rarely are they of a sufficient magnitude to disrupt the overall uniformity of these zones. Because of the gradual nature of transition between and relative continuity across these ecological complexes, the term 'steppe' will be used as an encompassing unit for these ecological zone types for the remainder of this writing.

The mountainous sub-regions of Eurasia's geography are marked by 7,000meter-high mountain ranges of the Tien Shan and Altai to the west, and the Greater Khingan Mountains and ribbons of mountainous topography at the edges of the Mongolian Plateau to the east that break the arid, low relief plateaus and prairie expanses (Shahgedanova, 2003: 244). While geologically diverse in age and structure, the mountain chains themselves occur with a "geographic homogeneity aligned in a sinuous and occasionally discontinuous band" (Taafe, 1990: 24). Trending southwest to the northwest over thousands of miles, mountain ranges reach from the Caucasus and southern margins of Central Asia to the northeastern tip of Siberia with major mountain chains branching off this axis towards Mongolia and Manchuria (*Ibid*).

Isolation from climate moderating oceanic influences gives the vast Eurasian heartland a continental and semi-arid climate with extreme temperature fluctuations (Zhong et al., 2018; Shahgedanova, 2003; Christian, 1994; Taafe, 1990). The distance from oceans along with mountain barriers limiting maritime air influences gives the region the highest degree of continentality on earth, where winters are cold or extremely cold, and the summers are either warm or very hot (Di Cosmo et al., 2009; Christian, 1994: 181; Taafe, 1990). The resulting high aridity and extreme temperature fluctuations lead to an ecological productivity that can cope with the short growing seasons through immense grasslands with little topographical variation (Christian, 1994: 182).

[22] For example, a belt of grassland can be traversed for 6,000 miles from the Pacific Ocean with the most significant form of variety encountered being between grass types (Taafe, 1990).

Over thousands of years, composting of these grasses has endowed the steppe lands with rich soils (Shahgedanova, 2003; *Ibid*).

Given its aridity, the effective moisture (or the ratio of precipitation to evaporation) is the most indicative factor in the region's climate regime (Liu et al., 2014; Di Cosmo et al., 2009; Shahgedanova, 2003; Christian, 1994; Taafe, 1990). Average precipitation ranges from 10 inches to 20 inches as a whole and precipitation only exceeds the rate of evaporation by 30 to 59 per cent (Taafe, 1990: 34). However, extensive river systems – the Danube, Dnieper, Don, Volga along the western steppes with the Ob-Irtysh draining into the Kazakh steppe to the east – provide substantial hydrologic compensation (Fedoseev A.P., 1964). Moist European air masses and snow melt from the Tien Shan provide the majority of the Zungarian steppe sub-region with moisture, while grasslands approaching Mongolia to the east have a close water table (Taafe, 1994: 36).[23]

3.2.2. Eurasian Civilizational Development History

From one perspective, moisture deficits, short growing seasons, and extreme continentality of Eurasia created distinct challenges for human habitation on the Eurasian steppe (Christian, 1994: 176). Yet Eurasia's moisture regime creates a deficiency benchmark only insofar as it precludes extensive rain-fed or irrigation-based farming and a moderating climate regime required for large scale crop agriculture (Di Cosmo et al., 2009; Frachetti, 2009; Christian, 1994; Lusigi W. J., Glaser G., 1984; Dahl, G., and Hjort, A., 1976; Andrianov, 1968). However, what was restrictive in one sense merely established development possibilities which derived from different solution sets. Abundant steppe grasslands with rich underlying soils provided necessary elements for a thriving food system based on pastoral herding and nomadism (Lusigi W. J., Glaser G., 1984; Khasanov, 1978).[24] Ultimately, these physical environmental realities set in motion a particular historical development process which beget a particular civilization of peoples. The solutions for making use of the region's

[23] Which has been tapped for centuries (Andrianov, 1969). The immense desert zone stretching east from the Caspian to the edge of the Gobi and Ordos deserts in Mongolia have supported human settlement since antiquity owing to fertile oases along the Syr Darya and Amu Darya rivers (Kohl et al., 2002). Alluvial soils of the Amu Darya delta and loessal piedmont plains are drained by the Syr Darya (Taafe, 1990). The social significance of the water table in terms of artificial well construction and maintenance will be discussed later in this section.

24 Although these grasslands vary in type and quality, a common feature is that they have provided an abundant and easily utilized fodder base for pastoral nomadism. The black-earth soil regions in the steppe typically are covered by tall pinnate feathergrasses, fescue, and mixed grasses (Binney et al., 2017: 82). In the drier southern portions of the steppe, different varieties of feather grasses and other cereal grasses dominate the biotic structure (Shahgedanova, 2003). Very often, an area in the steppe will have a succession of different varieties of grasses from May to autumn providing a wide range of fodder opportunities (Masanov, 2000; 12; Ivanov, 1973).

ecological productivity crystallized into distinctive ways of life, economic structures, politics, and worldview (Bauer et al., 2007; Kohl et al., 2002; Spooner, 1973). Settling in the steppe meant developing strategies to exploit food energy indirectly, by living off other animals that could metabolize the abundant grassland biomass (Forbey et al., 2009; Frachetti, 2009; Christian, 1994: 190; Dahl, G. and Hjort, A., 1976; Spooner, 1971). While Christian notes how hunting was the first adaptation type that became normal in the region, developing subsistence strategies based on hunting was extremely difficult and capped human population size, ultimately limiting human settlement of Eurasia for several hundred thousand years (1994: 184).

The model of nomadic/pastoralism that remains current and most elaborated by scholars proposes pastoral nomadism as a food-producing economy based on specialized livestock husbandry and grazing regimes across associative collectives (Honeychurch, 2014; Khazanov 1984; Lusigi, W.J. and Glaser, G., 1984; Spooner, 1971). For Eurasia, the general roaming process, selection and basic elements of nomadic labour did not undergo system-wide change until the beginning 20th century with Soviet collectivization.[25] While the relatively unchanged circumstances in land, vegetable cover type, and water and soil resources precluded transforming or scaling up the material and technical base of the nomadic livestock-breeding economies in any radical way, they provided a constancy by which nomadic societies could endure (Bunyatyan, 1984).

The historic nomadic economy in Eurasia was based essentially on multispecies breeding of livestock, both small (sheep and goats) and large (horses, cattle and camels).[26] Ecozones discussed in Section 3.2.1. were exploited through a system of seasonal rotation of pastures. This required residential mobility either of the whole population, or in sequences where some members travelled at different moments to attend to other elements of the nomadic system (such as supporting product production from animal derivatives, sowing of crops, etc.) (Shahgedanova, M, 2003; Petrov, 1975). Within this mobility framework, the specific biological requirements of each species in a herd resulted in different patterns of grazing across a pasture (ecological zone). As a consequence,

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[25] The Soviet system centralized methods of animal husbandry in combination with the concentration of huge flocks and herds, leading to complete collapse and erosion of 55 million hectares of pasture-land (Kreutzmann, 2013: 3; Apollova,N.G., 1969). The organizing practices of nomadic peoples under the new environmental management regime struggled to adapt to state land privatization (Pianciola, 2001: 237).

[26] Species delineation and resulting breeding practices, however, traditionally draw on different, non-Linnean characteristics, such as color, gait (in horses), and use type (i.e. beast of burden) (Mathias, 2008; Masanov, 1995; Andrainov, 1982).

foraging requirements of individual species in a herd, as well as their age with respect to the breeding cycle, designated the timing and conditions by which a pasture's productivity could be maximized (Masanov, 1995: 30). Migrations were timed to coincide with the most favourable conditions (vegetative and hydrologic) within the process of pasture selection. Thus, the particular needs of a herd acted as the mechanism connecting land and people. Humans and animals moved from one seasonal location to another: the *Kystau* (winter sites), *Kokteu* (spring sites), *Zhailau* (summer sites) and K*uzeu* (autumn sites) (Masanov, 1995).[27]

Nomad pasture techniques, therefore, are characterized by a high seasonality with naturally in-built periods of regeneration (Manzano et al. 2021: 653). The resulting processes created a general grazing calendar. Winter rangelands historically focused on satisfying forage demand determined by the duration and extent of snow cover and, therefore, were located primarily in desert and semi-desert ecological zones (Masanov, 1995: 63). Summer pastures were situated mainly to the north or in mountainous or low mountain terrain (*Ibid*: 67). The main factor in choosing *Zhailau* was the availability of consistent water sources throughout nomadic route ways (*Ibid* 100). Meanwhile, spring and autumn pastures were located enroute from winter pastures and to summer pastures and acted as an intermediate travel bases of nomadic migrations. Therefore, they played a connecting economic and ecological role between *Kystau* and *Zhailau* (Andrianov, 1985).[28]

The following sections detail specific strategies built into the grazing regimes across seasons to highlight the degree of refinement of livestock strategies. In doing so makes the logic of the system more transparent to act as a better contextual backdrop to which later resource discussions can be situated.

[27] Pasturing names and terminology most common to Kirghiz and Kazakh peoples although the same general seasonal division of grazing lands can be applied more widely to other groups (Masanov, 1995: 121).

[28] Intra-seasonal calendar systems have been documented for many pastoral groups. For the Afchâr, a Turkish Oguz tribe residing in modern-day Azerbaijan, to Khorâssân and Kermân, summer pastures were split – one being purely pastoral until the end of June while the other was cultivated for winter and spring cereals and summer vegetables. When livestock descended down from higher elevations in September with herders, other family members would stay in the mountains for one or two more months until mid-November to complete the crop cultivation (McLachlan, K. and Stobbs, A.,1980; Tapper, 1969).

Winter

Winter was the most difficult season for livestock survival (Andrianov, 1978). Therefore, it required the most elaborated strategies relative to other seasonal grazing regimes. Winter pasture locations were determined primarily by a minimum duration of 2-3 months (to allow for other pasture areas to regenerate and for the appropriate forage to come into season), warmer climate, and lower chances of severe snowstorms (Masanov, 1995: 91). According to Masanov, winter pastures had to be well protected from the winds, proximate to comfortable watering sources, sustain a layer of grass under the snow, and have access to dry fuel stocks that could be collected in large quantities (1995: 290). As a result, wintering was mainly located in the valleys of hills with rivers (*Ibid*). In warm and calm weather, livestock could be grazed on the windward sides of slopes and hills while in hollows, reeds, and shrubs in colder weather (Pogorelsky, 1949: 147). Within a decided winter pasture, it was managed according to its specific topography to optimize its feed capacity (Petrov, 1975: 175; Rubel, 1969). Therefore, more snowy areas were used for grazing at the beginning and at the end of winter, while steep depressions and northern slopes of hills were used during the coldest months (Pastner, S., 1976: 286).

Grazing habits of specific livestock species were integrated into seasonal considerations to produce highly developed herding strategies. Environmental conditions such as snow depth and type could be accounted to allow for optimal pasture use. As Masanov notes, a common feature of winter grazing was guiding sheep and goats according to a strict series of lanes that radiated outward from watering sources (1995: 95). This was to ensure sufficient forage remained available as feed would harden after the livestock had walked over top and cloven-hooved sheep would be unable to paw through (*Ibid*: 102). In bad weather, sheep were grazed against the wind, in order to control their drifting (*Ibid*: 95). If a strong wind removed snow cover, or warmed an already used pasture, then sheep and goats could re-graze the site (Petrov, 1975: 36). However, in fine and light snowy weather, nomads grazed sheep away from the main *Kystau* site, closer to the periphery of the spring (*Kokteu*) pasture (*Ibid*: 37). Winter pastures occupied a territory to the extent of sheep's daily grazing area, roughly 3-4 kilometres (Andrianov, 1978). Therefore, winter pastures are often at times divided, firstly, into pastures located near *Kystau*, on which young animals and weak livestock were grazed and snow cover more easily cleared, while the remainder of the herd were grazed further afield (Pershits A. I. and Khazanov A. M., 1979; Andrianov, 1978: 280).

Strategies for optimizing pasture lands also were generated through grazing certain species in areas that were inaccessible for others. Cattle grazing in winter then, became associated with the

sheep grazing system through the process of maximizing pasture resources not accessible to sheep and goats. In cases of deep snow but with vegetation protruding (since cattle do not dig), cattle were grazed to make use of vegetation that could not be utilized by sheep and goats. Horses made pasture areas productive according to their own needs and abilities (Potanin, G.N., 1867 [in Masanov, 1995]). Horses were amenable to grazing on rocky terrain and snow cover could be up to 30-40 cm, and even as high as 50-60 cm as they could dig through snow while cattle, camels, and small livestock species could not. Because horses could travel up to 50 km per day, they typically were kept separate from other livestock in winter pastures. (Sadykov, 1981: 7 [in Masanov, 1995: 97]).

Another intricacy of the grazing system is seen through how to gain the most productiveness of a pasture in a single use. For example, after grazing cattle, camels, or horses, grazing sheep was almost impossible as the larger animals left deep tracks in the snow (Masanov, 1995: 93). These developed a hardened frost and prevented sheep or goats from grazing (Fedoseev, A.P., 1959: 4). In instances of deep and dense snow layers, the pasture was cleared of snow manually depending on the species of the herd (Masanov, 1995: 93). For sheep and goats only the top layer of snow was removed or slightly loosened, whereas for cattle it was necessary to completely clear the whole pasture (*Ibid*; Andrianov, B.V., 1978)

Spring

The spring migration typically occurred from March until the beginning of May (Stôber, 1978 [in McLachlan, Keith, and Andrew Stobbs, 1980: 218]). This was in order to coincide with the breeding season when livestock were lactating and unable to move quickly or long distances (Masanov, 1995: 71; Pershits, A.I. and Khasanov, A.M., 1979; Rubel, 1969). Therefore, spring pastures were coordinated around seasonal optimizing so that herds could remain stationary for longer periods, particularly for when young were born, typically in April (Fedoseev, A.P., 1964: 7). All of this reflects pastoralists' understanding of the intricacies of the environmental situation and the aim to make the best use of what is available in their disposal of resources (Radchenko, 1983: 139).

Summer

For the summer pastures, herds were directed to flat plains and lowlands in the open steppe where forbs and cereal plants were reaching their peak growing, or to previously unsuitable areas due to deep snow or dry vegetation (Masanov, 1995: 69; Fedoseev, 1959). Grasses in previously inaccessible snow-covered hollows and ravines, and shade from relief these features, maximized summer pasture resources (Masanov, 1995; Pershits, 1958: 72). The most time-consuming process in the warmer months was provisioning livestock with water. In summer, this was upwards of 2-3 times a day and was very laborious as livestock needed to be restrained from rushing watering holes (Masanov, 1995: 95; Ishenko et al., 1928). Therefore, herds were watered in batches as folk experience attested to the need to guide livestock in sequenced groups to prevent stampeding, particularly by easily-agitated stallions (Masanov, 2000: 95).[29]

Autumn

The autumn cattle grazing system followed seasonal productivity trends and correlated with late-blooming vegetation species whilst moving towards winter pastures (Ivanov, 1973: 156). Unlike spring, the autumn period was longer since the transition to winter pasture commenced only once a sustained snow cover arrived (Masanov, 1995; Fieldstrup, F., 1927). Therefore, the boundaries of the autumn period were irregular and changing and its duration directly depended on the nature of precipitation and air temperature (Masanov, 1995: 13).

Across these seasonal dynamics, a style of relating to the land was indirectly connected via pasture requirements of livestock species (Masanov, 1995: 14). Viewed from the water cycle, certain vegetation types reach maximum productivity in spring whereas others only reach their peak growing by mid-autumn. This optimal productivity of vegetation types could range from 2-3 days, to several weeks (Binney et al., 2017; Fedorovich, 1973; Fedoseev A.P., 1964). Therefore, the process of wandering is mainly the process of using grazing land in the most optimal terms - when feed resources reached maturity (Masanov, 1995: 76). More drought-resistant plants, such as

[29] Watering proceeded with 10-15 camels taken to water first as they drank carefully and did not stir up sediment. Next batches of 10-15 goats were taken with horses taken last unless they are a younger and more inexperienced herd. In the case of the later if sensitive to agitated water, horses are watered before camels. Lastly, in batches of 15-20 goats, they are watered sheep and goats, very few are legible to water. Sheep and goats standing but they stir up water with their feet" (Ischenko et al., 1928.: 64 cited in Masanov, 1995: 88).

wormwood (*Artemisia absinthium*) and several Tamarisk or salt cedar species (*Tamarix*) growing in sandy soil, are common in the Kyzyl-Kum steppe-desert regions and amenable to grazing year-round (Fedoseev A.P., 1964 [in Masanov, 1988]). As a result of these human-animal-Steppe ecology relations, only when pastures were able to offer vegetation for livestock feed *did those pastures have nomadic value* (Masanov, 2000: 122).[30] In the absence of a herd then, the need for possession and use of land and water resources was removed. Neither land nor water had nomadic value independent of livestock. The effects of this value creation mechanism will be discussed further in Chapter 6 Analysis.

Mobility itself generated value within the nomadic system as it created land use possibilities not achievable under sedentary conditions. This value was embedded in the livestock currency and could be enhanced based upon the number, types and quality of species produced. The process of value-adding then, was reflected in the composition of livestock herds as each species moved through pasture landscapes according to its own rhythm and carried its own nutritional requirements. For example, in the semi-desert zone of Kazakhstan, of the 288 plant species, horses and horned cattle would consume 109, while camels were able to eat 148, and sheep, 167 species (Ivanov, 1973: 63). From the steppe-desert species, the 180 species - particularly of the Artemisia genus, sheep consume 132 species while cattle only 24 (Ivanov, 1973: 61). Similarly, each species had its own adaptive ability with regard to water quality and availability.[31][32]

Distances to water sources were an important regulating factor and varied across seasons, as listed below:

> Sheep: in the spring — 4-6 km, in the summer — 3-5 km, in the fall — 5-7 km,
> Horses: in the spring — 6–9 km, in the summer — 5–8 km, in the fall — N/A

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[30] However, this style of land relation does not necessarily mean one that is highly extractive (in the sense of Hardin's 'Tragedy of the Commons' thesis) or transactional in nature. We can determine this to not be relevant by virtue of return and cyclic use of pasture areas. Indeed, winter was the most difficult season for livestock management in terms of survival rates and increased caloric necessities, winter pastures were "usually saved from generation to generation as something *hereditary* and *precious*" (Masanov, 2000: 66). Winter range lands then, were considered investment property and only changed in cases of extreme necessity (Rubel, P.G, 1969).

[31] Water containing salts from 1 - 3 gram /liter were deemed suitable for all types of animals and temporarily for people. Water with a salt content over 5gram/liter was suitable only for sheep and camels and temporarily for large horn cattle (Fedorovich B. A., 1973: 209; Fieldstrup, 1927).

[32] The maximum distance between water sources was not to exceed: 4-5km for small cattle, 2-2.5km for horses, 5-8 for goat and sheep, and for camels up to 8-10 km (Masanov, 1995: 95).

Cattle: in the spring — 5-6 km, in the summer 4-6 km, in the fall — 5-6 km

(Ishchenko et al., 1928: 217 [in Masanov, 2000]). [33]

Rates of wandering also were influenced by the concentration and size of each herd. In areas with more surface water sources, such as in foothill areas, there was less traffic compared to when moving through artificial (well) water sources as more dispersed water sources allowed for higher grazing intensity (Masanov, 1995: 75). As a result, staying times in a pasture are longer and herd movement rates are slower. When herds were in high concentration within a pasture, herds were forced to move at maximum speed with little rest time (Masanov, 1995: 86).

Another critical component in structuring grazing regimes was the need for overnight sheltering for some species. As sheep do not graze at night, they had to be driven into yards or sheltering areas, thus limiting their daily driving distances (Petrov, 1975: 80). During some seasons, cattle were kept in stone shelters or corrals fenced with trees, reeds, or brushwood walls (*Ibid*). Horses, on the contrary, could be driven to further pasture sites as they did not require overnight shelter and would graze both day and night (*Ibid*; Fedorovich, 1969).

Collectively, these overlapping factors of a multi-species herds and chains of social-ecological relations encompass what Masanov describes as the nomadic process (1988: 205). With winter as the most challenging season, the start of the nomadic process then was the start of snow receding as it catalysed vegetation growing processes (*Ibid*). Moreover, these overlaps can be complementary in nature with modifications of herd animals in order to, for example, balance age-sex structure and maintain a minimum breeding stock (Manzano et al., 2021: 653).

Groups of people within this process became affiliated through shared goals of livestock production (Masanov, 1995: 69). Because the sex-ratio and species composition of a herd is constantly changing across seasons, as animals from various groups are dynamically joined together and separated off again, there is constant pressure to make changes in herd makeup to maintain pasture optimization (*Ibid*). In winter, sheep from one aul were usually combined into a common flock (K*otan*) (Masanov, 1995: 94; Pershits A. I., Khazanov A. M, 1979; Andrinov, 1978). In turn, herders in more open steppe-plains looked to optimize the terrain for cattle and camel grazing conditions

[33] The driving speed for flocks of sheep ranged from 0.6-1.2 kilometers/hour to 1.1-1.5 kilometers/hour. Cattle driving speeds were roughly 0.5-1.6 kilometers/hour (Masanov, 1995).

(Fieldstrup, 1927: 78 [in Masanov, 1995]). At the same time, a minimum number of human groups required to meet the necessary tasks of a given herd in one moment was consistently in flux (Masanov, 1995: 98).[34] Yet patterns of human reshuffling could be traced across the nomadic system according to seasons. In general, the logic of labour within the nomadic system followed the principle that, "investments in animals creates larger herds that require greater spatial circulation to access sufficient pasture" (Honeychurch, 2014: 290). The majority of labour operations were only possible with close integration with pastoral groups - from shearing sheep to harvesting crops, to regular herd maintenance or food sourcing (such as fishing) (Masanov, 1995: 70).

Land and water use principles were predicated on an associations-based style of relations. (Petrov, 1975: 175).[35] Virtually no groups or communities within this system possessed a monopoly either on the land or water. Instead, access (as a proxy of ownership) was validated through demonstrated contribution to the maintenance or upkeep of the respective land or water cycles (Masanov, 1995: 82; Ishenko, 1928).[36]

Water ownership and access acquired a slightly different form in some locales of Eurasia where more irrigation-based water management strategies were pursued (Khazanov, 1984).[37] The main difference in the elaboration of more irrigation-based water harvesting as opposed to wells was

[34] The minimum labor contribution for livestock was roughly 5-6 households in winter and no more than 10-12 households in the summer period (Masanov, 1995: 87).

[35] The notion of ownership is conventionally approached through property rights – ownership in the steppe historically was resolved by one's demonstrated and validated contribution to the maintenance or creation of artificial water sources (or that your ancestors had). Because of the seasonal use of pastures, there was not the same motivation for such property guarantees and resource use when the conditions of use are not uniform throughout the year.

[36] There are two main types of water use in the steppe - natural and artificial. The first occurred in the forest-steppe zones, foothill and low-mountain areas, on alpine and subalpine meadows from snowmelt and constant river systems. Artificial sources of water use entailed tapping groundwater with wells, ranging from 1-10 meters in depth (Tolybekov, 1971: 84-86; 1979.P. 30; Pulyarkin, 1982: 148 cited in Khazanov, 1984). Particularly in the steppe-desert, groundwater was the main water source (Obyedkov, 1986: 92; Radchenko, 1983: 34). Distance between wells should not exceed 10–20 kilometers for healthy daily maintenance of 200 heads of cattle, or 500-600 head of sheep (Ischenko et al., 1928: 68–70). Considerable labor was needed for tapping underground aquifers and depended on groundwater location and soil quality. Wells at a depth of 4 meters required two people to dig if the bedrock was soft (Ischenko et al., 1928. S. 65). Although most wells were seasonal, they had to be maintained as the walls constantly collapsed, dried up or became dirty (Poletaev, 1875: 2-3 in Masanov, 1988). Most wells were seasonal in nature (Pulyarkin, 1982: 148).

[37] Primarily by channeling floodwaters during high water intervals (Abdullaev and Rakhmatullaev, 2015).

most likely due to more limited numbers of human resources that could be mobilized. The *chigir* is an example of one simple hydraulic structure and method for water intake from rivers to irrigate plots of land (Abduallaev and Rakhmatullaev, 2015). Water is collected into a series of cups attached to a rotating wheel powered by livestock before being directed into channels extending to various communities (*Ibid*). Upkeep of this irrigation water harvesting strategy was driven by the unpaid practice of *hashar* to coordinate labour contributions and material resources for the overall maintenance of the irrigation system. Although there was a decline in the 38,000 *chigirs* present in 1933 in the Khorezm region, Abduallaev and Rakhmatullaev note "*hashar* remains widely practiced in Uzbekistan and elsewhere in Central Asia" (2015: 853).

3.3 Conclusion - Part 1

Because the notion of sustainability draws on the question of human-environment relations, this section was provided to give salience to the historical development realities of Caspian Eurasian culture and as a necessary prerequisite for building a case study able to inquire into resource meanings. As can be seen from the above data, livestock grazing was aimed at maximum utilization of natural resources of the habitat and the grazing regime itself became a form of pasture management. The process of nomad – its rhythm and respective position of pastures – created factors unifying human populations with the geography (Masanov, 1995: 32). For the purposes of this chapter, notable anthropological and archaeological studies (with their biases qualified) were offered to convey the current model for interpreting Eurasia and pastoral/nomadic peoples. While the societal characteristics and histories of Eurasian peoples have undergone vast transformations and the nomadic system exists in totality only in historical form, the modes of understanding established by these life ways remain relevant to contemporary processes.

The preceding discussions are intended to offer a more contextualized background around illustrative points of the field sites where this research was conducted, not to generalize nor to proceed with a reductionist account. Turning to categorical questions of herd composition, for example, in order to designate mobility types (pastoral, pastoral nomad, hunter-gatherer, nomad), looking to number of settlements to qualify a population as sedentary or not, or designating threshold conditions within which grazing regimes could have historically occurred, is not the objective of this research. The arguments this research will make by situating fieldwork

observations with this information (in Chapter 6 Analysis) are not contingent upon the classification of mobility. Instead, this research's arguments rely on the fact that life was organized with some form of mobility of Eurasia's system, irrespective of its variations or proportional degree within Eurasian populations. Moreover, the discussions demonstrating the highly integrated nature of social and environmental relations substantiate this research's use of culture as the unit, and geography as the method for inquiry.

This experience of the chains of ecology-social-livestock relations beget modes of understanding. These became embedded in Caspian Eurasian consciousness to inform resource conceptualizations and ideas in the present. This section does not seek to present such variables and the relations between them in a strictly deterministic or linear way. Rather, it is to highlight just how the very meeting points of life phenomena have a sustained and a historically distinct system of knowledge for Eurasian peoples. Chapter 6 Analysis will re-situate this contextual information to demonstrate the significance of food in its ability to connect back to this value and understanding of the land and the land's provisions.

Chapter 3 Part 2– Sturgeon Resource Use and Caspian Sturgeon Conservation History

3.4 Introduction

Part II of this chapter will provide the relevant background of Caspian sturgeon's resource use history and associated conservation. Because this research investigates a people's relationship to a resource in order to build a case study, the history of human's use of that resource is relevant to this research. Giving context to the broader historical appreciations and nature of sturgeon use will better situate later discussions of resource interpretations.

First, a brief discussion of sturgeon's biological characteristics will be provided to give perspective of the species' physical requirements which dictate conservation and harvesting methods. Following on from this, a review of caviar use and pre-Soviet geopolitical history will give context to the early precursors of sturgeon appreciation and treaties regulating its exploitation in the Caspian.

Next, a discussion of sturgeon fishing history across the pre-Soviet and Soviet eras will be provided. These sections will present relevant information on Caspian conservation approaches and rationales developed during Soviet times owing to declines in natural populations. Much of the

Soviet-era physical infrastructure and institutional capacities for enabling Caspian sturgeon conservation which will be discussed have been leveraged by Caspian aquaculture producers under the nation-state system.

Next, a consideration of sturgeon biodiversity conservation concerns in the post-Soviet era will be presented. This component will be discussed primarily in terms of regulatory policies in the framework of the International Union for the Conservation of Nature (IUCN) and the agreement of the Conservation on International Trade in Endangered Species of Wild Fauna and Flora (CITES), administered by the UNEP.[38]

Lastly, an overview of the current global aquaculture industry, especially with regard to the Blue Economy concept as a multi-dimensional sustainability framework for shaping aquaculture discourse will give the necessary background to Caspian sturgeon aquaculture production and kinds of species conservation approaches.

Before proceeding, I differentiate between the Soviet and pre-Soviet on the grounds that the nature of fish harvesting witnessed a marked change with the arrival of the centralized Soviet administrative system. A new paradigm of land use for scaling natural processes particular to industrialized societies introduced a coherent and distinct conservation logic which previously did not exist in the Caspian. The establishment of aquaculture and fish hatchery systems in the Caspian demonstrate the presence of a conservation rationale and approach. While some of these development processes affecting sturgeon population levels have been under way since the 17th century arrival of Tsarist Russia to the region, they were not organized in a coherent manner until the beginning of the Soviet project. A more developed consideration of the conservation idea with regard to resource understandings will be presented in Chapter 6 Analysis.

3.5 Sturgeon Biophysiological Characteristics

A brief overview of some of the unique traits of sturgeon will be highlighted as their biophysiological and habitat requirements parameterize respective conservation management strategies for both wild populations and farmed individuals.

[38] Entered into force in 1975 (CITES, 1973).

Twenty-seven species of Sturgeon fish make up the *Acipenseriformes* order (Birstein, V. J. et al., 1997).[39] The generally accepted model of sturgeon's development has them emerging in what is now Western Europe, diversifying into distinct species in the freshwater basins of Central and northern Asia before spreading into the temperate latitudes of the Northern Hemisphere (Guinot, G., & Cavin, L., 2016). Today, sturgeons are native to a variety of climatic zones, including subtropical, temperate, sub-Arctic rivers, lakes and coastal waters and inner seas throughout: Azerbaijan, Bulgaria, China, the Islamic Republic of Iran (hereinafter: Iran), Kazakhstan, Romania, the Russian Federation (hereinafter: Russia), Turkmenistan, Turkey, Ukraine, other European countries and North America (Helftan et al., 2009). The majority of sturgeon are anadromous species, which describes fish born in freshwater which return to spawn while spending the majority of their lives in salt/brackish water (Bemis et al., 1997).[40] Commonly referred to as a primitive fish or living fossil, sturgeon are among the most ancient species of fish in the world (Gardiner, 1984).[41] Dating back in the fossil record to the Late Cretaceous, they have retained the majority of their morphological characteristics since (Carey, 2006).

The fish's enormous size is one of its most distinguishing traits. Atlantic sturgeon have been recorded at 14ft and 800 lbs (Fletcher, 2010). In 1897, Canadian newspapers reported a White Sturgeon off the coast of California weighing in at 1,400 lbs (*Ibid*). The Beluga (*Huso huso*) of the Caspian is the world's largest freshwater fish with the largest measured specimen weighing 4,570 lbs. and reaching 28ft (Carey, 2006).

In the Caspian ecosystem, there are six species of Sturgeon listed in the Table 1.

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[39] The order Acipenseriformes belongs to the Actinopterygii class (ray-finned fishes) and encompasses two families: Acipenseridae (sturgeons) and Polyodontidae (paddlefishes). The Acipenseridae family encompasses 25 species split among 4 different genera:17 *Acipenser*, 2 *Huso*, 3 *Scaphirhyncus*, 3 *Pseudoscaphihryncus*. (Birstein et al., 1997)

[40] Up until the Cretaceous Period, sturgeon swam and fed in the middle of the water column on other fish (i.e. pelagic piscivores) before later morphing into a bottom feeding species using the feeding specialization of benthic cruising (Carey, 2006).

[41] As a living fossil, sturgeon's present form has been unaltered since the Jurassic Period (199.6 million years ago) (Carey, 2006). Sturgeon are polyploid with their chromosomes (carrying matched sets of 4, 8, or 16) unlike most flora and fauna which are diploid (having a matched pair of each chromosome). These genetic traits offer invaluable insight into the development links between all descendants and clues of species evolution, they have been a source of widespread genetic investigation (Yanjun et al., 2020).

Table 1: Sturgeon species of the Caspian

Common Name	Scientific Name	Russian Name
Beluga sturgeon	*Huso huso*	Белуга
Russian sturgeon	*Acipenser gueldenstaedtii*	русский осетр
Persian sturgeon	*Acipenser persicus*	иранский осетр
Stellate (Starry) sturgeon	*Acipenser stellatus* & subspecies *cyrensis*	Севрюга
Ship (Fringebarbel) sturgeon	*Acipenser nudiventris*	
Sterlet	*Acipenser ruthenus*	Стерлядь

Source: Caspian Environment Programme, 2010

*All sturgeon species listed in the table above are in the IUCN Red List as endangered and in the CITES Convention Annex I of Annex II (Negroni, 2012).

Five of these species are anadromous: Great Sturgeon, (Beluga) (*Huso huso*) (Linnaeus, 1758), Russian Sturgeon (*Acipenser gueldenstaedtii*) (Brandt et Ratzeburg, 1833), Persian Sturgeon (*Acipenser persicus*) (Borodin, 1897), Stellate Sturgeon (*Acipenser stellatus*) (Pallas, 1771) and Ship (or Bastard) Sturgeon (*Acipenser nudiventris*) (Lovetsky, 1828) (Veshchev, 1998). Ship Sturgeon used to inhabit the Aral Sea and a sixth species, Sterlet, (*Acipenser ruthenus* (Linnaeus, 1758) is abundant in the Volga River basin, but is rarely found in the Ural River or in the Sea (Negroni, 2012).

Given their relatively high number of chromosomes, sturgeon displayed a strong tendency for interspecific and inter-generic hybridization under altered environmental conditions as well as under conditions of artificial propagation (Rainer, F. and Pauly, D., 2009). This is the result of the number and diversity of the river ecosystems of the Caspian region, which leads to adaptation characteristics for the river system where they reproduce, and for diverse intra-specific development. Some studies have recorded the Caspian sturgeon species with distinct sub-population, such as the *A. stellatus*, *A. gueldenstaedti* and *A. Persicus* (CaspEco Prodoc, 2009). [42]

42 Almost 20 inter-specific sturgeon hybrids have been recorded (Havelka, M., 2011).

3.6 Commodity Production from Sturgeon Derivatives

The main processed product from sturgeon aquaculture and wild harvest is its unfertilised roe, caviar. The other main product is its meat, which is sold smoked, canned, or frozen. Small quantities of caviar are used as ingredients in cosmetic products, such as facial creams (CITES, 2000c). Sturgeon swim bladders also are dried for isinglass, which is used to clarify wine and beer (Davidson, 1999). Live specimens, mainly of sterlet *Acipenser ruthenus*, are used commonly for ornamental purposes and some companies have started using sturgeon leather for various handicrafts in recent years (Bronzi et al, 2017). Finally, in the context of a rapidly expanding industry of aquaculture around the globe, sturgeon varieties are grown and sold as breeding stock for enterprises elsewhere (C. Berman, fieldnotes; February, 24, 2019). This research will consider the food-based derivatives of sturgeon – its meat and roe processed into caviar – rather than fish grown and traded for genetic breeding stock or its non-food-based derivatives.

3.6.1. History of Caviar Appreciation

The history of sturgeon use in human society is long and varied. The value of Caspian sturgeon's caviar within this history – particularly of Beluga and Russian sturgeon - is unquestioned (Shadrina, 2007). Historians claim that caviar consumption dates back to the beginning of human's ability to harvest fish and to collect supplies of salt (Grigson, 1973). Some 2,500 years ago, Herodotus wrote of Scythian tribes catching sturgeons in the Black Sea, Sea of Azov and in the Caspian (Fletcher, 2010). European travellers, such as Marco Polo and Olearius, along with the Arab writer Ibn al-Faikh in his *Book of Countries,* described the Caspian as the main source of sturgeons (Palatnikov and Kasimov, 2010).[43] In 2 B.C.E., Claudius Elian mentions a huge lake on the "land of the Caspians which is inhabited by a large sharp-nose fish, whose length reaches 8 cubits (3-4 meters)[44]….Their fat was traded widely for an ointment and boiled internal organs make clear and strong glue" (*Ibid,* 2010: 7). Coins recovered from burial mounds north of the Black Sea depict images of sturgeon heads along with the profiles of Roman emperors and Scythian kings (*Ibid*: 2).

[43] Although the Caspian historically has been known by nearly 70 names, from: Girkan, Khazar and Khvalyn (the latter was used in Russia until up to the 17th century); the Turks know it as Kutsgun Denizi, the Tatars – as Ak-Deniz, the Persians – as Dortsa and Shizir, and the Turkmens – as Kyukkyuz. Khazar Sea is the name of the Caspian Sea in Arabic (Bahr-al-hazar), Persian (Daryâ hazar), Turkish and Azerbaijani (Khazar deniz) languages. It originates from the name of people called Khazars, who in VII-X centuries established the Khazar Khaganate – a powerful state on the northwest coast of the Caspian (Palatnikov and Kasimov, 2010:6).

[44] References to special fishing lines connected to horses and oxen consisted of a special technique to catch and drag giant Beluga sturgeon from the Danube River (Palatnikov and Kasimov, 2010: 2).

Caviar has been a symbol of wealth and status across European and Russian (and later North American) societies for centuries (Grigson, 1973). Beliefs in the medicinal properties of the eggs fuelled its consumption and eventual symbol as a luxury commodity (Gronow, 2003). Early reports of caviar's rising significance for Tsarist Russia date back to 1704 at the time of Peter the Great (Fletcher, 2010; Saffron, 2002). After issuing a state monopoly over the fishing industry, 1,500 live sturgeons were transported to Moscow annually to meet luxury demand (Saffron, 2002). This practice continued until the Russian revolution in 1917 (Saffron, 2002). The seventeenth and eighteenth centuries witnessed the uptake of caviar as a fashionable luxury item in European markets, particularly after the fall of Napoleon and the growing presence of Russian aristocrats in western salons (Shadrina, 2007; Saffron, 2002).[45] German businessmen and advancements in refrigeration technologies are credited with the exportation of caviar to the United States in the 1870s (Carey, 2006; Saffron, 2002). During the first half of the nineteenth century, harvesting of Atlantic sturgeon (*A. oxyrinchus*) by suppliers from the USA and Canada made up the bulk of world caviar production (Carey, 2006). Drastic declines in Atlantic sturgeon populations, however, all but halted U.S. production and virtually all caviar was produced by the USSR by the Second World War (Fletcher, 2010, Saffron, 2002).

Since the end of the 20th century, sturgeon aquaculture began to substitute production from capture fisheries (Bronzi et al., 2017; Kautsky et al., 2001). Aquaculture as a means to combat illegal sturgeon harvesting for caviar fuelled the industry's growth considerably in subsequent years (Bronzi and Rosenthal, 2014). Although market demands for wild derived caviar remained prevalent, caviar from farmed sources has increasingly gained acceptance. These trends are highlighted in Figure 9.

[45] This was achieved in primarily because of refrigeration technologies developed by Greek merchant and entrepreneur, Joannis Varvakis, then later by Johannes Dieckmann in Hamburg (Saffron, 2002).

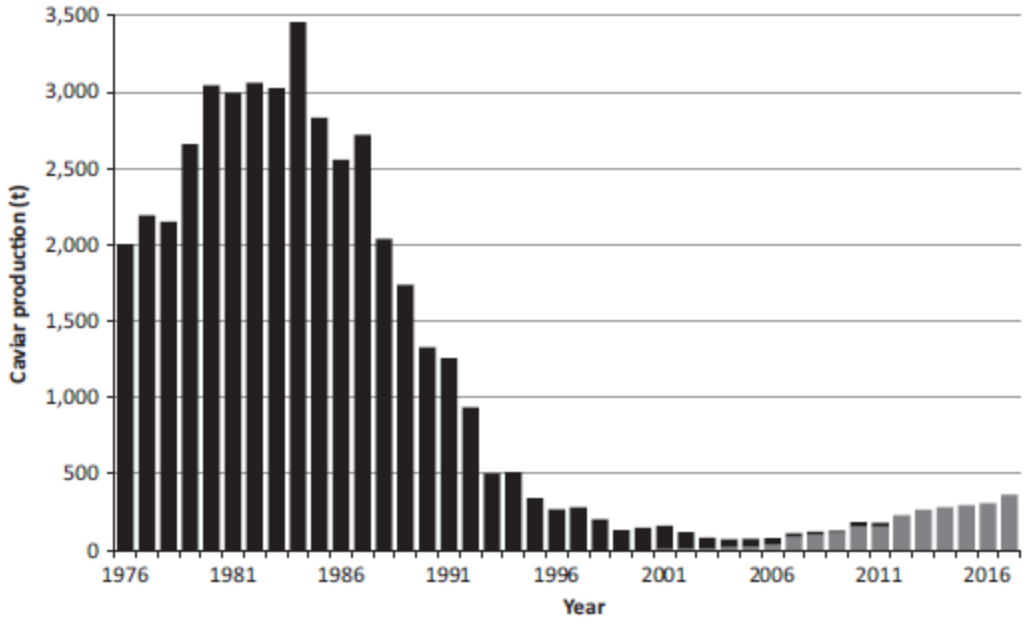

Figure 9: Global caviar production in tons from fisheries (black) and aquaculture (grey). (Bronzi et al., 2017).

There are three main traded species of sturgeon for caviar production: Beluga, Osietra (Russian sturgeon) and Sevruga (stellate sturgeon) and roughly 80% of which is taken from three species of sturgeon in the Caspian Sea: Russian sturgeon (around 20% of the market), stellate sturgeon (28%) and Persian sturgeon (29%) (Bronzi and Rosenthal, 2014). The colour and size of the caviar are influenced by the species and the stage of maturity of the roe, the most sought after and expensive being derived from Beluga (Lopez et al., 2020).

3.7 Sturgeon, Caviar and Caspian Fishing History

3.7.1 Caspian Geopolitical History

At present, five sovereign states define the Caspian's 6500-kilometer littoral boundary: Iran (900 km), Turkmenistan (1700 km, comprising the shores of the Kara-Bogaz Gol), Kazakhstan (2000 km), Azerbaijan (800 km), and Russia (1100 km, 300 km of which falls under the territory of the Astrakhan region, 600km to the autonomous republic of Dagestan, and 200 km to Kalmukia) (Raczka, 2000: 189). The independent states of Azerbaijan, Kazakhstan, and Turkmenistan are new political entities created after the dissolution of the Soviet Union in 1991.

Figure 10 depicts the geographic boundaries of the Caspian Basin.

The Caspian Sea runs north and south, extending over 1,200 km, with an average width of 320 km. It covers approximately 400,000 sq km (an area slightly larger than Germany). The population of the region is about 14 million, distributed over the coastal provinces of five countries: 6.5 million in Iran, 3.9 million in Russia, 2.2 million in Azerbaijan, 0.8 million in Kazakhstan and 0.4 million in Turkmenistan.

Figure 10: Caspian Basin map with important tributaries for sturgeon harvesting (UNEP, 2010).

The Caspian has an extensive history of political entities and governance structures presiding over the waterbody and littoral areas. Each system had varying degrees of fishing industry development and treaties for negotiating use and access to the waterbody.

The Mongol Empire gained control of surrounding Caspian territories following the geopolitical void of declining Arab-Muslim dynasties in the early Middle Ages (Raczka, 2000). The Caspian's eastern shores became the Mongol's western-most frontier under Genghis Khan before his sons later incorporated the entire waterbody into the empire (Christian, 2018).[46] With the Golden Horde eventually sitting astride primary waterways in the Black Sea and the Caspian, sturgeon were plugged into a wide set of trade routes within the Silk Road. The relatively stable political-legal regime and greater security provisions under *Pax Mongolia* expanded trade in the Caspian. Increased trade opportunities helped develop a strong fishing industry in the region and expanded port cities along key waterways (Saffron, 2002; Raczka, 2000). Salted sturgeon was transported as far as the Black Seas coast and Constantinople and by the 15th century, Venetians were importing two shiploads of caviar annually from the Mongols (Raczka, 2000).[47] Although internal weakening of the Golden Horde diminished Mongol control over the territory, many of the port areas became principal sites for fishing industries and caviar production which exist up to the present day.

In the waning of Mongol power by the 15th century, Tsar Ivan IV Vasilyevich (i.e. Ivan the Terrible) led Russian colonists south along the Volga River before annexing the Khanate of Astrakhan in 1556 (Saffron, 2002; Dyeryagin, 1977). This gave the Russian Tsardom complete control over the Volga and its important trade-routes to the Caspian (Saffron, 2002). In the war against the Crimean Tatars in 1570 AD, Tsar Ivan IV Vasilyevich acknowledged a group of semi-nomadic peoples known

[46] Particularly after the military successes of Batu Khan against Muscovite princes which allowed the Golden Horde to settle along the southern steppe and Caspian regions (Saffron, 2002).

[47] Although long transport times meant much of it would arrive spoiled or require too much salt for Italian preferences. Advancements in refrigeration and barrel technologies with linden wood for ship cargo developed by Greek merchant and entrepreneur, Joannis Varvakis in the 17th century, then later by Johannes Dieckmann in Hamburg, overcame caviar transport issues, helping to spread its popularity in Europe in the 18th century (Fletcher, 2010; Saffron, 2002). Fresh caviar should be kept at -3°C for safe preservation for 6-8 months. Salting the perishable roe keeps the eggs from spoiling but they can quickly freeze if temperature drops below -3°C.

as the Don Cossacks (Muscovy Cossacks) n order to form a buffer state (Malikov, Y., 2011).[48] With many of their fortified camps were along sturgeon spawning grounds in the Volga delta, the Don Cossacks became infamous fishermen and the main caviar producers and eventually were granted exclusive fishing rights (Saffron, 2002; Raczka, 2000).[49]

The revival of Persia's Safavid Empire to the south and the emergence of Russia along the Caspian's northern coast ushered in a new era of power-vying during the 17th and 18th centuries (Christian, 2018). Despite attempts to establish greater influence in the region by revitalizing key port cities (most notably Astrakhan under the Romanovs) or boosting naval capabilities (by Nader Shah in the 1740s), neither Russia nor Persia achieved outright control of the Caspian (Raczka, 2000; Sievers, 2000). Sturgeon fishing and caviar production, however, were effectively a state monopoly from the reign of Tsar Peter the Great of Russia (Dyeryagin, 1977). Concession of fishing access became more of a bargaining point between the two growing empires.

3.7.2. Treaty History

The treaty history between Russia and Persia (the eventual political entities of the Soviet Union and Iran),[50] produced important institutional legacies for accessing and managing Caspian resources (Mir-Babyev, 2002). The first recorded treaty concerning Russian-Persian relations over the Caspian was the Treaty of 1723 (Treaty of St. Petersburg), where Russia secured usury rights over the waterbody and present-day Iranian littoral areas (Sievers, 2000).[51] Russia's growing military

[48] A loosely-banded group of intermingled ethnicities (primarily Tatar) and refugees of Russia's feudal system (Saffron, 2002).

[49] When Tsar Alexei ascended the throne in 1645 and tried to organize this loose amalgam of Cossacks (Raczka, 2000). Later attempts by Tsar Alexei to organize the Don Cossacks after he ascended the throne in 1645 resulted in rebellions against Moscow's taxation-based disciplinary attempts. Cossack officer, Stenka Razin, was the primary leader of the revolts (Longworth, 1969). After he was hung in the Red Square, Tsar Alexei imposed regulations on all caviar trade, imposed a government tax on all sales and required 1,500 live sturgeons to be transported to Moscow annually to meet luxury demand (Fletcher, 2010; Saffron, 2002). This practice continued until the Russian revolution in 1917 (Saffron, 2002).

[50] The name of "Persia" was replaced with the name "Iran" in 1935 by governmental decree (Fishman, 2010). On December 29, 1922 the Treaty on the Creation of the USSR and the Declaration of the Creation of the USSR formed the Union of Soviet Socialist Republics, effectively renaming "Russia" as the "Soviet Union" (Borzecki, 2019).

[51] Later treaties of 1729 and 1813 (Treaty of Perpetual Peace and Friendship) reaffirmed Russia's expanding ownership rights, but allowed for navigation rights of both empires (Sievers, 2000: 53). The Convention between Persia and Russia for the Exchange of Territory, May 27, 1893, followed by the Commercial Convention between Russia and Persia, November 9, 1901, ceded some territorial rights back to Persia (Sievers, 2000: 52).

strength produced subsequent treaties reaffirming Russia's control insofar as the Persian empire's access to the waterbody's resources and navigation and trade rights were concerned, leading to two significant treaties: The Gulistan Treaty of 1813 and the 1828 Turkmenchai Treaty, which established unequal relations (Sievers, 2000). Both were annulled in 1921 under the new Soviet Russia with more equal treaty clauses and was superseded by the Protocol of 1940, designating the Caspian as the joint property of Russia and Persia (Sievers, 2000; Mehdiyoun, 2000).

However, aside from formalities, well-established economic activities of shipping, fishing and resource exploitation under Russia only intensified under Soviet rule while Iran's fishing activities became negligible. Although an understanding of a right to fish up to ten nautical miles from each state's coast emerged by 1940, there was no delimiting of "fisheries zone or territorial sea" (Englefield,1995: 30). Since the dissolution of the Soviet Union in 1991, Iran alone has maintained monopoly of its caviar industry through the state monopoly, Shilat.

3.8 Caspian Conservation History

3.8.1. Caspian Management During the Soviet Era

The concept of complete management of the Caspian as a unit began in the beginning of the 20th century (Peterson, 2019). The Soviet Union's extensive hatchery systems established by the mid-20th century, laid the infrastructure in which Caspian aquaculture continues to operate.

At the outset of the Soviet project, the primary task was to stimulate industrialization in the early years. After the October Revolution of 1917, the country had to establish new production systems and a corresponding national economy system of management (Caroli, 2003). It took a relatively long time to establish production forces themselves. Construction of a socialist economy in a primarily subsistence-based peasant society was aggravated by the civil war, armed intervention, and economic blockade (Bernstein, 2018). The main difficulty for stimulating industrialization was accumulating capital funds (Ehrlich, 1980). The shortage of money made it necessary to centrally concentrate available resources both geographically and administratively (Dobb, 1948). Eventually, the economy became based on exclusively state-owned land, natural resources and means of production (*Ibid*). In the early years of Soviet industrialization, problems of ecology were not so acute and attitudes regarding environmental protection were not pronounced. Thus, no objective mechanism to coordinate environmental safeguarding was developed (Jancar, 1987). As far as fishing was concerned, Soviet planning and policy were designed for increasing fishing volumes and to advancing fishing techniques, not for carrying out species conservation (Österblom, H., & Folke, C., 2015).

By the 1950s, electrical power became a focal area of concern for advancing Soviet society (Carey, 2006). Hydropower was central to this ambition as it was one of the most efficient ways to produce electrical power (Weiner, 1988). The Caspian is fed by nearly 300 rivers which are subdivided into five main tributary systems listed below in terms of annual input levels:

Volga – 80%

Terek, Sulak and Samur (combined) – 2%

Ural - 5%

Kura - 3%

Sefidrud, the Haraz, and nearly 122 more in the territory of Iran (combined 10%) (Negroni, 2012).

Many of these rivers became principal sites for hydroelectric projects (Helms et al., 2005). Beginning with irrigation weirs in the 1930s then large dams in the 1950s on the Kura River (Mingachevir), as well as mega dams on the Volga in the 1960s and additional large dams on the Sefidrud River in the 1970s, ninety percent of sturgeon spawning grounds on the Kura/Araz and Volga Rivers became blocked (Negroni, 2012). Carrying melted ice from the Arctic, the Volga River is the largest tributary of the Caspian and transports more water than any river in Europe. It is one of the world's most complex delta systems (*Ibid*).[52] The Soviet Union's hydroelectric ambitions culminated with the completion of the Volgagrad Dam in 1959 which, at the time, was the largest hydroelectric station in the world (Carey, 2006).

Sturgeon migrating long distances up Caspian tributaries as part of their breeding cycle were blocked from many primary spawning grounds (Schletterer, M. et al., 2018; Negroni, 2012; Carey, 2006).[53]

Figure 11 below shows the fragmentation of sturgeon spawning grounds.

[52] The Volga River reaches a length of 3,530 kilometers and flows into the Caspian via 800 tributaries and ducts. The width of the delta expands by 10 times from the top of its maritime boundary. The total area of the delta is 19 thousand km^2 (Russia cbs, 2011).

[53] The Volga River containing 80% of sturgeon species spawning terrain and 90% of traditional Beluga spawning territory (Avakyan 1998).

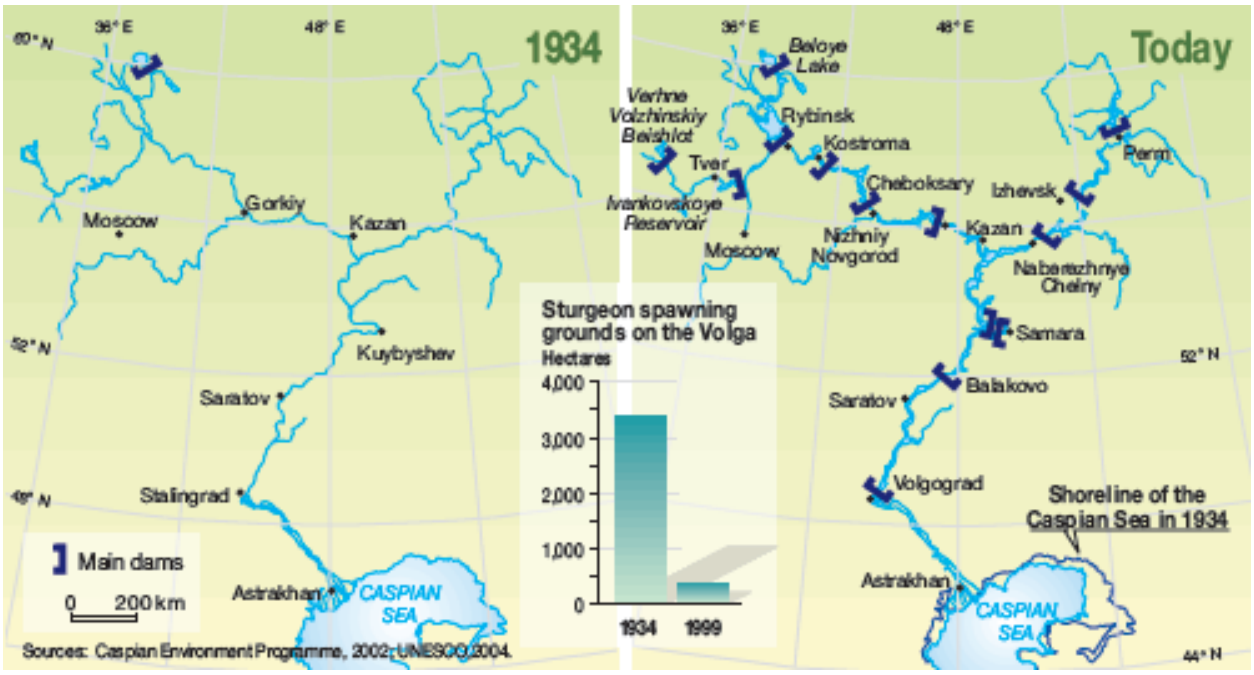

Figure 11: Fragmentation of the Volga River over the last 70 years (State of the Environment, CaspECO 2012). Large scale changes in Caspian tributary hydrology on account of hydropower projects affected critical sturgeon spawning grounds and wider nutrient cycles in the Caspian.

Before the Soviet Union's hydroelectric projects, fishing was the primary impact on Caspian sturgeon. Harvesting of sturgeon occurred along tributary rivers and in coastal waters. Although decreased levels of fishing activities owing to the First and Second World Wars and the Russian Civil War (1914-1924) allowed for a degree of natural population recovery, advancements in fishing vessels and technologies enabled fishing to take place further offshore and for longer durations at sea (Khodorevskaya, R. P., 2009). Sturgeon harvest increased considerably. The highest recorded levels in terms of number occurred between 1931 and 1940 (Ruban, G. I, & Khodorevskaya, R. P., 2011: 1999; Pavlov, A. V., 1970).[54] Conservation measures including banning of certain fishing gear and quota limits were imposed on fishing in the central and southern parts of the Caspian in 1938, enabling partial recovery of wild stock (Ruban, G. I, & Khodorevskaya, R. P., 2011). Yet abatement to fishing activities resumed after the Second World War. Efficient new nylon netting systems along tributary systems in the north of the Caspian and increased fixed hooks

[54] Although average fish weight of Beluga sturgeon and Russian sturgeon harvested in the north Caspian (where there was a longer history of sturgeon fishing) were half of those recorded from 1928 – 1930 (Ruban, G. I, & Khodorevskaya, R. P., 2011).

(primarily for fishing pike, perch, and bream) resulted in increased sturgeon bycatches which had greater proportional impact on immature sturgeon (*Ibid*). When construction of largescale hydroelectric works began, wild sturgeon populations were undersized and only partially recovered (Khoroshko, P. N., 1972).55 Particularly on the Volga, the Volgagrad Dam shortened the river's length by a quarter (Negroni, 2012). This led to egg overcrowding in spawning areas downstream from the Volgagrad Dam, resulting in low birth rates (Vlasenko, 1982).[56]

After considerable concern for sturgeon decline had been expressed by Soviet scientists, breeding sturgeon in artificial environments for release became the primary mechanism for sturgeon recovery levels in the wild (Mamedov, 2019; Berdichevskii, L. S., 1963). The first fish hatchery was established in Mingachevir, Azerbaijan in 1954 and was the first in the world (*Ibid;* Ruban, G. I, & Khodorevskaya, R. P., 2011).[57] While the process for farming sturgeon had been developed as early as the 19th century by Russian scientists, there was not an economic rationale to invest in the resource-intensive rearing of fish in tanks and artificial environments (Mamedov, 2019). A system of elaborate hatchery centres eventually were constructed along many of the Soviet Union's riverways for a variety of anadromous species, including the Caspian Salmon (*Salmo ciscaucasicus*) (Negroni, 2012). Also, many reservoirs were built because the Soviet scientific community advocated protecting natural forms of breeding for a variety of aquatic species (Gerbilskiy, 1959).[58]

The 1962 bans on sturgeon fishing in the Caspian Sea (permitted on tributaries during migration) until 1981, along with the use fishing gear which indiscriminately caught large-scale numbers, gave greater control over setting allowable catch levels. By 1977, total sturgeon catch reached pre-Soviet levels at 28,860 tonnes annually (Ivanov and Mazhnik, 1997). However, this high catch level was due to generations which had spawned prior to damming of the lower Volga with the Volgagrad Dam (Ruban, G. I, & Khodorevskaya, R. P., 2011). Increased levels of sturgeon hauls eventually

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[55] The slow maturation time of sturgeon, particularly for Beluga (18-20 years) for enabling natural recovery and reaching sustainable populations complicated conservation efforts.

[56] Beluga (*Huso huso*) were the most significantly affected with 90% of their historical spawning grounds in the Volga (Ruban, G. I, & Khodorevskaya, R. P., 2011).

[57] The Soviet Union already had extensive laboratory facilities in place for studying and conducting research on sturgeon with the first built in Azerbaijan in 1919 (Mamedov, 2019). But these research centers originally were not designed for large scale breeding and rearing of sturgeon.

[58] The Ural River, another primary spawning ground for Caspian sturgeon, was never dammed for this reason, because it was valued scientifically (Berman, *field notes, 2019*).

outpaced natural recruitment of new fish stocks (Vlasenko, 1979). Stable gains in catch levels during the 1970s across Caspian littoral areas gradually decreased during the 1980s (Ruban, G. I, & Khodorevskaya, R. P., 2011; Berdichevskii, L. S., 1963). The drastic drop after Soviet management of the waterbody ceased in 1991 is attributed primarily to poaching and reversed improvements in sturgeon species recovery from Soviet conservation measures. Figure 12 shows catch levels of Russian Sturgeon over a fifty-year period beginning in 1933.

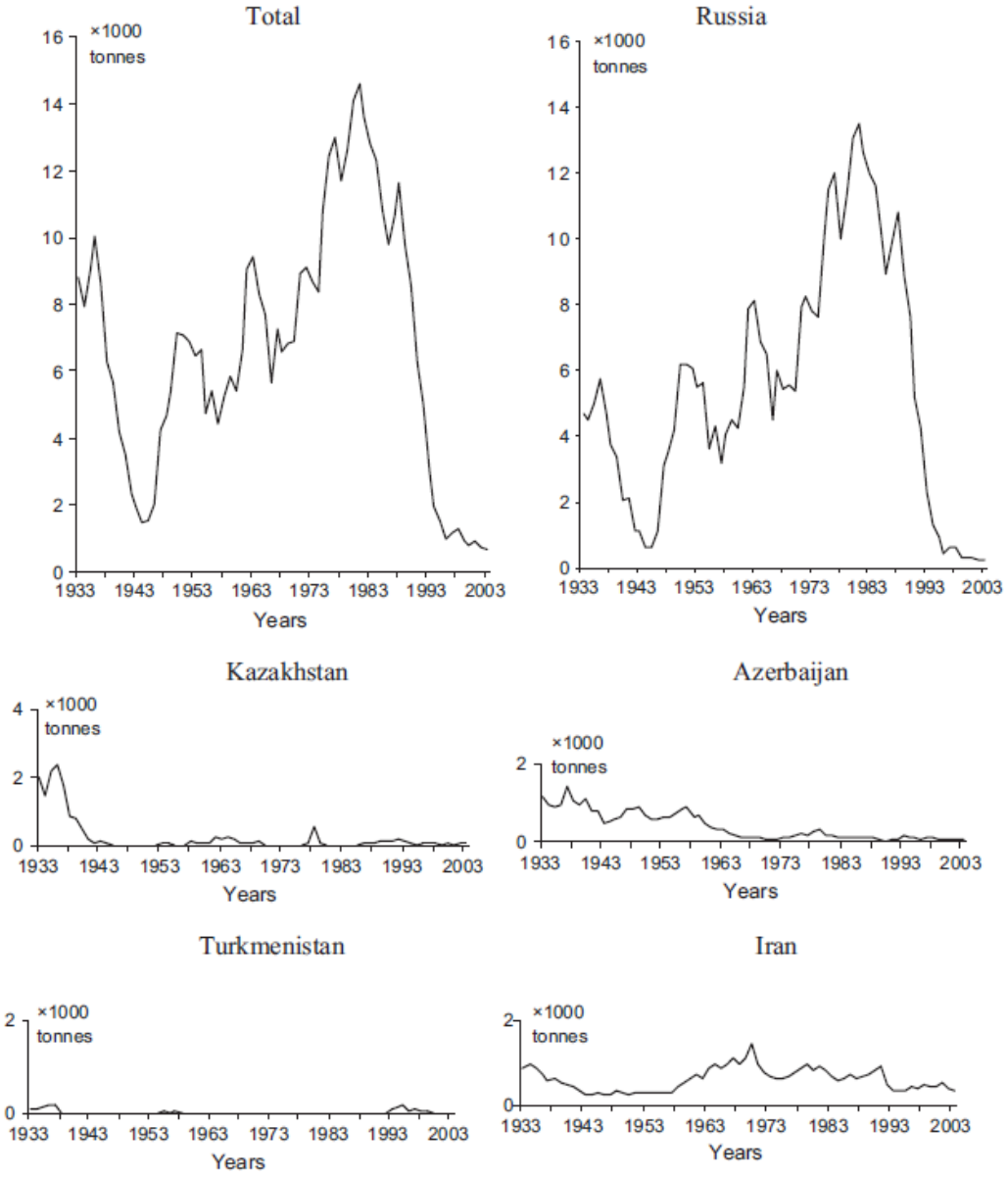

Figure 12: Commercial catches of *Acipenser gueldenstaedtii* in the Caspian basin following from the development of advanced fishing fleets after declines to overall fishing levels during the Second World War (Spravochnik…, 1986; Mazhnik and Kovaleva, 1986, 1987, 1992, 1999, 2001; Mazhnik et al., 1993, 1997, 2002; Martynova, 1994, 1995, 1996, 1997, 1998; Mazhnik and Martynova, 1999, 2000; Shvartskopf and

Golovina, 2003; Shvartskopf and Kovaleva, 2004; Shvartskopf and Oganova, 2005; Shvartskopf and Nechaeva, 2006, 2007) (in Ruban, G. I, & Khodorevskaya, R. P., 2011).

3.8.2. Caspian Sturgeon Management post-1991

Illicit sturgeon harvests post-1991 of Stellate Sturgeon alone reached 10,000 tonnes with catch levels not accounting for Beluga and only: Russian, Stellate, and Sterlet at 25,000 tonnes. According to Khordorevskaya, the Kura River had lost its significance as a spawning ground and fishery and an insignificant number of fish return to the Terek River to spawn (1997). Although sturgeon populations had recovered in varying degrees as a result of high scientific and governmental investment, these measures required ongoing monitoring and active management. Moreover, many factors affecting sturgeon population levels remained poorly understood. While scientists could monitor wild stock numbers, the Soviet Union's expanding industrial activities often introduced considerable uncertainty into sturgeon population assessments. One sturgeon specialist interview respondent described the wider impacts of hydroelectric projects in addition to restricting spawning grounds:

"After the hydroelectric dams were built all Caspian resources were 'broken' because of the large-scale alterations to natural processes – nitrogen and phosphorous from the land and nitrogen and phosphorous levels in the waterbody depended on this natural flux from the Volga. Bio-productivity dropped 80% in the Caspian from the damming. There remains uncertainty about how fish respond to these changes and whether this affects if they decide to return to spawning grounds or not."[59]
(AQUCLTR11 Interview, Almaty, Kazakhstan, February 25, 2019).

The dissolution of the Soviet Union amounted to a sudden loss of funding and coordination of hatchery restocking programs. The state management element of fisheries was reduced to basic monitoring of catch quantities while most controls carried out by the former state authorities were abolished (Mamedov, 2019).[60] Fishing production (riverine and marine) passed into the hands of joint-stock companies and small local groupings of fishers, resulting in a sharp decline in fish catches and a reduction in stock numbers of several valuable species. Coupled with the drastic

[59] Nitrogen and phosphorous cycles in the Caspian depend crucially on the Volga River flow. The Kura makes up only 2% of Caspian tributary contributions and the Ural, 5%. The remaining are from diverse small river sources from Iran (Berman, C., *fieldnotes* February 28, 2019).

[60] In Kazakhstan the fish committee *Kazrybkhoz* (Berman, C., *Field notes*, March 2, 2019).

increases in unregulated fishing, the mandate for species conservation was lost and many Caspian sturgeon were on the verge of extinction by the end of the century (Khodorevskaya et al., 2009).

By the early 2000s, numerous theories had been put forward to identify Caspian sturgeon's continuing decline. Many dynamics are overlapping and interrelated. Particularly with the dissolution of the Soviet Union, assessing the degree of impact between factors remained difficult as data either was not available or available only for limited time horizons and there was limited scientific exchange between the five Caspian littoral states until the mid-2000s.[61] The following non-exhaustive list offers a brief outline of the primary factors which have been theorized:

1. Pollution of river and sea waters in the Caspian. Some areas continually have high levels of pollutants, mainly in the vicinity of outlet areas and river deltas, although records and data are irregular and became particularly complicated towards the end of the Soviet era (Mitrofanov, 2005).[62] While the scientific literature provides considerable evidence of the detrimental impacts of the specific pollutants on sturgeon, such as myopathy, the mechanisms behind these diseases remain poorly understood.[63]
2. Sea level change: The Caspian is notorious for dramatic sea level fluctuations and debates on potential impacts from these hydrologic changes on sturgeon breeding have been debated for decades (Khoroshko, P. N., 1972). Recent findings however suggest that "sea level change has barely affected the biodiversity and fish resources" with impacts from sea level change on spawning and feeding rates, and changes remained well "inside natural fluctuations of species numbers" (Mitrofanov and Mamilov 2015: 164). That is, sturgeon depend on sea level changes as they can slightly change their marine migration routes or feeding areas. Instead, sturgeon spawning depends on more river discharge in certain years.
3. *Mnemiopsis leidyi* (Comb Jelly) jellyfish introduction in the late 1990s to early 2000s. Thought to have arrived on the ballast of a ship from the Black Sea, the species has been documented as having significant impacts on the Caspian ecosystem. Particularly for

[61] In Kazakhstan, for example, there was not a fish database collection until 2011. As the Ural and Volga are transboundary, and Caspian waters are shared across five nation-states, fish conservation is dependent on policy coordination in respect to fish exploitation and exotic species introduction (Berman, fieldnotes, 2019).

[62] River waters are more polluted with heavy metal ions and chemicals coming from industrial and agricultural sources. The most dangerous ones include phenol-like chemicals, such as benzo-pyrenes, and organo-chlorine pesticides (Amirgaliev, 2008).

[63] Chronic polytoxicosis are normally cited, although exact substances, dosages, and periods of impact usually are not specified. Chronic polytoxicosis is a disease typical of long-lived fish species such as Common Carp, Pike and Pike-Perch (Lukyanenko, V. I., 1989). However, it disproportionately affects sturgeon given their long maturation period (Romanov and Altufiev, 1990; Shatunovskiy et al., 1996).

sturgeon, they compete over common zooplankton food sources (Abdusamadov and Belyaeva, 2015; Pourkazemi, 2006).

4. Dam construction: As anadromous fish, the construction of numerous dams along Caspian rivers during the Soviet campaign for mass hydroelectric generation overlapped with sturgeon's main spawning grounds (Volga, Ural and Kura Rivers) (Negroni, 2012; Ruban, G. I, & Khodorevskaya, R. P., 2011; Carey, 2006). However, there was a specific mechanism to compensate for dam impacts on sturgeon spawning with the creation of an extensive hatchery system.
5. Overfishing: Overfishing remains the most widely cited source sturgeon fish decline in the Caspian. The collapse of the Soviet Union resulted in a removal of the otherwise powerful enforcement measures controlling the Caspian's lucrative fishery resources. 6465

The new state governments of Azerbaijan, Kazakhstan, and Turkmenistan faced challenges in maintaining fish stock numbers for future use. Additionally, although these Caspian states entered the independence era with considerable infrastructural endowments and significant natural resources,[66] the Soviet Union's economic declines prior to 1991 resulted in increasingly being unable to finance important industry maintenance and advancements (both in terms of capital and technology) across all economic sectors (Dorian, J.P., et al., 1993). With Caspian sturgeon population continuing to decline and explanations of attributing factors remaining, conservation strategies took a new approach. The nature of differing conservation styles will be discussed further in Section 5.2. The following paragraphs gives a brief introduction to the primary means of sturgeon conservation today.

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[64]During the communist era, the Soviet Fisheries Ministry maintained a monopoly on exports while the Sovrybflot agency, under auspices of the ministry, was tasked with production at two processing plants: Astrakhan and Guryev. The Soviet Fisheries Ministry also was responsible for overseeing sturgeon restocking programs (Collins, 1992).

[65] This is particularly impactful for large species – such as for Sturgeons, Common Carp, Perch-Pike, Volba – because older individuals in the species population become rarer (Ruban, G. I, & Khodorevskaya, R. P., 2011). The overall population reproductive success rate is lowered as older species members are more fecund. Some studies have documented an adaptive response prompting earlier maturation in Sturgeon to cope with fishing levels, although insufficient for reaching sustainable levels (Negroni, 2012).

[66] The Caspian basin and its hydrocarbon wealth, such as the Shah Deniz and Kashghan fields, in particular.

The predominant approach to contemporary species conservation is through market incentives. This market method of conservation focuses on supply chains and how conservation can be integrated through regulatory measures to prohibition which can be backed by a robust legal regime. For sturgeon species, CITES is the primary regulatory mechanism. CITES provides recommendations for establishing species harvest verified quota systems based on scientific assessment (Harris, L. and Shiraishi, H. 2018). Data collected is then shared with the CITES Secretariat to establish export quota levels (CITES, 2018; CITES, UNEP-WCMC, 2017). However, these assessments are not used for sturgeon grown artificially in aquaculture (Harris, L. and Shiraishi, H. 2018).[67] In the case that no quota has been established after communicating wild stock assessment data with the Secretariat, then international trade of wild sourced sturgeon caviar or meat is not permitted per the IUCN membership conditions (*Ibid*). As of 1998, the International Union for Conservation of Nature (IUCN) had listed all commercially utilised sturgeon species world-wide in Annex II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (COP-10, Harare) regulations (Bronzi and Rosenthal, 2014; Traffic, 2012).[68][69]

To deal with these problems, the Caspian Sea Aquatic Bioresources Commission (CAB) was established in 1992 (UNEP-WCMC, CITES, 2017; Mundy, V. and Sant, G 2015). Commission membership consisted of Russia, Azerbaijan, Kazakhstan and Turkmenistan (Mursaliev, Araz, and Ogli, Otay, 2021). The Islamic Republic of Iran was invited as an observer and became official member in 2001 (*Ibid*). CITES regulations gave further impetus for scientific collaboration and governance mechanisms between the Caspian Sea countries. Deepening discussions on the need for coordinating environmental management in the Caspian culminated in 2003 with the Framework Convention for the Protection of the Marine Environment in the Caspian Sea (the Tehran Convention) (Abdullaev, Iskandar and Rakhmatullaev, Shavkat, 2015). The Agreement established procedures for the rational use of shared sturgeon, Kilka (*Clupeonnella cultriventri*) and Caspian

[67] This discrepancy has been cited as a source of regulatory shortcomings for creating parallel or "grey markets" (Doukakis, 2012).

[68] CITES is "the international agreement [which] aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival" (Uhm, 2016: 4). For species listed on Appendix II, CITES documents are to be granted only if trade is not detrimental to the species in the wild.

[69] The Acipenseriformes have the highest proportion of Critically Endangered species among all of the most threatened animal orders (17 CR – critically endangered; 2 EN – endangered; 4 VU – vulnerable; 2 NT– near threatened; 2 LC – least concern).

seal(*Pusa capsica*) resources and to conduct joint research on wider Caspian ecology (Pourkazemi, 2006).

At the time the (CAB) was the only official organization and platform for connecting Caspian states in management of the waterbody. While the CITES system set out a reliable monitoring strategy, different methodologies for sturgeon stock assessments were used across the littoral states (Carey, 2006). For the four post-Soviet states, the techniques and methodology for assessment were the same as those used during Soviet times (Berman, C. *Field notes*, March 2, 2019).[70] The discontinuity with Iran's procedures created difficulties in the effectiveness of establishing quota limits and population numbers. Moreover, while monitoring of legal sturgeon fishing and caviar production could be assessed under the CITES framework, it did not capture domestic and national consumption level data (Harris, L. and Shiraishi, H. 2018). Within each littoral state of this study, the organizational structures remained largely the same as in Soviet times with research agenda continuing to be set by the central government. What has changed was the financing structure where the tender system has allowed the government to deal with the privatization transition (Berman, C. *Field notes* February 16, 2019). Research methods for assessing sturgeon stock in the Caspian have stayed the same but now have "more modelling abilities and new computer technologies" (AQUCLTR14, Atyrau, Kazakhstan, February 16, 2019).

Despite efforts for greater coordination of conservation mechanisms and implementation through the Caspian Aquatic Bioresources Commission, as well as implementing CITES regulations by most littoral states,[71] the 2009 Wuhan IUCN reassessment of the Acipenseriformes status indicated that the conditions for almost all species had worsened, with more than 44% of these species classified as even more threatened than in the 1996 assessment (Bronzi and Rosenthal, 2014; van Uhm and Siegel, 2016). The World Wildlife Fund currently estimates that 85% of the world's 27 sturgeon species are on the brink of extinction (2017). While the transport of endangered species products across borders becomes more difficult under CITES protocol, the regulatory measures cannot stop overfishing directly. This has resulted in critique of CITES regulations as a limited conservation strategy as it only regulates trade rather than establishing mechanisms for addressing wider factors threatening species, such as habitat loss or a lack of alternative jobs for poachers (Doukakis, P.,

[70] Post-Soviet assessment used troll net techniques while Iran relied on gill net techniques, creating difficulties in coordinating assessments and comparing data (Berman, C. *Field Notes* March, 2019).

[71] Turkmenistan has not joined CITES membership.

2012; Gault et al., 2008). As of December 2010, export quotas for caviar and meat of Caspian sturgeon had not been sent to the Secretariat, resulting in yearly zero export quotas (Harris, L. and Shiraishi, H., 2018).[72]

The dissolution of the Soviet Union resulted in a new era of legal relations for managing the Caspian. Prior to 1991, the Caspian was a closed waterbody bordered by the USSR and Iran with its use regulated based on the treaties outlined in Section 3.7.2 (Mojtahed-Zadeh, P. and Hafeznia, M., 2017). The creation of four independent countries (Russia, Kazakhstan, Azerbaijan, and Turkmenistan) introduced new geopolitical realities which called into question the Caspian's pre-existing legal regime. Classifying the waterbody (either as a 'sea' or a 'lake') in order to design a legal framework, remained problematic for international regulatory regimes due to its unexampled characteristics (Sievers, 2000).[73] After the issue of a legal regime was resolved with the signing of the Aktau Convention in 2018 (UNEP Caspian Regional Sea Programme; Tehran Convention website; Sievers, 2000). Documents of Caspian state political discussions and the associated body of legal-political literature on the Caspian legal regime topic are vast. While an important event for the region's institutional history, it does not pertain to the main question of this research. The 2018 Aktau Convention did not change the management or fishing of wild sturgeon populations, nor did it have any implications on sturgeon aquaculture production.[74] While the resulting legal regime widely claims to enable better management outcomes and better clarify the conservation mandate, no changes specifically pertaining to sturgeon have come about from the Convention. The methodologies for monitoring Caspian species developed during Soviet times remain in effect (AQCLTR11 Respondent, Almaty, Kazakhstan, February 2019).

3.9 Wider Context of Caspian Transitioning Economies and Appeal of Aquaculture

The challenges arising in fisheries management of Azerbaijan, Kazakhstan and Turkmenistan were taking place in the context of widespread systemic rupture and change in the wake of Soviet dismantling. Caspian hydrocarbons and energy reserves have been critical bases for economic

[72] However, a moratorium on sturgeon fishing in the Caspian was proposed during the 2010 Third Caspian Summit in Baku, with a final agreement reached at the 34th meeting of the Commission on Aquatic Bio resources of the Caspian Sea in Astrakhan in December, 2013 (FISHERY, 2013).
[73] Namely, that the Caspian has no connection to the Atlantic or the Pacific Oceans yet has saline water (UNEP Caspian Regional Sea Programme).
[74] The Convention primarily addresses issues of military access and commercial shipping vessels (Bayramov, Agha, 2020).

growth for each of the three study states of this study with the extractive sector arguably provided the capital vital in the immediate aftermath of the Soviet break-up (Heinrich, Andreas, & Pleines, Heiko., 2015). The details regarding the geopolitics, economic rationales, and environmental implications in prioritizing the hydrocarbon sector in the region's economic development contains a vast literature with a scope beyond that of this research. What the following discussion intends to demonstrate is how sturgeon aquaculture created complementary possibilities which were valuable for developing new state economies whilst addressing species conservation concerns. Aquaculture allowed for expanding activities in the food and agriculture sector and offered a clear model for addressing conservation concerns. Moreover, many former Soviet states looked to foreign partnerships to finance and to restore industrial activities. In a market-based internationalized system, creating conditions with less likelihood for socio-political conflict to leverage natural resource wealth was critical for external investment (Dorian, 1993).[75]

Particularly in the case of sturgeon being listed as threatened and endangered species by the IUCN, aquaculture is accorded considerable management value as a means to circumvent illegal sturgeon trade and to protect precarious wild populations. Wildlife farming is not only pursued as a strategy to reduce pressures on wild populations, but also as a supplement to resource-intensive law enforcement and prohibition regimes measure (Uhm, D.P. and Siegel, D., 2016). Effectively, farming of any threatened wild species assists with conservation so long as the demand is met by legal supply (Doukakis et al., 2012). To this end, the following section gives an overview of what aquaculture consists of, and how it has contributed to sturgeon conservation efforts in particular. These discussions will be framed by a wider consideration of the aquaculture industry's growth in recent decades fuelled by food security concerns and climate change mitigation measures embodied in the Blue Economy Framework. While these rapidly evolving industry developments are not seen as deterministic for Caspian sturgeon producers, they are an important backdrop for tracing the idea of conservation and the changing nature of sturgeon species protection. A more elaborated discussion of aquaculture in terms of its role in supporting a particular conservation logic will be presented in Chapter 5 Fieldwork Findings and Chapter 6 Analysis.

[75] The degree to which FDI and economic liberalization was pursued varied immensely between this research's three study sites, Kazakhstan liberalizing the most with Turkmenistan remaining notably isolated.

3.10. Aquaculture Overview

This section gives an overview of key global aquaculture industry trends and clarifies relevant terminology and frameworks that will be used in the remainder of this dissertation. While the history of Caspian sturgeon resource use demonstrates some overlap between traditional capture fishing and culture fisheries, the term aquaculture is used in this writing to refer to its 20th century developments beginning with the Soviet Union's large-scale industrialization project. This allows for engaging with the paradigm shift in human-environment relations that occurred under industrialization processes, as well as the marked industry growth transpiring beneath the Blue Economy concept.

3.10.1. Aquaculture Growth

Aquaculture is the fastest growing food production sector worldwide (Ahmed, N., Thompson, S. & Glaser, M., 2019; Cai, J., and Zhou, X., 2019). Between 1990 and 2016, the sector witnessed a sixfold increase in production with an average annual growth rate of 5.8% (FAO, 2018; Guillen et al.2019). In total, 598 aquatic species actively were being cultivated in inland, coastal and marine aquaculture (FAO, 2018). Fish is one of the most traded food commodities worldwide, with more than half of fish exports by value originating in tropical and subtropical developing countries. (Ahmed, N., Thompson, S. & Glaser, M., 2019; Barange et al., 2014).

According to the Food and Agriculture Organization of the United Nations (FAO), by 2013 approximately 90% of global fisheries were either overfished or fished to maximum capacity (Barange et al., 2018; FAO 2016). By 2050, global production from aquaculture is forecast to at least double, with well-managed fisheries expected to flatline or even decline over the same period, as shown in Figure 13 below.

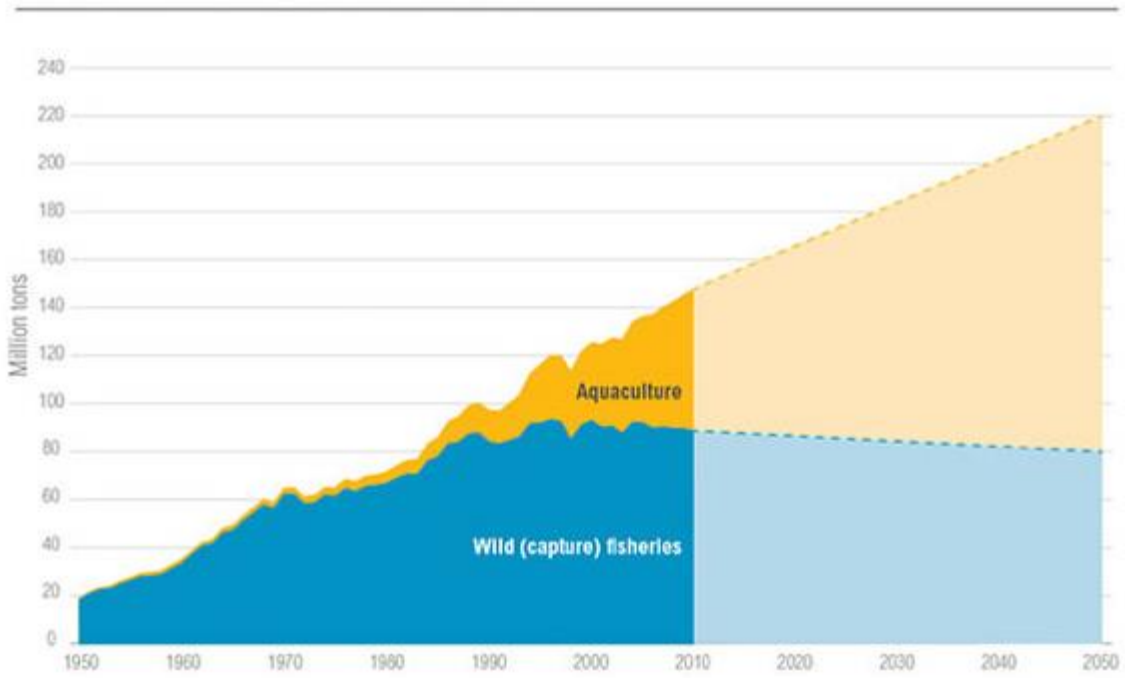

Figure 13: Projections of aquaculture and capture fishery contributions to global fish demand. Assumes 10 percent in wild fish catch between 2010 and 2050 and linear growth of aquaculture at an additional 2 million tons per year. (World Resource Institute, 2014. Historical data 1950 – 2010: FAO. 2014. "FishStatJ." Rome: FAO. Projections 2011-2050. in WRI calculations).

3.10.11. History of Aquaculture

While popular discourse and general scientific study regard the topic as a post-World War II phenomenon, aquaculture activities are thousands of years old (Kautsky et al 2001). Aquaculture (also known as 'culture fisheries') is an economic human activity that uses and transforms natural aquatic resources into commodities valued by society (*Ibid:* 185). Aquaculture involves the enclosure of species ranging from fin fish, molluscs, crustaceans to aquatic plants for the goal of enhancing harvests.[76] Aquaculture exists in varying degrees of intensity with some production only excluding predator competition, others supplementing food supply (semi-intensive), to the provision of all nutritional requirements (intensive) (FAO, 2016; Katusky et al., 2001:185). Scaling up of production through more intensive aquaculture practices is achieved by increasing the

[76] Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, or protection from predators. Given the global market system, individual or corporate ownership of the stock being cultivated is implied (Kautsky et al 2001).

number of individuals per unit area. Higher intensity systems have greater technology and fossil fuel requirements as they depend mainly on formulated feed pellets along with oxygenation and water recirculation tank systems. Aquaculture enclosures can range from ponds, tanks, and cages (FAO, 2018).[77] New methods of integrating flooded rice fields with fish farming are being trialled as new food production strategies (Baruah, U.K. and Borah, Chetta, B., 2006). Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, "aquatic organisms harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as common property resources, with or without appropriate licenses, are the harvest of fisheries" (FAO, 1997: 195).

In 1950, two million tons of fish and shellfish were farmed globally (FAO, 2020). By the end of the century, aquaculture production had grown 20-fold to 36 million tons and in 2018, global fish production exceeded 197 million tons (Ahmed, N., Thompson, S. & Glaser, M., 2019).[78] While capture fisheries have experienced a 14% rise in production from 1990 to 2018, aquaculture production has increased 527%, aided by the 122% rise in total food fish consumption during the same time period, Figure 14 below (FAO, 2020).

[77] Accordingly, this fieldwork only encountered the use of pond systems for sturgeon farming. Penned net systems in the north Caspian were trialed in 2018, but were destroyed by sea ice and winds. Sunken cage designs were proposed for some lake systems in Kazakhstan, but were at the early stages of development and had not yet been trialed for sturgeon growing at the time of this research.

[78] 175 million tons in live weight equivalent actually available for human consumption (FAO, 2020).

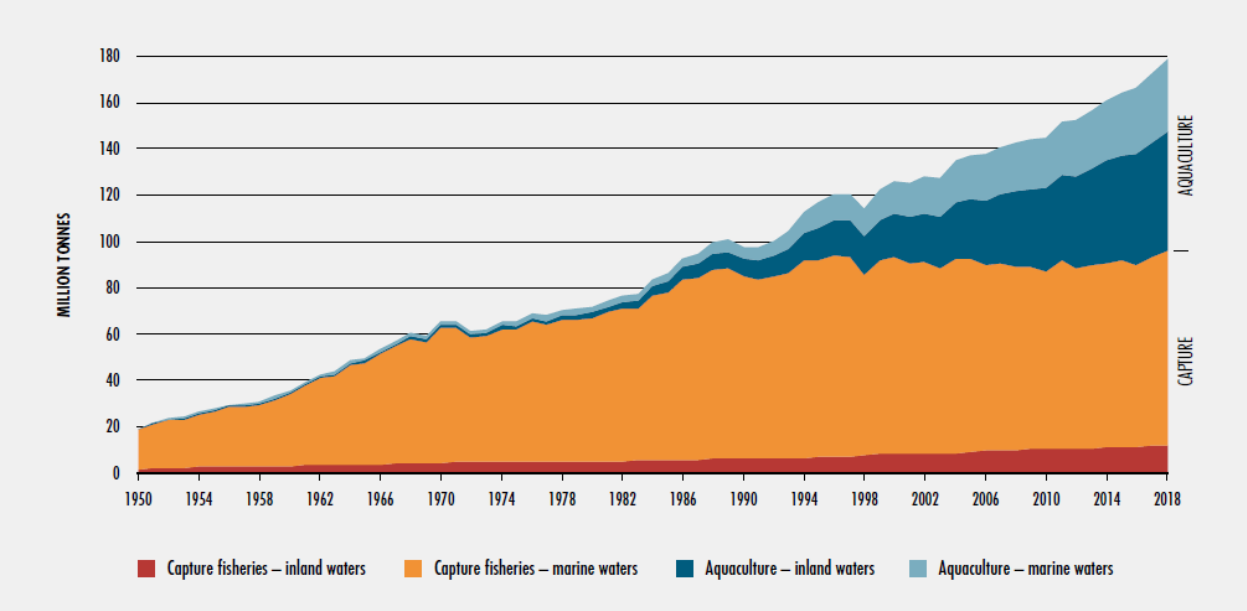

Figure 14: World capture fisheries and aquaculture production (excluding production of aquatic mammals, crocodiles, alligators and caimans, seaweeds and aquatic plants) demonstrating the growing contribution of aquaculture relative to capture fisheries to global production (FAO, 2020).

Amidst climate change concerns, new food production methods, particularly those with lower land-use intensity, are being proposed as important strategies for ensuring food security (Béné et al. 2016). The arguments and evidence for justifying expanded farming of aquatic species range from growing population concerns, declines in land-based agricultural productivity, to depleted fishing stocks in natural river and ocean systems.[79] The Blue Economy concept represents the most formalized current framework for addressing such issues.

3.11. Blue Economy Concept and Aquaculture

Blue economy emerged as a concept for addressing sustainable development challenges related to poverty reduction and economic growth at the "Rio + 20" United Nations Conference on Sustainable Development (UNCSD) in Rio, 2012. With human activities seen as continuing to pollute and to threaten marine and coastal biodiversity, the Blue Economy has since gained considerable attention in the global food sector for the roles fisheries can play in achieving SDGs (FAO, 2020: 174). Framed with the same grounding principles as the Green Economy to "contribute to eradicating poverty as

[79] According to the FAO, 87% of global fish stocks are fully or over-exploited.

well as sustained economic growth, enhancing social inclusion, improving human welfare while maintaining the healthy functioning of the Earth's ecosystems" (Para 56. The future we want. UNCSD 2012), the Blue Economy concept proposes economic models that do not breach ecological thresholds specific to marine and coastal settings (Cai, J. & Zhou, X., 2019). Accordingly, aquaculture has been incorporated as a key variable within the Blue Economy agenda for addressing interrelated social and environmental concerns pertaining to food security, nutrition, and climate change.

Although there is much debate regarding the maximum sustainable yields of specific fisheries or what constitutes a sustainable fishery, global capture fisheries unquestionably have been under heavy and sustained pressure, particularly since the Second World War (Pauly et al. 2003; Hilborn 2011). While studies have documented successes in fisheries management to limit overfishing, many aquatic species remain threatened from diverse anthropogenic impacts in coupled with sustained fishing pressure (Costello et al. 2008; Harley et al. 2006; Worm et al. 2009). Aquaculture then offers the most concrete and viable alternative to move away from supposedly compromised traditional 'catch fisheries' methods of production.

Aquaculture's contribution to global protein needs relative to other meat sources has witnessed remarkable growth in recent years (Figure 15). Highlighting this trend also shows how increasing aquaculture maps onto sustainability principles enshrined in the Blue Economy framework and has been facilitated by efforts to reduce terrestrial meat production sustainability.

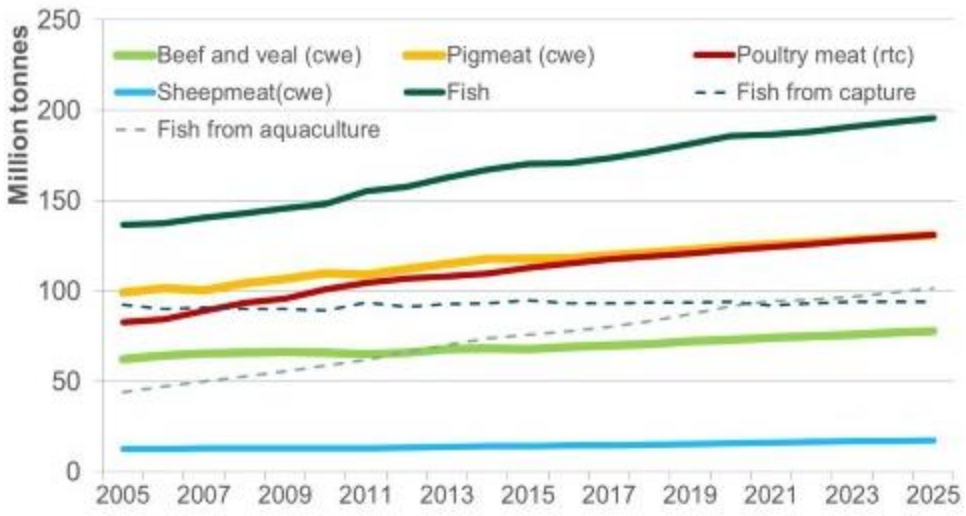

Figure 15: Global meat production trends highlighting the marked rise of fish production relative to traditionally land-based meat sources. Projections for decreased contributions from capture fisheries and rising aquaculture production also are shown (OEC/FAO, 2021).

An important factor in the rising global output of fish protein from aquaculture has been technological and nutritional advancements in feed efficiency for fish. Typically requiring less than one kilogram of feed to add another kilogram of weight, improvements in fish feed stocks (primarily from insects and fish meals) have brought fish protein production efficiency close to that of poultry as seen in Figure 16 (Huis, van, Arnold, & Oonincx, Dennis G.A.B., 2017; Glencross, B.D, Booth, M, & Allan, G.L., 2007).

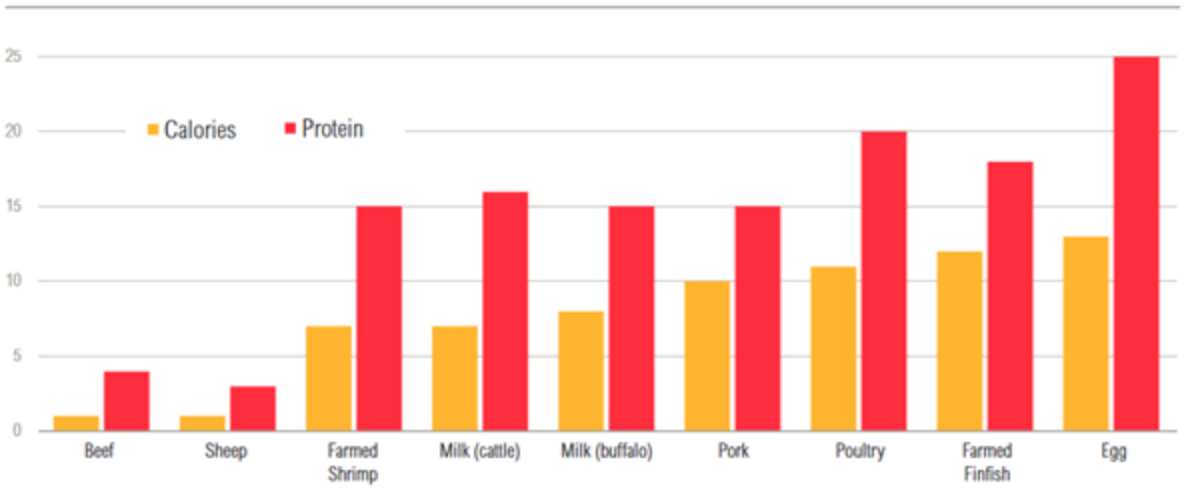

Figure 16: Farmed finfish and terrestrial animal protein percent or units of edible output per 100 units of feed (edible signifying calorie and protein content of bone-free carcass) (WECD/FAO, 2020). Efficiency gains in the feed-to-calorie/protein ratio through improved fish feeds is advancing finfish production as primary protein source globally.

Provided efficiency gains in fish feed and increasing uncertainty over terrestrial-produced protein sources (poultry, pork, dairy, and beef) farmed fish production growth is projected to continue to outpace other protein industries, as pictured in Figure 17.

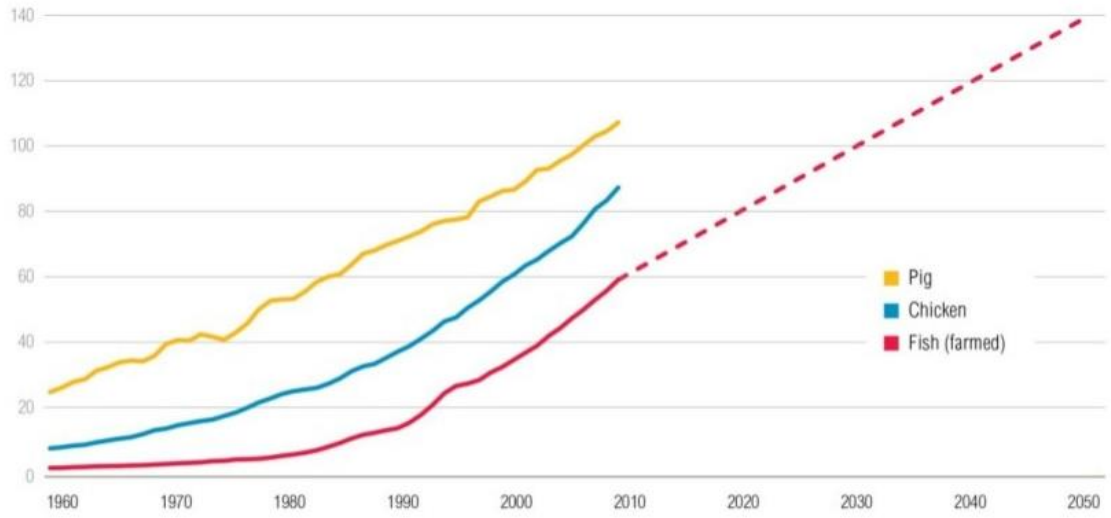

Figure 17: Aquaculture production projected trends for meeting global demand (in Million Tons [Mt]) (World Fish/FAO, 2020).

Many of the development challenges the Blue Economy aims to address, however, long pre-date its conception. What makes the Blue Economy concept as a means for tackling these issues noteworthy is the degree to which concerted local, national, and international initiatives have mainstreamed the concept and spurred aquaculture's growth around its guiding principles. Moreover, advancing technologies and rising commodity prices are giving additional impetus to the aquaculture industry's rapid expansion and orientation around applying new technologies. The effects of such industry developments were evident in abundance during the course of this research's fieldwork and will be discussed at length in Chapter 5 Fieldwork Findings.

3.11.1. Global Sturgeon Aquaculture

In terms of sturgeon aquaculture specifically, rearing of Caspian and many other sturgeon species today spans a myriad of geographies well outside of endemic habitats. The following figures demonstrate the industry's fast growth trends and individual country contributions. Figure 18 shows the global sturgeon production (t) from fisheries during the period 1950 to 2017.

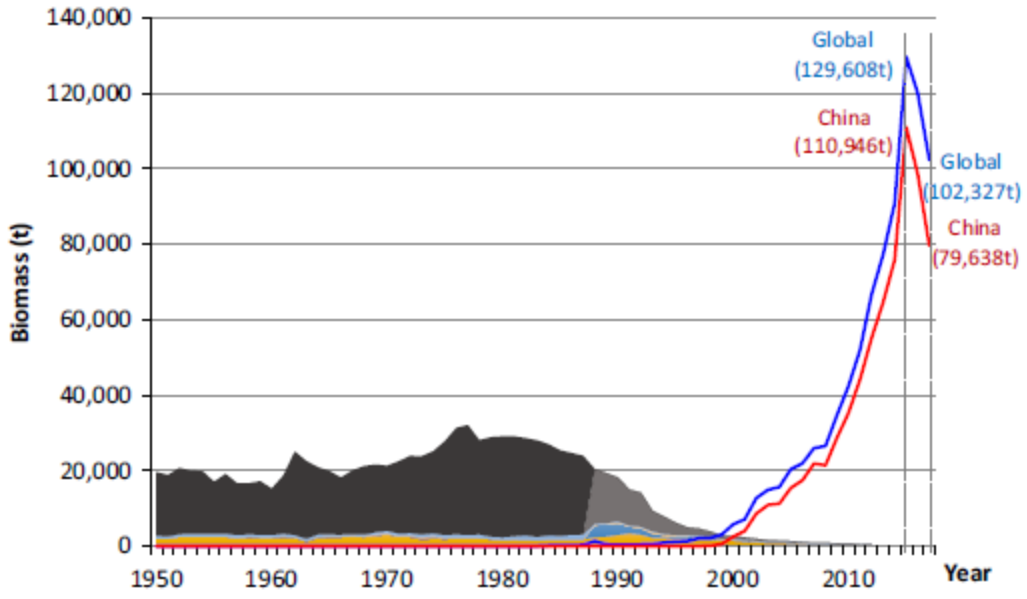

Figure 18: Global sturgeon catch rates from 1950-2017 (in metric tonnes). Global sturgeon production (t) from fisheries (shaded areas, dark grey = USSR, mid-grey = Russian Federation, light grey = USA, orange = Iran, blue = Kazakhstan) between 1950 and 2011 (FAO statistics), and estimates from sturgeon aquaculture (solid lines, blue = global, red = PR China) between 1984 and 2017 (Official data taken from FAO statistics for the period 1950 – 2011 (FAO FishtatJ) and estimated productions until 2017 (Cited in Bronzi et al., 2017; Bronzi and Rosenthal, 2014) in: (Bronzi et al., 2019).

Since 2017, sturgeon aquaculture has expanded beyond traditional largescale sturgeon-rearing countries (namely Iran and Russia). The total number of operating sturgeon farms globally reached 2,329 in 2017, although this data set does not include farms producing under several tons of sturgeon products annually (Bronzi et al., 2019). Country-specific contributions to sturgeon aquaculture reflecting the growing geography of sturgeon farms are depicted in Figure 19.

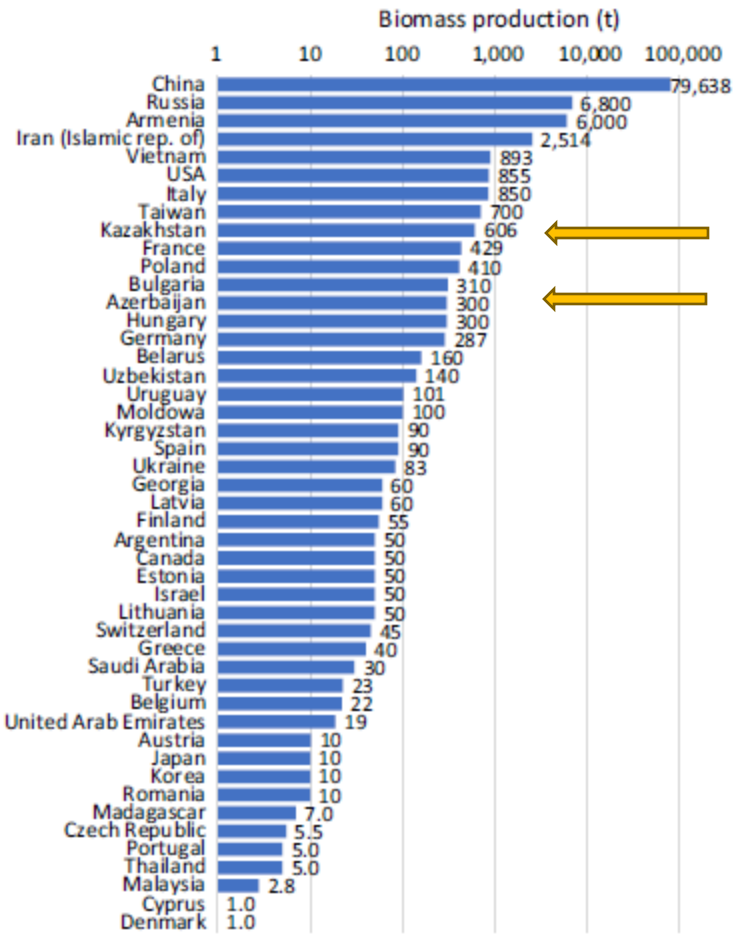

Figure 19: Sturgeon production (t) per country in 2017. Production rates from two of the three study sites of this research (Azerbaijan and Kazakhstan) are highlighted. X-axis numbers are presented in logarithmic format (Bronzi et al., 2019).

3.12. Part II Conclusion

Part II of this Chapter 3 provided an overview of factors relevant to this case study's object of study, sturgeon fish. The significance of its main commodity derivatives, caviar and meat, along with Caspian sturgeon's biophysical characteristics gave insight into the nature of sturgeon fishing history, as well as species conservation measures. A brief overview of current global aquaculture dynamics was given in order to develop a comparative conservation argument in later chapters for the purpose of demonstrating how these factors shape and reflect resource meanings. The ethnographic component and interview responses presented in Chapter 5 Fieldwork Findings will build on the contextual information presented in this chapter to demonstrate how the economic rationalities and conservation logics expressed by the Blue Economy framework emphasize

resource understandings and use values which were not recorded during the course of this fieldwork. Instead, Caspian sturgeon use and production in Azerbaijan, Kazakhstan and Turkmenistan exhibited a resource meaning that enabled connections to the Caspian's cultural knowledge system. Most concretely, this was evidenced by increased production of sturgeon meat over caviar, and how this increased production is being generated in large part for the local market arising out of local values and resource understandings. A more developed discussion of this will be presented in Chapter 6 Analysis.

Chapter 4 – Methodology

This chapter presents the research methodology employed. It also describes the research design, research theory, method of data collection, method of data analysis and possible limitations. This research employed the exploratory approach in order to build a case study of Caspian sustainability and resource understandings. The aims and primary components of this methodological chapter are depicted in Figure 20 below.

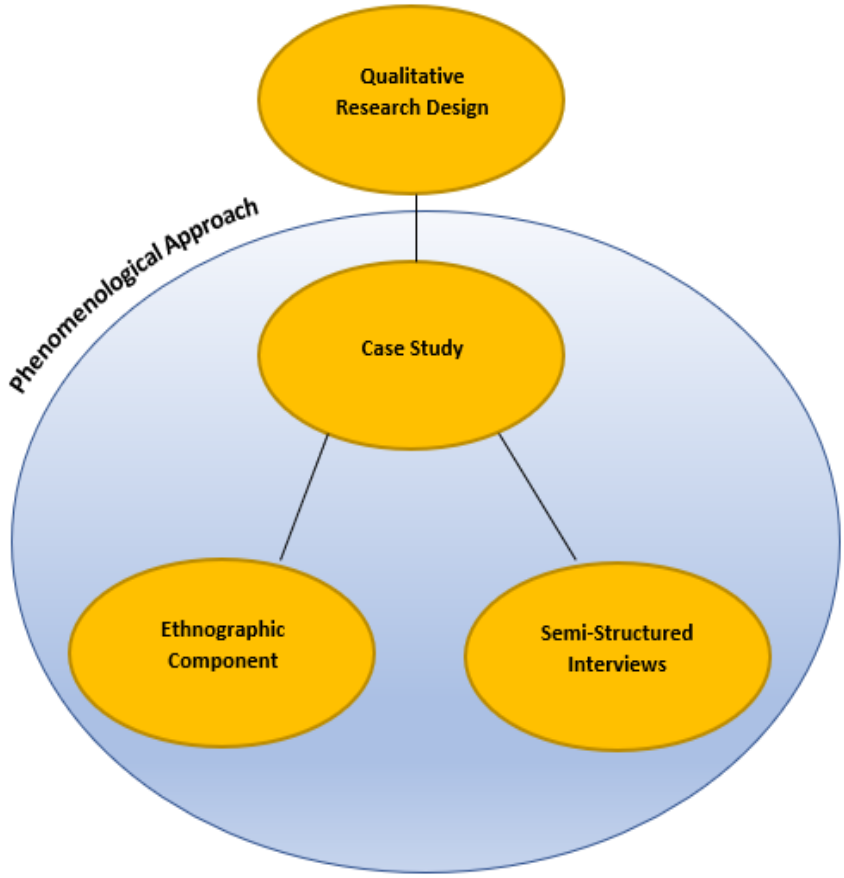

Figure 20: Research design and methodology. Illustrates the qualitative design of this research which built a case study by employing ethnographic techniques, semi-structured interviews within an overarching phenomenological approach (Berman, C. 2021).

4.1 Research Design Methodology

Research methodology indicates the process and framework by which research is conducted in order to generate findings (Remenyi et al., 1998). Ultimately, the choice of methodology is determined by the questions being raised (Mohajan, 2018). This research employed the qualitative approach over quantitative as it was best-suited to the inductive nature of this research question. Qualitative research focuses on the way(s) people interpret and make sense of their experience with the goal of understanding social realities (Strauss & Corbin, 2008). Inherently, it is exploratory in order to arrive at new explanations for how and why a social phenomenon functions as it does in a particular setting (Mohajan, 2018). A range of techniques for data collection and analysis can be employed for qualitative research. These include purposive sampling, semi-structured and open-ended interviews, ethnography, discourse analysis, case study, comparative method, and historical research (Cibangu, 2012; Gopaldas, 2016). Therefore, qualitative research is an umbrella term that refers to various theoretical perspectives and allows for synthesizing different disciplinary foundations (Creswell, 2009). The qualitative tradition builds from: social and cultural anthropology, philosophy, history and sociology, while also incorporating theoretical perspectives of: narrative, phenomenology, grounded, case study, ethnography, historical research and content analysis in order gain a "deep understanding of the particular" (Creswell, 2009; Domholdt, 1993: 127). In this way, people's belief, experience and meaning systems can be engaged with from the local perspective (Gentles et al., 2015). The goal of the qualitative approach is to generate new concepts and theories that are not achieved from statistical analysis and empirical calculation (Brink, 1993). Instead, concepts and phenomena are interpreted systematically from the perspective of members of the social context the research is being conducted (Tuffour, 2017).

In contrast, quantitative research focuses on numbers and uses statistical techniques to test a theory (Choy, 2014). With a particular emphasis on objectivity, Fraenkel & Wallen (2003) state that the quantitative method tests whether the predictive generalizations of a theory hold true. Therefore, quantitative research is deductive in nature and allows inferences to be made based on direct observations and to establish causal relations (Kerlinger & Lee, 2000).

Culture-specific understandings of 'what is a resource' have yet to be coherently understood in Eurasia. Because the resource notion is conveyed predominantly through the sustainability concept, the deductive premises of sustainability need be examined such that observed phenomena can be accounted for in a systematic manner. The IPBES Framework described in Chapter 2 Literature Review provides a useful model to these ends. The pattern of Caspian cultural resource meanings and sustainability expressions recorded during this research's fieldwork in aquaculture

facilities, as well as mapping local use practices of sturgeon, allows for testing the premises of sustainability from a culturally-informed perspective. If sustainability has been formulated predominantly by particular systems of knowledge, and by institutions which relate to knowledge in particular ways, then sustainability and resource concepts must be qualified by the socio-cultural setting in which it is located. From there, culturally-derived conceptualizations of resources can be proposed.

The limited number of studies on sustainability-related work in the Caspian post-1991 primarily have assessed sustainability quantitatively. The bulk of this work has been through development agencies and national development policies which have relied on survey and close-ended questions. Examples include surveys and data collection conducted by non-governmental organizations working in the sphere of biodiversity and species conservation (World Wildlife Fund),[80] and state consultations with the United Nations programmes to facilitate the implementation of the Sustainable Development Goals (Aliyev, 2011). However, this data does not account for the possibility of different interpretations, explanations or perceptions of the resource notion and ways in which sustainability can be conceptualized. This produces a research gap that this thesis intends to address. What these quantitative and deductive studies produce is a compilation of sustainability's work in the Caspian according to how it is conventionally understood. They are not an examination of the measures and methodologies used in the course of conducting these studies.

At the time of this research's fieldwork from November 2018 to May 2019, and in August 2019, cultural variables in the Caspian pertaining to resource meanings had not become represented quantifiably to a meaningful degree for this research question. Therefore, this research determined that quantitative research design would not be sufficient for assessing the genuine nature of Caspian resource understandings. Although some factors can and have been measured quantitatively (historic aquaculture production rates, Caspian wild sturgeon restocking, Caspian ecosystem characteristics and dynamics) these data sets in themselves could not answer the main question of this research: the cultural meaning of the resource notion in the Caspian. Therefore, quantitative data was useful only insofar as supplementary information within this research's qualitative research design.

[80] Action plan incorporates public awareness campaigns for strengthening support for Protected Areas (PAs) as integral to species conservation (WWF, 2016).

To this end, specialists in sturgeon aquaculture and experts working in the conservation sphere within the Caspian were interviewed first in order to establish local interpretations of the sustainability concept and underlying resource ideas. From this, gaps in terms of cultural expressions of the resource notion with respect to the use of sturgeon fish could be triangulated. Because this case study proceeds at the level of culture, a side ethnography was conducted in order to build a more representative case study which could capture alternative resource understandings and which could account for variables across the socioeconomic spectrum. Taking a phenomenological approach, food practices could be incorporated as potentially meaningful within the question of resource understandings and modes of environmental values.

Qualitative research components used: case study, phenomenology and ethnography

4.1.1 Case study

The case study was the primary component of this research's qualitative methodology. A case study is one of the most popular research designs used in qualitative social research (Sturman, 1997). Simons specifies how the case study design of research incorporates ethnographic and observational data to give powerful representation of a phenomenon that accurately reflects a context (2009). Case studies are not used to test hypotheses, but hypotheses may be generated from case studies (Creswell, 2014). Described further, the "case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system" (Simons, 2009: 21). An in-depth understanding through interrelating variables is reached by attending to the 'how' and 'why' aspects of a unit of study (Yin, 2009). It is conducted by using multiple sources such as: questionnaires, interviews, observations, written accounts, and audio-visual materials (Creswell, 2009). A case study can be quantitative or qualitative research within a bounded setting (Mohajan, 2018). Provided the principal research question and nature of available data, a qualitative methodology was determined to be best suited within the boundaries of the Caspian cultural system which remain only marginally theorized.

In order to build a case study, I followed an exploratory, mixed methods approach. This entailed integrating the analytic strengths developed through phenomenological and ethnographic methodologies, as well as drawing on a range of disciplines. Integrating insights from across disciplines as broad as anthropology, geography, archaeology, political ecology, and development studies may qualify this research as highly trans-disciplinary from some research perspectives. Yet transdisciplinarity is not a new science (Pimbert et al., 2019). Rather, it reflects a refinement of the methodologies used for doing science. Moreover, it creates the capacity to allow the science to

evolve and to engage with the social realities of the time. Taking cue from the IPBES Framework, this research hopes to contribute towards the importance of methodological pluralism such that multiple sources of evidence can be taken as valid and analysed systematically. In using a range of methodological approaches which can conduct social *and* environmental analyses, local experience can reveal how economics are often misplaced, the significance of history and memory, as well as how interactions between people and the environment beyond simplistic animist accounts (*Ibid*).

The rich detail collated by case study is powerful for demonstrating how causality cannot always be drawn for every context. This is important for development studies research as it brings forth new interpretive bases or concepts that can be meaningful elsewhere. As expressed through the IPBES Framework and in discussions provided in the Chapter 2 Literature Review, existing theoretical understandings of what constitutes sustainability do not account for alternative sustainability articulations and resource meanings in a sufficient way. The application and testing of the 2017 IPBES model, as a theoretical framework on sustainability, allowed a case study to be built that incorporated knowledge system aspects relevant to the culture of Caspian peoples. Analyses that track references and patterns within a theme allows qualitative research to engage with cultural modes of meaning-making.

Building on the literature review of Chapter 2, sustainability must be treated as a historic process. While this research primarily looks to identify cultural aspects not yet connected to theory and conceptualizations of sustainability or resources, it recognizes that these cultural features are the result of historical processes. While this research acknowledged the inherent nature of change within any system, the capacity of the case study for addressing causal complexity and potential for achieving high conceptual validity is what allowed this research to build links across seemingly disparate actions, historical developments, and cultural practices (George and Bennett, 2005).

4.1.2 Phenomenology

Using a qualitative research design, this research was able to take a phenomenological approach in order to engage with a wider range of sustainability possibilities and resource meanings. Phenomenology is an examination of the lived experience and aims to make explicit the subtle structures of everyday occurrences (Honer, Anne & Hitzler, Ronald, 2015). The phenomenological approach is useful in its ability to bring out experiences which are deeply rooted in ordinary lives, yet frequently overlooked, and the context in which the interpersonal interacts with the world (Huynh, Tuyen & Torquati, Julia, 2019; Aspers, Patrik, 2009).). Phenomenology can be very sensitive to cross-cultural difference by considering which aspects of human experience are

invariant across backgrounds and cultures (Askegaard, S. and Linnet, Jeppe Trolle, 2011). Phenomenological research does not aim to flatten these differences, but, instead, offers research a way of looking at similarities and differences (Wertz, Frederick, 2015). Phenomenology shows us we inhabit or are embedded in worlds in which norms and customs are structured into the background – embedded in the pregiven world are numerous norms for interacting with other people (Csordas, Thomas, 2011).

As Chapter 3 demonstrated, the history of human interactions and subsequent understandings of the environment in Eurasia were distinctly shaped by physical and geographic realities of the steppe. The phenomenological approach allows micro practices observed in the present to be made significant through a philosophical framework to connect seemingly small acts to bedrock features of a culture (Flaherty, Michael, 2008). With much of Eurasia and Caspian people's cultural facets remaining pre-conceptualized, this fieldwork could approach observations as reflections of how Caspian peoples understand themselves whilst embodied in a cultural world conditioned by geography.

Guidance for conducting fieldwork in a phenomenologically-minded manner was significant for building the case study that this research did. Areas where there is little knowledge of how to account for everyday experiences can benefit from phenomenological research (Paul, 2017). As Tuffour suggests, phenomenology is a kind of inquiry that takes a thoughtful understanding of the aspects of social interactions in order to investigate their underlying central meaning(s) (Mohajan, 2018; 2017: 52). With roots in philosophy, phenomena can be described according to the ways in which participants attempt to make sense of lived experiences (Creswell, 2014). Customary agricultural and/or resource practices have revealed that they can be studied as sources of cultural and ecological information and can be studied objectively (Pimbert et al., 2019). This has been underscored in a growing body of literature documenting diverse and highly-developed human-environmental interaction systems, especially in recently industrialized settings (Vergunst, Jo, 2018; Howard, Penny McCall & Smith, Alexander, 2017; Iared, Valeria Ghisloti et al., 2016; Descola, P., & Lloyd, J., 2013).

With an emphasis on the exploratory approach, this research attempted to identify sustainability's conceptualizations and the degree to which sustainability's resource premises could be located within the Caspian culture's relationship with sturgeon fish. Guided by the IPBES Framework with

the intention of capturing cultural expressions of the resource notion, this research posits questions such as: What are the concepts and language within which the idea of sustainability is spoken? What motivates/prompts/inspires discussions of sturgeon fish and caviar and in what settings do these most readily occur? Where and how are the values surrounding sturgeon resources learned?

As Nelson et al. describe, relationships to resources are embedded in holistic socio-ecological knowledge systems (2018). Accurate understandings and transmission of this knowledge rests on knowledge of the whole system. Scholarship has extensively documented how these resource relationships are encoded in food practices and customs (Manzano et al., 2021). This research therefore incorporates an ethnographic component in order to offer and endogenously-informed representations of resources within the knowledge system it is examining.

Although a phenomenon as an object of inquiry can be something simple and mundane, the phenomenological approach engages with it in a rigorous, critical and systematic way (Paul, 2017). In conducting phenomenologically-minded fieldwork, sturgeon 'happenings' could be registered without going so far as to designate them as economic, rational acts, meeting biological needs, etc. Unintentionally categorizing events in these ways, particularly while in the field, reduces the likelihood of culture meaning-making modes. Instead, phenomenological data was processed during post fieldwork analyses. These findings are presented in Chapter 5 and analysed further in Chapter 6, and justify the contextualization information provided in Chapter 3. The procedures for analysis of these themes will be described in the research data analysis subsection later in this chapter.

4.1.3 Ethnographic Component

Ethnography is derived from the anthropological tradition and examines the subjective world (Saxena, 2020: 5). It seeks to develop a "portrait of a people" through in-depth observation (Mohajan, 2018:36). Rooted in the study of people's everyday lives, the behaviours, values, and interactions of a defined context are deeply studied, described, and interpreted (Creswell, 2014). Ethnography allows the researcher "to explore with a people their rituals and customs" to consider how phenomena occurring in a group's lives is experienced (Mohajan, 2018: 38).[81]

Conducting an ethnography became necessary in order to account for how sturgeon are appreciated in Caspian Eurasia. Becoming immersed in the fields of study and attuned to nuanced

[81] Even if "rituals" or "customs" are not stated explicitly as such.

cultural realities, ethnography allowed data presented in daily narrative form to be recorded as noteworthy during fieldwork, and significant to this research's final results. The prolonged stays and multiple fieldwork visits to each of the three study sites allowed this research to develop an insider perspective and to observe social phenomena as they occurred naturally. This research's ethnography built on pre-fieldwork familiarity of the Eurasian region. Exposure to Eurasian life and culture during previous work and research trips gave this case study preliminary insight into the region's development history and institutional makeup in order to identify relevant social patterns and modes of thinking. Through the inductive approach, this research listened to the narratives to locate the 'normal' for the cultural setting in which the deductive variables – resource and the concept of sustainability – were being examined. Significant post-fieldwork analyses allowed for data to be situated within appropriate and well-informed frameworks to convey accurate and meaningful findings. As this research is a work of development studies, it made use of the field's creative disciplinary space to pursue ways in which rich cultural detail could be connected and made relevant to environmental values and appreciations.

Ethnography is a tool mainly of social sciences (Mohajan, 2018). Developed largely in the early 20th century, ethnography has been used across many social science disciplines as a means to engage with societal differences (LeCompte, Margaret D., & Schensul, Jean J., 2010). However, early ethnographic studies often emphasized the distinctiveness of cultures and projected western forms of organizational life (Descola, P., & Lloyd, J., 2013). Oftentimes, explanations of human actions were given on the basis of rational choice, behaviouralism, or as single causal factors. Critical studies scholarship discussed in Chapter 2 increasingly are highlighting the methodological shortcomings of such approaches inherited theoretical bases.

As Chapter 2 discussed, the concept of sustainability originated predominantly within western societies. Growing critical studies research has been highlighting the ways in which the sustainability concept relies on the notion of 'resource,' and how conventional applications of sustainability ideas reveal discrepancies in understandings and values. Accordingly, this research remained attentive to these growing insights from critical studies to learn how to use the tools of ethnography without giving greater meaning to exogenous concepts and ideas. The phenomenological approach proved integral to these ends by creating thinking pathways which did not relativize nor universalize cultural understandings. In order to address the principal research question and sufficiently attend to the cultural means by which something comes to be defined as a resource, it was necessary to examine where and how sturgeon occurred across the Caspian

cultural landscape. This justified the ethnographic component of this research. As will be discussed in Chapter 5 and Chapter 6, post fieldwork analyses revealed that these ethnographic observations were crucial reflections of a culture's relationship to the idea of resource and its lived form.

The ethnographic component allowed this research to study "an entire group that shares a common culture" (i.e. a common culture derived from the Eurasian steppe geography) (Reeves et al., 2013; Leedy & Ormrod, 2001). With culture as the subject, ethnography was particularly useful as it permits cultural parameters including categories of geography, social, religion, and shared experiences (Mohajan, 2018: 38). The idea of "local knowledge" developed by Clifford Geertz, which describes "the shared ideologies, norms, and values that are transmitted, learned, and maintained by a cultural group" gave key grounding for this research's fieldwork and analysis stages. In linking the historical physio-geographic realities to cultural customs, ethnography allowed this research to demonstrate that such cultural practices are relevant to resource meanings. Applying the conventional sustainability notion with its embedded resource conceptualizations in a cultural setting introduces many possible correlations and potential explanations for human-environment interactions. Through ethnography applied in critical research, lived realities can be brought centre to consider what generates resource understandings. Synthesizing these methodological approaches into this research's qualitative design allowed for a holistic documentation of Caspian resource understandings and the cultural modes that give those understandings meaning.

However, offering deterministic conclusions as to what a resource is in the context of Caspian Eurasia is not within the scope of this research. Instead, using the IPBES framework as a method for inquiry, the cultural lines by which a resource functions and gains significance could be highlighted. Through the connections afforded by ethnographic insights, this research could demonstrate the deductive limitations of sustainability and conventional environmental understandings. In doing so, this research hopes to clarify areas where future analysis is needed, and to expand scholarly interest in such topics.

4.2 Research Theory – The IPBES Framework

Post-fieldwork analyses of the collected data revealed that Eurasian food ways are intimately linked to and reflect a distinct history of human-steppe environment relations and institutions.[82] The goal

[82] The terms 'institutions and institutionalization describe process whereby social practices, such as food harvesting/sourcing and consumption practices, are regular and continuous enough to constitute an institution (Stal, Herman, 2015). Looking to the physical geography as a source for food institutions can

of social sciences is to clarify the 'what's and how's' of social phenomena. At first inspection, food often is taken to be a means for survival common to all societies. Yet the values and institutions connecting through and related to food reveal the diversity of symbolic and functional meanings that food encompasses.

The IPBES framework offers an analytic approach which "recognizes the pervasive role of culture in defining all links between the environment and humans" (Díaz et al., 2019). By emphasizing the significance of social-ecological relations, a range of socio-cultural, economic, and environmental processes to bear (Greif, Avner, & Laitin, David D., 2004: 634). Furthermore, the framework elevates the role of local knowledge while allowing for engaging with diverse stakeholders and perspectives (Díaz et al., 2019).

Oftentimes, the natural sciences and economic disciplines aim to establish universally true categories. However, these perspectives can come at the exclusion of knowledge and knowledge creation which are context specific. Rooted in and sustained by local conditions, local knowledge systems can easily be misinterpreted or overlooked by not seeking to validate itself within different cultural settings. Building from analyses of the lived human experience, the social sciences amply document this problematic history by highlighting the context-dependent nature of human-environment relations. While categorical distinctions and divisions are common features to any system, the IPBES Framework possesses a capacity for simultaneously engaging with concepts which may not be commensurate. This analytic strength makes the IPBES Framework uniquely well suited for this case study's research question.

Emerging research employing the IPBES Framework highlight the utility of the conceptual model by cutting across and integrating diverse disciplinary insights and epistemic values. By explicitly recognizing that a range of views exist, the framework provides a base for convincing theoretical alternatives for an array of human-environment relationship questions. Many of these seek to address the issues discussed in Chapter 2. Given the scope of the IPBES Framework, this research could represent change (and continuity) as a function of knowledge within and across knowledge systems. Connecting diverse fields of inquiry, dynamics in aquaculture industry operations,

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demonstrate not only how these institutions were conditioned by such realities but offer pathways for examining how resource meanings are embedded in food institutions.

sustainability conceptualizations, economic regulations, and cultural understandings of human-environment relations could be made relevant to the cultural case study of sustainability.

Aquaculture industry experts were selected for the semi-structured interview component of this research for their perspectives on economic restructuring around market principles. Yet these industry insights also demonstrated how markets reflect institutional arrangements which are embedded in distinct knowledge system make ups. From here, this research could place attention to where knowledge system contrasts arise in the context of resource understandings. The conceptual strengths of the IPBES Framework allowed this research to account for institutions and knowledge pre-dating the nation-state and Soviet eras. This allowed for tracking the nature of change and continuity across Caspian systemic transitions. Helping to reveal sub-surface and taken-for-granted elements of the Caspian knowledge systems and cultural facets, the analytic tools created through the IPBES Framework gave an approach to offer more salient understandings of the Caspian sustainability experience and points of identifying resource meanings.

The literature on Caspian state failings to meet general norms of conservation and sustainability have contributed to projections of backwardness or incompetence that feed into a sustainability dichotomy (i.e. that sustainability is pursued via these means and principles and not others). The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was the established regulatory framework through which Caspian aquaculture could participate in the global economy.[83] Exporting and importing sturgeon products performed in compliance with the rules set out by CITES serves a twin-purpose: implementing sturgeon conservation measures and demonstrating a conformance to internationally accepted sustainability norms; establishing industry operational standards and codes of conduct under which sturgeon harvesting could take place through visible and legally recognized channels (Uhm, 2016; Shadrina, 2007). Moreover, the standards of conduct outlined through regulatory frameworks, such as CITES, not only shape the nature of environmental management within an economy but become implicated in foreign investment as well. From the perspective of state governments, ensuring accountability ranging from legal reforms to providing state and land support, was significant because FDI matters to a state's development outcomes. With regard to marine conservation consolidating around the Blue

[83] Under the system controlled and maintained by the national managerial and scientific authorities of CITES, caviar shipped for export must "possess a document of permission, while containers must bear special labels that identify the country of origin, the fish species from which the product is derived, the year of production, the type of caviar (*wild* i.e. from nature, or from farmed sources), the number of manufacturing enterprise, and the identification number of the shipped batch" (Uhm, 2016: 126; Shadrina, n.d.).

Economy concept, global sustainable development commitments are increasingly consolidated around a single set of normative principles that Caspian aquaculture must remain responsive to (Samerwong, P, Bush, S.R, & Oosterveer, P.J.M., 2017).

In the case of the Caspian sturgeon aquaculture industry in Azerbaijan, Kazakhstan and Turkmenistan, the vast majority of literature emphasizes collapsing sturgeon populations, ecosystem degradation on account of hydrocarbon extraction and Soviet-era industrial practices, and an inability of littoral states to address illicit trade of caviar. As a consequence, Caspian littoral institutions become constrained by the need to rectify images of institutional weakness. In the age of internationalization, ensuring stable environmental management regimes to incentivize foreign investment to operate commercially viable projects, addressing such critiques becomes highly significant. Adapting to the sweeping changes brought on by the end of the Soviet Union remains an ongoing and complex process for Azerbaijan, Kazakhstan, and Turkmenistan. Provided these contextual realities, the IPBES Framework offers a different pathway for analysing values, ideas and practices arising through sturgeon in Caspian Eurasia, and means for engaging with endogenous features.

4.3 Data Collection Methodology

4.3.1 Semi – structured interviews

Because not all aspects of Caspian sustainability were known prior to fieldwork, highly semi-structured interviews gave the necessary exploratory potential for new ideas within a sustainability landscape to be brought forward. This is evidenced in the inductive nature and exploratory approach of this research. Aquaculture workers and fishing industry experts as interview subjects allowed for assessing the nature of the sustainability concept in terms of Caspian sturgeon biodiversity conservation. This research conducted semi-structured interviews of aquaculture managers, technicians, and capture-fishery[84] fishermen to document understandings of sustainability, as well as work-place practices indicative of knowledge preferences towards best 'management' of sturgeon as a resource. Interviewees were selected based on their respective positions and roles within Caspian aquaculture and sturgeon harvesting in order to understand

[84] This research takes the definitions of aquaculture provided in Chapter 3 in order to distinguish between capture and culture fisheries: "Aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators" (FAO, 1997: 195).

their views on sustainability. This research also documented unspoken aspects of their respective work activities to gain a perspective of the skills and training seen as necessary to their work with sturgeon production. These are detailed in Chapter 5 Fieldwork Findings. Recording a fuller picture of human interactions with a said resource, sturgeon, meant more knowledge forms could be captured and collectively how they affect the narration of the sustainability concept and resource notion.

Importantly, the same interview questions were posed to respondents working in commercial ventures as well as state-run sturgeon hatcheries. This allowed data to be collected which could then assess how a resource (i.e., sturgeon) ought to be sustained and by what means (knowledge, expertise and skills, physical infrastructure, and technologies). The different approaches towards sturgeon production allowed this research to map different logics and approaches to species conservation, and how this unfolds at the local level and day-to-day aquaculture in the form of skills and professional backgrounds. These nuanced differences in practices and approaches at the level of the farm or hatchery floor affect what and how something is or is not observed. As will be discussed in Findings of Chapter 5, these differences are implicated in policy decisions regarding biodiversity conservation procedures and strategies at the state level.

In order to broaden my understanding of sustainability regime's current work in the region, eight semi-structured interviews with sustainability experts were conducted. Many experts working in formal state and international sustainability sectors (i.e. environmental conservation agencies such as WWF, UNEP, UNDP), quickly revealed that most of their sustainability conceptualizations relied on particular and externally narrated resource notions. While interviewees were all local residents and originated from one of the three Caspian states of this study, there was a notable lack of sustainability as defined by local understandings. These discrepancies assisted in distinguishing features of different knowledge systems during post fieldwork analyses.

In total, 48 interviews were conducted (35 semi-structured and 13 unstructured) and are listed in Appendix 1. Semi-structured interviews were divided into two respondent categories:

a) individuals whose work was directly related to Caspian sturgeon fishery production (via either capture or culture fishery activities).
b) Individuals whose work pertained specifically to sustainability or biodiversity conservation work in the Caspian.

Furthermore, all interviewees were local and resided in the same approximate locale as the aquaculture facilities or traditional fishing areas. The same methodological principle was applied to experts from sustainability organizations in the region. It was important for this research to interview respondents whose work was not decoupled from the Caspian knowledge system. The decision to interview individuals who were local also was dictated by a matter of credibility.[85] Respondents had to be knowledgeable about industry operations so that this research could assess how the sustainability regime and associated biodiversity conservation measures (i.e. such as CITES protocol) affect sturgeon aquaculture activities.

Lastly, semi-structured interviews of sustainability and biodiversity conservation organizational experts were conducted to gain a more holistic perspective of the sustainability regime in the Caspian cultural context. These respondents represented organizations with a clear history in sustainability and biodiversity conservation work in the region, such as the World Wildlife Fund (WWF), Caspian Environmental Programme (CEP), United Nations Development Programme (UNDP). Similar to sturgeon aquaculture respondents, sustainability expert interviewees had to have comprehensive grasp of the norms, concepts and guiding principles of the sustainability. This typically was discussed within the language of Sustainable Development Goals (SDGs). Data from these respondents facilitated analyses across knowledge systems to highlight different modes of conceptualization and meaning-making.

4.3.2 Ethnography

This research incorporated unstructured interview as an ethnographic technique in order to investigate culture-specific modes of resource meaning-making and values. Ten unstructured interviews were held with informants who:

a) Were from the region by birth and had lived and worked in one of the three sites of this research for the majority of their lives

[85] Several interviewees acquired skills training from outside the geographical boundaries of this research (i.e. Astrakhan, Moldova, Iran) in order to perform their responsibilities in sturgeon aquaculture production. This has become increasingly frequent in the last decade. Implications of this, in terms of what skills were sought, how these enhanced or changed aquaculture production outcomes, and whether such training opportunities were being considered within the Caspian region, will be discussed in Chapter 5 – Findings. However, all participants had returned from such trainings for at least one year and were interviewed in the geographical bounds of this research's designated study area.

b) Worked in NGOs in close contact with development projects, small scale start-ups promoting recreation and could comment on the changing nature of human-environment relation styles, or in universities as social science scholars.

The unstructured nature of these interviews allowed this research to incorporate the ethnographic method.

Field notes are the primary way in which ethnographic data is recorded (Allard and Anderson, 2005). This allows for non-verbal components of a research setting to be documented. These can include: facial expressions, gestures, uses of space and physical surroundings. The researcher's response(s) to the actions of respondents or members of the cultural setting create a valuable data set from which hypotheses can emerge. The participant observation approach was also extremely valuable for this research as the actions of semi-structured interview participants listed above could be recorded as data. These observations emphasized the diversity of skills and kinds of expertise that are incorporated into aquaculture activities and the changing relevance of conservation approaches (Chapter 5). Indicating gaps in contemporary sustainability literature, these ethnographic insights helped this research identify how these gaps arise as a function of knowledge system features. These interviews were extremely useful for alerting me to alternative processes embedded in the history of Caspian culture's environmental relations, as well as for shaping my expectations for locating sustainability from the Caspian cultural perspective.

More informal settings selected by local informants were used in order to record any indicators and/or cues within the setting. In essence, it allowed for a phenomenologically-minded observations by acquiring data from a place of listening and observing as opposed to telling or guiding. With this in mind, Herbert Blumer's theoretical approach of symbolic interaction which focuses on the meanings that shape society and human behaviour was crucial for developing this research's findings. Symbolic interaction posits that meanings are social products which shape, and are shaped by, the social interaction of individuals and context. As will be discussed at length in Chapters 5 and 6, sturgeon fish meat in traditional cuisine, may appear unremarkable or irrelevant from the perspective of sustainability, or that food practices operate in unrelated cultural dimensions. As will be discussed at length, from the vantage of Caspian culture, food phenomena reflect highly relevant aspects of a knowledge system and embedded resource meanings.

Given the inductive nature of this research, the naturalistic ethnographic approach was most appropriate for structuring fieldwork proceedings. Rather than developing all research questions prior to entering the field site, naturalistic ethnography formulates questions, concepts, and

theories after entering the field site (Marquez Garcia, Jose Ignacio, 2015; Lillis, 2008; Allard and Anderson, 2005). This research remained committed to a core question: what is sustainability in the Caspian; and how is it conceived insofar as what culturally constitutes a resource. Because there is very limited data regarding this topic and the region of Eurasia has received very little scholarly attention within development studies, it was important for this research to clarify concepts and connections after immersing and engaging with the Caspian cultural landscape.

In spite of the fact that social sciences regularly make use of relatively formal, learnable techniques, such as those described in the interview sections, ethnography remains an important methodological strategy within qualitative research that takes a different approach (Lillis, 2008; Jeffrey, Bob, & Troman, Geoff, 2004). As suggested by Macaulay, Catriona et al. most ethnographers claim that intuition can be as important as rational plans in making for successful research (2000). Many in the current generation of social scientists challenge the epistemological orientation that all researchers work as neutral observers (Abu-Lughod, Lila, 1991). Rather than striving to approximate laboratory conditions in order to offer positivist explanations for social phenomena, considering how researchers create and pursue their research question is highly productive (*Ibid*). In other words, when individual researchers proceed into the field with a mindfulness of their own subjectivities, skills training, and professional backgrounds, an important attentiveness to the nature of their work follows (Lillis, 2008). Additionally, in an increasingly globalized system, the sharp insider-outsider binary that has prevailed social science methodological discussions for decades is being revisited for many research settings. As Abu-Lughod stated, more and "more of us are halfies" (Abu-Lughod, Lilia, 1991:48). Engaging with how a researcher understands themselves within their socialized research context facilitates more informed findings can be reached (Bob, & Troman, Geoff, 2004). With an eye to my own cultural background and resource understandings, the ethnographic method with the phenomenological approach enabled a productive and insightful framework for detecting resource interpretations while remaining aware of my own assumptions. The Fieldwork Findings of Chapter 5 will detail what the ethnographic component of this research brought to light as indicators of resource meaning and differences as a function of knowledge systems.

4.4 Data Analysis Methodology

Qualitative data analysis generates a large volume of data. While the kind of qualitative data that is produced can vary depending upon the research design used, they are subject to the same principles of analysis.

The 48 interviews conducted during the course of this research's fieldwork produced close to 200-pages of transcriptions. Over 150 pages of fieldwork notes for ethnographic considerations were generated as well. The challenge for social science research is to perform an in-depth analysis that presents the findings in a concise and logical way [Clifford, 1997]. In order to cope with the large volume of data, analysis techniques such as 'coding', 'memoing', and thematic analyses were used.

Coding is an "efficient data labelling and data-retrieval device" (Miles & Huberman, 1994, p. 65). Following recommendations of Miles & Huberman, a list of preliminary codes was created before fieldwork in order to connect data directly to questions and concepts developed during the first year of the PhD work (1994). Based on evolving ethnographic insights while in the field, this coding system was adjusted in appropriate ways. This allowed for inductively incorporating relevant data and observations that resulted in more empirically-derived coding labels. Coding was an on-going exercise performed throughout the data gathering process. Through the inductive approach, this research attuned itself to the narratives of sustainability and resource concepts to derive an evolving set of codes while in the field. Points of continuity across narratives and cultural expressions were noted within this coding scheme. Later, this established a 'normal' within the cultural matrices of Caspian sustainability.

Memoing was an important supplement to coding and entailed writing a few sentences or a paragraph throughout the fieldwork stage. As Miles & Huberman suggest, memoing is "one of the most useful and powerful sense-making tools at hand" (1992, 74). In addition to reporting data, memoing proved to be very helpful by tying scattered fragments of data into recognisable clusters. This facilitates making connections of those clusters with the concepts under investigation. In addition to reporting the data, memoing allowed scattered threads of data to be brought together into recognizable clusters. This was particularly useful when it came time for post-fieldwork data analysis and charting emergent themes in the data. 'Scrutiny techniques' described by Ryan and Bernard outlined a useful framework for identifying repetitions (reoccurring topics) to prompt deeper analyses (2003).

During post-fieldwork data analysis, fieldwork notes and interview transcripts were re-read several times. This was done to revisit primary data having refined my conceptual perspectives and in order to bring new insights to the data after revisiting the literature. The data analysis itself becomes a dynamic process of weaving together themes, looking for patterns where themes intersect, and identifying key ideas or units of meaning and material acquired from the literature.

An intensive data analysis begins once it is determined that all necessary data has been collected and/or transcribed.

At this stage, the data itself becomes a tool to think with "and one looks to see whether any interesting patterns can be identified" (Hammersley and Atkinson, 1995). Based on the researcher's immersion in the data and in the field site, patterns emerge that meaningfully reflect the literature, research site context, and data recorded. As the data analysis progresses, these patterns are developed into thematic categories with each transcript re-examined for phrases, sentences or participant quotes seen as relevant to a defined category within the central research question. Also, data from interview transcripts was triangulated with ethnographic field notes to make analyses more robust for a more informed case study. This also helped to minimize risks of inappropriate subjective interpretation of the data.

I looked for reoccurrences in respondent quotes, metaphors, analogies and common cultural behaviours. A list of possible cultural conceptualization modes for what constitutes a resource, as an analytic path for mapping Caspian sustainability, was devised to contribute to the IPBES Framework.

Analysing all interview transcripts and ethnographic fieldnotes were extracted, reduced and assess, which required a significant amount of time. To transpose the IPBES Framework in a local context for domain prioritization, I converted qualitative data to numbers. This was essential for avoiding pitfalls arising from inaccurate interpretation or minor reporting errors resulting in a different order of CSR domains. By adopting the format of *Likert Scale*, I was able to translate sustainability perspectives (about four sustainability domains) into numbers, to enhance the precision of interpretation. The content analysis revealed certain patterns in sustainability/resource understandings in the context of Caspian aquaculture, which allowed for synthesizing individual views into a contextual model.

4.5 Limitations and Scope of this Research

While this study recognizes its limitations, it hopes that findings from this research will motivate further study to address some of these gaps. Although I attempted to produce a comprehensive, systematic analysis of resource meanings in the Caspian context, several variables presented challenges this research worked to overcome to the best of its abilities. This section describes those limitations.

First of all, the concept of sustainability has a history of institutionalization and conceptual formalization outside the Caspian region. This history has been political and increasingly normative amidst growing climate change debates, as the literature review in Chapter 2 suggests. Therefore, sustainability institutions and ideas arriving in the Caspian post-1991 landscape also carried these political debates. Data was collected from interview respondents who generally were aware of these debates and conveyed this implicitly or by making explicit reference to them. This introduced a bias probability in the data. Typically, when respondents are asked about their attitudes towards such issues, they naturally have ethical and intrinsic desires to appear concerned. They also may be compelled to provide more socially desired answers instead of truthful ones with respect to the questions asked. This might be especially true in the case of managers and sustainability experts, hoping to appear more committed to the normative dimension of sustainability and/or sturgeon species conservation. Ethical concerns stemming from the normativity of sustainability created a risk that information provided by interviewees might be overstated or that answers may be provided which do not necessarily correlate in terms of attitude. This discrepancy in data collected from explicit interview responses justified the ethnographic component of this research as the unspoken behaviours and patterns of cultural practice could be treated as important points for triangulating interview responses.

While my research interests were not of a political nature specifically, politicization of sustainability within the context of interviews did arise. This occurred when sturgeon biodiversity conservation activities taking place in the Caspian were being evaluated between the five littoral states, particularly by external actors. This research noted several instances of strong defensiveness when issues of pollution in the Caspian were discussed. Similarly, regulatory frameworks for biodiversity conservation, such as CITES, affect the operational landscape of Caspian aquaculture industries. While this research does not deny that sustainability has become increasingly standardized and framed by conventional resource narrations, this research contends that such regulatory frameworks and sustainability rationales do not offer the sole bases for how resources can be interpreted. While sensitivities pertaining to the ability of governments or industry to meet normative standards or regulatory requirements within the Caspian environment were recorded during interviews, these responses were not treated as indicative of resource meanings in themselves.

Second, due to time limitations, this case study is restricted to aquaculture activities in three of the five Caspian littoral states. The Caspian littoral area consists of five independent nation-states with a variety of political entities (i.e., Dagestan, Kalmykia). However, this case study was restricted to aquaculture activities in three of the five Caspian littoral states: Azerbaijan, Kazakhstan, and

Turkmenistan. While these states share water borders with Russia and Iran, and are connected via various Caspian institutions, this research pursued a cultural case study, not an examination of nation-state relations. Although political and economic factors between Caspian littoral states affect the nature of aquaculture and sturgeon conservation, this research inquired into the role of culture and endogenous resource meanings within these production processes. Moreover, given the recent creation of the nation-state system in the region, this research asserts that state political and market economic factors were addressed implicitly within this cultural analysis. Also, I do not intend to statistically generalise my findings to all Caspian littoral entities as Russia and Iran have distinct civilizational and development histories. However, provided globalized economic realities, studies on the ways in which Azerbaijan, Kazakhstan and Turkmenistan's respective state relations outside the region affect sustainability internally could be an area of important future work.

Given all limitations stated above, I do not claim to produce an entirely representative portrait of the Caspian resource meanings. As Chapter 3 stated, the social and linguistic histories of Eurasian societies are vast and give the region and irreducible tapestry of knowledge and cultures. Rather than generalizing across, this research endeavoured to capture essences of Caspian resource understandings as a function of knowledge that enabled this history of societal flourishing. While follow up data collection trips were precluded by the Covid-19 pandemic, this research recognized that definitive resource definitions for Eurasia could not be produced based on the findings from one study alone. With much of Eurasia remaining poorly conceptualized, extensive and more detailed studies will be required. Instead, what this research hopes is that these initial findings can prompt and provide bases for more informed research in Eurasia. Furthermore, some of the sustainability findings of this study can offer relevant interpretive bases for social analyses elsewhere.

Space precludes more detailed description of methodologies and research tools utilised for this research. This chapter provided a brief overview of the methods used in this study of sustainability and resource meanings in the cultural context of Azerbaijan, Kazakhstan and Turkmenistan. The application of this methodology is reflected in empirical part of this research (Chapters 5-6), where the case study of the three Caspian littoral state's aquaculture industry and sustainability landscape is analysed in detail.

PART III

Chapter 5 – Fieldwork Findings

This chapter will discuss the fieldwork findings from Azerbaijan, Kazakhstan, and Turkmenistan. It is divided into two parts.

The first discusses data acquired from aquaculture facilities in each of the three sites of this study. Specific examples of sturgeon growing techniques and supporting knowledge will be presented within a consideration of how these approaches stem from the environmental conservation imperative arising in industrialized societies. This section will develop a discussion of the conservation imperative by contrasting the distinct strategies and logics emerging from market-based economies and the Soviet model in the context of Caspian sturgeon. While this fieldwork observed varying degrees of sturgeon growing knowledge and techniques developed during Soviet times compared to strategies emerging from market economies across visited facilities, this chapter approaches continuing use of Soviet capacities as part of a strategy for developing a viable business model. The main purpose of this section is to highlight current trends in the Caspian aquaculture industry landscape to demonstrate how the industry is orienting to meet a distinct domestic market for sturgeon meat, rather than caviar derivatives. Chapter 6 Analysis will build on information presented in this chapter to demonstrate how these industry trends reflect an investment to enable culture, and how the culture is what carries resource meaning and understandings.

Section 2 builds on these discussions to engage with the possible precursors of the local sturgeon market. It is presented based on the findings from the ethnographic component of this research. This section engages with sturgeon from the perspective of being culturally embedded. Observations of how sturgeon fish function as a noteworthy food and protein source will be introduced in order to begin to develop a two-fold argument: a) for how food creates a mode by which the environment can be interpreted in culturally relevant ways and, b) how this interpretive mode becomes instilled with cultural value over time. Archaeological studies and bone isotope analyses will be presented to substantiate the historical significance and use of sturgeon by Caspian peoples. Data presented in this section of Chapter 5 will be expanded in Chapter 6 to suggest that this market for sturgeon products exists because of culture and the distinct history of human interactions with the geography of Caspian Eurasia.

Chapter 5 Part 1

5.1 Introduction

5.1.1. Unit of Analysis

This research undertook a seven-month ethnographic investigation with semi-structured interviews in over 12 sturgeon fish hatcheries and aquaculture facilities, in addition to related monitoring agencies in Azerbaijan, Kazakhstan, and Turkmenistan (Appendix 1). The following review of the visited sites were chosen specifically because of their stated role in producing Caspian sturgeon commodities, as well as their varying degrees of participation in sturgeon conservation work.

Although the first section of findings from interviews and observations at sturgeon farming sites will be presented according to the state in which they were recorded, this chapter does not characterize this data as distinctly belonging to, nor expressing a representation of, an inherent trait of the respective nation-state. The borders themselves are too recent a phenomenon in the Caspian for meaningful analysis. That is, the collective consciousness of statehood had not percolated into each respective nation state's political structures to a sufficient degree for discrete study of resource meanings and sustainability considerations. While the aquaculture infrastructure capacities, operation histories, and ownership structures varied between facilities,[86] this research maintains that more connects than separates the three sites of this study by virtue of culture.[87] For the sake of the proceeding discussions, state borders are acknowledged only insofar as to orient the reader and to make simpler account of this research's fieldwork proceedings.

5.1.2. Qualifying Soviet and Market-Economy Industrial Systems and Conservation Styles

This fieldwork was carried out nearly thirty years after Azerbaijan, Kazakhstan and Turkmenistan transitioned to economies based on market principles. Provided the global implications of climate change, conservation and environmental management strategies put forward for a variety of mitigation measures have become prominent features for the nation-states of this study. Not only have these been integrated to facilitate transition processes and to enable Azerbaijan, Kazakhstan,

[86] These circumstances were the consequence Soviet infrastructure and institutional decisions due to the physical ecology of the Caspian and the life cycles of Caspian sturgeon, not necessarily for the purpose of economic development.

[87] Cultural unit as a unit of analysis demarcated by culture-geography as set out in discussions from Chapter 3.

and Turkmenistan to become recognized as participants in international environmental and sustainability efforts, but they have become pathways for transmitting principles sustainability and resource ideas to organize economic activities around a particular logic.

However, the idea of environmental management at the level of the entire waterbody was not new to the Caspian. Sturgeon aquaculture developed as a conservation strategy to balance the production goals of the industrialized Soviet state. Yet the Soviet conservation approach proceeded along its own rationales and methods distinct from those pursued by economies organized under market principles.

Entering into a market-based reality after the dismantling of the Soviet Union necessarily led to a change in the nature of the industrial production of sturgeon and species conservation approaches. Structural transformations at the outset of nation-statehood became implicated in diverse ways for Caspian sturgeon farming: from the level of day-to-day facility operations, the manner in which sturgeon aquaculture contributed to sturgeon conservation efforts, to the nature in which producers understood their economic roles and viability. However, a notable degree of practices and techniques for rearing of Caspian sturgeon developed during Soviet times remained in use. While these Soviet-era capacities created important bases for redirecting economic activities under new systemic realities, they were unfit for market conditions. Specifically in the context of sturgeon fish farming, the Soviet system generated considerable technical abilities and modern scientific know-how, yet they now required supplementing with market economy knowledge. Namely, this entailed new aquaculture specialists with redevised skillsets and competencies to enable financial success. Examples of fieldwork data concretely demonstrating the effects of newly required skillsets, along with how this shapes conservation approaches, will be detailed in later subsections of visits to fish farm sites and data from semi-structured interviews.

The purpose of this brief introductory section is to comment on the nature of environmental conservation required by industrialized societies, and the particular forms this took under the Soviet centrally-planned and current nation-state economies with respect to sturgeon fish farming. While acknowledging important institutional and structural differences between the Soviet and nation-state framework, this research treats both systems as a form of industrialism. The justification for this is to allow for an eventual and more balanced consideration of the role of culture in Caspian Eurasia resource understandings under scaled-up and pre-modernized conditions.

Industrialism is qualified on the grounds that society becomes organized around a growth-oriented style of resource use as natural system productivities become scaled up for the goal of greater industrial output. The results of these industrial activities are then redirected in a variety of ways for the purpose of development. As a consequence of industrial growth under both systems, however, what this brief section aims to make clear is that some form of environmental conservation beyond natural regeneration becomes necessary to safeguard production goals over the long durée.[88] The distinct strategies and approaches to environmental conservation between market-based and centrally-planned economies are apparent in the case of sturgeon fish, particularly at the level of breeding and rearing programs.

To offer a brief introduction of key differences between Soviet and market-economy conservation logics vis-à-vis sturgeon: the Soviet conservation strategy effectively was premised on ensuring better sturgeon fingerling survival rates and longevity in the wild by mimicking natural ecosystem dynamics within fish farm facilities. In contrast, market-oriented aquaculture devises strategies to optimize growth rates in order to meet demand more efficiently, thus minimizing incentives for unregulated activity. Sturgeon hatcheries developed under the Soviet system carried the mandate of restocking wild populations, as well as conducting research to inform policy-making. As will be elaborated in the discussion of farm visits (Azerbaijan Section 5.2.1) reproductive fish farming under the Soviet system and emphasized genetic preservation in order to meet the conservation imperative.[89]

Soviet sturgeon hatcheries were not tasked as commercial operations for the production of fish products and had to be repurposed to fit market needs to continue operations. Under a market system, the base requirements for commercial aquaculture ventures are to increase breeding productivity such that fish meat and fish by-products can be harvested at efficient rates. From a

[88] The role of technology and technological advancements through an array of material enhancements and/or improved scientific understandings is acknowledged as an important element in industrial strategy and how environmental conservation can be achieved for both systems. However, a more elaborated discussion of this feature is outside the scope of this research question.

[89] The genetic conservation principle is well expressed by the FAO/UNEP Report on Conservation of the Genetic Resources of Fish: "The objective of nature conservation is to preserve for posterity as much as possible of the earth's biological and ecological diversity" (1981: Section 1.3). The justifications range from moral arguments (i.e. that all species have the right to exist regardless of human capabilities to destroy) to pragmatic economic considerations and human welfare (i.e. preserving diversity is a prudent and proven strategy for resilient food and natural systems and helps to minimize adverse impacts from manmade and natural disasters).

conservation perspective, the rationale is that producing fish meat and by-products in such regulated settings will allow for meeting commodity demand while reducing pressure on wild populations. Effectively, business success enables to the conservation mandate of sturgeon protection to be met.

Concrete example of how these contrasting conservation logics unfold at the level of sturgeon farm operations will be detailed in Section 5.2 after providing an overview of significant sturgeon enterprises from each site of the study (Sections: 5.2.1.,5.2.2., and 5.2.3). Setting the scene of current sturgeon farming ventures will give better context for changing conservation styles in the Caspian. More importantly for the purpose of this study, highlighting the growing presence of market knowledge in Caspian sturgeon aquaculture will allow this dissertation to establish an argument of how market knowledge pursuits are not simply a means to an end, but facilitate paths for connecting back to culture.[90] The degree of market knowledge presence, as well as the relative degree of Soviet- era knowledge and technique carry-over, varied between each Caspian sturgeon farm visited. Despite variation in Caspian sturgeon business strategies, Chapter 6 Analysis will expand on ideas introduced in Chapter 5 to substantiate how the pursuit of market knowledge ultimately enables paths for connecting back to culture through endogenous forms of sturgeon appreciation and understandings.

The next section will return to discussions of the global aquaculture industry introduced in Chapter 3 in order to highlight relevant aspects of the industry affecting realities in which Caspian sturgeon producers operate. However, this research does not treat these international dynamics in a deterministic way for Caspian aquaculture ventures. Rather, the following paragraphs will allow for Caspian operators to be contextualized within the global scene to then develop a discussion as to why (and how) culture creates an important domestic market for sturgeon products. Specifically, Caspian Eurasian culture creates an appreciation for and sustains a local market for sturgeon *meat* products. In generating this domestic market, culture gives the base into which foreign partners and national financiers can invest.

[90] Culture as in values and environmental understandings developed during pre-modernized and pre-industrialized times in Eurasia.

5.1.3. Economic Considerations for Caspian Sturgeon Farming within Global Aquaculture

Over the last decade, the food and agricultural sector have been identified as the sector with the largest growth potential (Kurmanalina et al., 2020; OECD, 2013) and aquaculture as the fastest growing animal-based protein industry within the sector (Farmery et al., 2017). This high growth potential has attracted significant investment interest. Interacting with efforts to mainstream the Blue Economy Framework (Ch. 3), which looks to aquaculture as a cornerstone of its policy agenda, aquaculture has witnessed significant growth and industry development.[91]

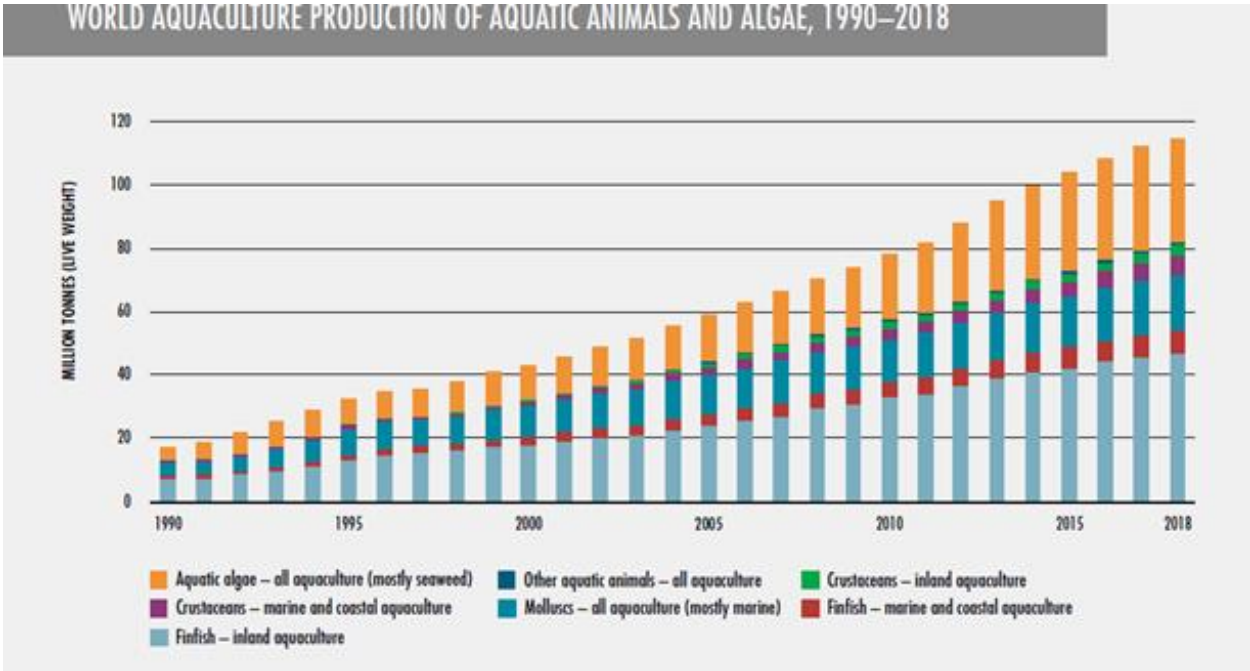

Figure 21: Proportions of aquatic animals and algae to global aquaculture production (FAO, 2018). Figure 21 highlights the significant rise in aquaculture-based products for a variety of species since 1990.

During the early stages of transitioning to market economies, the commercial importance of caviar sparked an interest in sturgeon farming. Simultaneously, growing concern for sturgeon species conservation, as well as the role of aquaculture in food security (Ch. 3: Blue Economy discussions),

[91] Increased concern over various aquaculture practices have been expressed amidst industry expansion. These range from issues of: water pollution, habitat destruction, overuse of antibiotics, release of disease agents, requirements of wild-caught fish meal and fish oil to produce feed, and a range of impacts on wild fish populations. This has resulted in an imperative for addressing issues to which almost exclusively high-tech and costly innovative practices are capable of delivering. While many of the concerns are valid, 'business-as-usual' aquaculture practices are presented as questionable and risk business viability in the long term. Ultimately, these industry issues have reinforced the financialization of the sector.

further consolidated and motivated advancement of sturgeon aquaculture in the Caspian. Current and growing investment interest in aquaculture globally, as shown in Figure 1 above and Chapter 3, has resulted greater application of technology and research to facilitate industry growth. Under these conditions, high investment in technologies and R&D become necessary not only to be competitive, but to be commercially viable.

Specifically in the case of sturgeon, their unique physiological requirements[92] and slow maturation time[93] make them difficult to grow commercially. As one aquaculture expert stated:

> "There are many technologies in the world, but aquaculture is very expensive. It costs about two million euro to produce 100 tons of sturgeon."
>
> (AQUCLT9 Respondent, Almaty, Kazakhstan, March 10, 2019)

These high levels of investment and investment structure, which typically entail foreign partnerships, become implicated in Caspian aquaculture producer business models. Under these conditions, many of the Caspian's aquaculture ventures rely on individuals with significant financial assets, foreign donors, or joint-stock companies with holdings in various sectors and a broader financial base. [94][95] Moreover, and as Section 5.1.2 outlined, the new sturgeon conservation logic brought on by market conditions required new physical infrastructure and employee capabilities. Across all three fieldwork sites of this case study, interview respondents demonstrated how the

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[92] Sturgeon have a low tolerance of water quality parameters outside a limited range of pH, ammonia levels, and oxygen saturation relative to other fish species (Berman, C *Field notes* April 2019).

[93] [1]8-20 years for non-hybrid varieties of Beluga sturgeon; 13-15 years for non-hybridized Russian sturgeon (Berman, C *Field notes* November 2018).

[94] The rapidly decreasing proportion of small-scale sturgeon farming entrepreneurs to large industry players documented during this course of the fieldwork gives strong indication of this trend. Particularly in the case of Azerbaijan, many small-scale fish farms were established in the 1990s with USAID grants, often with restaurants attached. None of these small-scale sturgeon farms funded by international grants were still in operation during the course of this fieldwork in Azerbaijan. Turkmenistan farms were financed only by domestic investors while Kazakhstan represented a mix of European investment and domestic partners.

[95] Another indication of the increasingly high investment nature of the aquaculture sector is the marked rise in the number of guides for impact investing in sustainable aquaculture. Since 2016, Jones and Scott discuss the significant growth in partnerships across capital investment firms and key environmental conservation organizations around the idea of Blue Revolution. At present, forecasts suggest producers will need $150 to $300 billion USD in capital expenditures in the next ten years to build out the infrastructure required to accommodate consumer demand (Jones and Scott, 2019).

aquaculture industry had moved from a subsidized model to a high-investment, debt-based enterprise model. Given current trends in the global aquaculture industry (Ch. 3), and with Azerbaijan and Kazakhstan pursuing sturgeon farming through more international partnerships (Turkmenistan was the exception in this regard), Caspian aquaculture ventures become implicated in international industry dynamics. The remainder of this section will discuss these industry dynamics from the perspective of the kind of knowledge that became necessary to incorporate in order to pursue sturgeon aquaculture in the Caspian. At the core, knowledge of the market became necessary to build on Soviet-era capacities. The kinds of competencies and institutional know-how developed under the Soviet system, along with those being pursued by ventures operating under the nation-state system, will be represented as knowledge preferences. This idea of knowledge preferences and its changing nature within Caspian sturgeon aquaculture will be elaborated through a contextualized discussion of sturgeon breathing habits observed during farm visits, and the distinct types of expertise used for interpreting sturgeon behaviour (Section 5.4).

Financing Caspian aquaculture amidst global industry investment developments largely was pursued through privatization, although there was variation in this approach between Azerbaijan, Kazakhstan, and Turkmenistan. At the time of this research's fieldwork, Turkmenistan recently had privatized state sturgeon hatcheries and transferred all sturgeon conservation activities to a Turkmen joint-stock commercial venture. Azerbaijan followed suit immediately after this research's first round of fieldwork. While a follow up fieldwork trip was intended to investigate the nature of this privatization in Azerbaijan further, this was cancelled due to the Covid-19 pandemic. Data collected from sturgeon farm and hatchery operations in Kazakhstan evidenced a diverse investment landscape with ventures financed by international partners (particularly Scandinavian), as well as local financiers.

Rather than examining these investment partnerships exclusively along lines of financial transactions, economic incentives, and/or enterprise prospects, this research considers how culture creates a particular market to which foreign investment in sturgeon aquaculture is attracted. In developing and sustaining a particular form of sturgeon appreciation (specifically, sturgeon meat), culture supports the market to which enterprise can invest. While marketing and business strategies are pursued and known to augment or to reshape the consumer market

landscape, sturgeon meat use in the Caspian was in existence long before the introduction of such market practices.[96]

To this end, the ensuing sections will detail specific examples of sturgeon fish farm enterprises across each site of this study. These examples not only will demonstrate growing preferences for market knowledge to supplement Soviet-era sturgeon infrastructure, but, crucially, will highlight a theme of the specific kind of market Caspian sturgeon aquaculture increasingly is being directed towards – that of sturgeon meat (as opposed to caviar). Clarifying the commercial model of sturgeon aquaculture based on the specific business strategies of Caspian producers allows empirical evidence collected from the fieldwork to demonstrate how the industry is aligning to meet local preferences. While foreign investment and foreign partner interests introduce important points of consideration for aquaculture venture decisions, interview data demonstrated that Caspian producers are targeting *domestic and/or regional* Eurasian consumer markets, not European or wider Asian markets. Although some interview respondents mentioned the prospect of foreign export of sturgeon products, this remained contingent on business outcomes within the domestic market first at the time of fieldwork interviews.

International trade regulations and certificate requirements for export of sturgeon products significantly affects Caspian aquaculture business decisions. The rise in the number of trade regulations for sturgeon products (CITES) since Caspian states came into existence made foreign markets for many Caspian producers financially prohibitive. Numerous interview respondents listed the requirements for international sale and associated costs:

> *"In order to export, you need: veterinarian documentation for certificate of quality, invoice and a declaration of conformity so that you can obtain CITES certificate (processed in capital cities) for international export. It is very expensive"* (AQCLTR6 Respondent, Aktau, Kazakhstan, March 2019).[97]

[96] Interview respondents discussed the history of fishing importance in terms of protecting access to this resource base: "One hundred years ago, long before Soviet times, there were very conservative and traditional fishing boundaries maintained over where your fishing territory was (directly behind your home). This was the practice maintained even until now in some areas. People are still deeply protective about this system" (EXPRT15 Respondent, February 2019).

[97] This sentiment was expressed by seven respondents in total. Interview respondents from one facility were in the process of applying for tax subsidies from the government for veterinary certificates.

The financial and staff resources needed to meet such regulatory requirements made foreign export of sturgeon products unviable for nearly all farms visited at the time of this research's fieldwork. As culture is the main topic of analysis for this dissertation, detailing the various international regulatory factors influencing aquaculture business decisions beyond what was provided in Chapter 3 goes outside the bounds of this main research question. While discussions for international sale were mentioned as a possibility, interviewees did not share or give any indication of concrete steps being taken in this direction.

This chapter will present fieldwork data from interviews in order to advance an argument later in Chapter 6. Clarifying the commercial model of sturgeon aquaculture in the Caspian, based on the specific business strategies being pursued, allows empirical evidence collected from the fieldwork to demonstrate how respective knowledge types are being leveraged in large part to connect with and are in implicit alignment with the local cultural system. By way of introduction and in order to frame the following sections, data presented in this chapter will be used later to highlight the significance of culture in two respects: a) underscore the role of culture in enabling the economics of Caspian sturgeon aquaculture (especially in the short-term) and, b) demonstrate how culture sustains a distinct interpretation and understanding of the resource notion by virtue of the civilizational development history within the Eurasian landscape.

The proceeding interview data from aquaculture specialists and data collected during fish farm visits will demonstrate aquaculture's reorientation towards meat (as opposed to caviar) by virtue of pursuing market-based knowledge as a supplement to Soviet-era technical capacities and endowments. Chapter 6 Analysis will elaborate on how this becomes meaningful in terms of resource understandings when examined through the lens of culture.

5.2 – Farm Visits

5.2.1. Azerbaijan

Two farms were visited in Azerbaijan. Additionally, the capital, Baku, hosts regional chapters of many international conservation organizations (UNEP, WWF), and is the base for the country's agricultural and environmental ministries and affiliated agencies. A total of eight weeks during November 2018 – May 2019 were spent interviewing conservation experts to gain better understanding of the current discourse around conservation, and deeper insight into the realities of the Caspian sustainability landscape. The results from these conservation organization interviews greatly informed this research's analysis and subsequent findings by bringing out how

sustainability is conceptualized along particular lines. This has a two-pronged effect: sustainability as a concept becomes narrated according to particular systems of thought and ideas (Ch.2) which are exogenous to Caspian Eurasia; and how this affects how sustainability comes to be understood internally (to be elaborated in Chapter 6). Significant time in-country was required as well to process paperwork and to gain approval for visiting Azerbaijan's state hatchery.

The following section will discuss the newest sturgeon enterprise in Azerbaijan as it is the most significant for the purposes of this study. Pursuing a particular business model that leveraged Soviet-era research capacities in genetics, the venture recently had acquired significant foreign investment to finance plans for constructing the world's largest sturgeon farm. With plans to include a school for training fish farm specialists, a fish feed production centre, public museum, research facilities, and sturgeon farming area, the farm is envisioned as a multi-component complex.

By going beyond the scope of conventional sturgeon aquaculture, the enterprise aimed to position itself as a unique player with a strong base in the regional sturgeon market.[98] One month after the completion of this fieldwork, Azerbaijan's state fish hatchery (Xili) was privatized and formally transferred to this enterprise. Located in the Neftchala region on the Kura River, a the only spawning site for Caspian sturgeon within Azerbaijan's territory. Figure 22 shows the location of the Xili hatchery along the Kura tributary.

[98] Currently, China is the largest producer of caviar in terms of volume. See Chapter 3.

Figure 22: Location of Xili State Hatchery in Neftchala, Azerbaijan (Source: Google Maps).

Figure 23 gives an aerial overview of the planned construction site for the sturgeon complex and expansion of current hatchery facilities at Xili.

Figure 23: Aerial view of Xili State Hatchery expansion site currently under construction (Lumen, 2019).

Figure 24 provides an image of Xili's main nursery pool area. The hatchery supported over 200 tanks and a series of outdoor ponds and transition pools to support the release of 1 million sturgeon fingerlings during Soviet times.

Figure 24: Xili nursery floor (Berman, C., May 2019)

The base of this enterprise stems from how it leveraged the scientific research during Soviet times under the Academy of Sciences Institute of Physiology in Baku to attract foreign investment. As introduced in Chapter 3, sturgeons are of interest genetically as their relatively unchanged status makes them important for understanding vertebrate evolution. In essence, analyses of sturgeon phylogenetic and taxonomic relationships allowed for an important species identification methodology to be developed.[99] Research interest in sturgeon genetics for a range of applications and analyses was pursued across several Academy of Science Institutes during Soviet times. With the world's first sturgeon hatchery built in Azerbaijan on the Kura River, the Institute of Physiology in Baku became a leading research department in sturgeon genetics (Mamedov, 2019). Additionally, researchers at the Institute were able to continue on-going studies despite wide-ranging challenges during the transition era.

[99] This is now the primary tool for tracking and identifying caviar sources under CITES protocol

"The Institute has a 60-year study period. We had the necessary contacts to hatcheries in order to obtain samples during the transition era. This lack of data gap makes our studies very valuable" (AQCLTR19 Respondent, Baku, Azerbaijan, March 2019).

The important findings in genetics by the Baku Institute of Physiology (ensuing Section 5.2.1.a), made possible in large part by access to such data, provided a crucial base for attracting foreign investment interest. The business model the sturgeon complex venture is pursuing having acquired foreign investment, gives important indication of a target market. This research asserts that such a market exists because of cultural values and forms of sturgeon appreciation. Moreover, the sturgeon enterprise envisions training a future generation of aquaculture specialists that will map onto these cultural features.

In cultivating a new cohort of fish farm specialists through the complex's training school, the enterprise aims to produce a new domestic base of small-scale fish farms.

"People in the last few years have become very interested in aquaculture… [Venture] wants a "regional scale training facility to train technicians for fish farming because the aquaculture sector has a lot of interest since many people were previously more interested in going into the oil sector. Now we are coming back and the oil sector can't absorb next generation of workers like before, so we are hoping to use agriculture as the sector for this" (AQCLTR13 Respondent, Baku Azerbaijan, March 2019).

The venture hopes to act as the main supplier of fish feed for new regional fish farming ventures. Establishing such a client base would finance expanding operations at the sturgeon complex, as well as help to fund further research.

The majority of fish farm feeds is in the form of pellets from blended fish meal and fish oil (Katusky et al., 2001).[100] However, declines in global supplies of stock for fish feed is driving industry research to develop alternative fish feeds. Much of the genetics research and research capacity of Baku's Institute of Physiology builds from studying the biochemical indices in order to inform Soviet era hatchery policy. At the time of this fieldwork, the Institute was testing the effects of different proteins and lipids on sturgeon brain bio-indices to test the relationships between feed alternatives and nutritional parameters in sturgeon products. In order to illustrate the kind of research capacities required for such ventures, the following section briefly describes important

[100] Fish feed for sturgeon at Xili was imported from producers in Israel when fieldwork data was being collected.

studies conducted by the Institute of Physiology in Baku. Moreover, detailing such research areas and their relationship to sturgeon policy-making gives important clarity to the Soviet conservation logic, and the ways in which it was conducted.

5.2.1.a. Baku Institute of Physiology Research History

The Soviet Union pioneered much of sturgeon genetic research that continues today and was derived from the purpose of meeting the conservation mission. When natural Caspian sturgeon breeding became compromised by the construction of large hydropower works on critical spawning sites, the resulting program of mitigation strategies built on an approach for restocking wild Caspian sturgeon populations through supplementary artificial breeding. Sturgeon hatchery facilities were integrated with scientific research to investigate and to enhance the techniques used in artificial breeding and rearing of different species of sturgeon. The sturgeon born in hatcheries were raised until particular development stages before being released into natural waters. Through this conservation approach, hatcheries eventually became responsible for 90% of Caspian sturgeon reproduction (Ruban, G. I, & Khodorevskaya, R. P., 2011). With release and survival in the wild as the ultimate goal of such conservation initiatives, genetic considerations were essential for viable and healthy wild populations.

Extensive research conducted by the Institute of Physiology investigated the relationships between fish feed and corresponding protein profiles in the brain, blood and liver in addition to other biochemical indices (such as weight and length) to better inform hatchery policy. Moreover, feed formulation for sturgeon is known to have a significance influence on ontogenetic developments of sturgeon. In the 1970s, the Institute carried out several studies comparing the effects of living fodder (i.e. *Artemis* worms) and vitamin-enriched dry feed on sturgeon development based on the aforementioned biochemical indices. The studies determined that receiving live feed during critical development periods (between 2-3grams mass) was one of the most significant factors in sturgeon development (Kasimov, R., et al., 2016). These findings were significant for hatchery operations as enhanced feed strategies ensured better survival rates in the wild by improving the early development conditions in artificial environments. Hatchery-rearing also could be made more efficient based on these more informed feed regiments. Also, the effects of these development differences were also shown to have significant effects on the taste and qualities of sturgeon products (Ryu, Q. et al., 2017*)*.

Related studies conducted by the Institute of Physiology give better illustration of the context of fish feed research for improving hatchery breeding outcomes in terms of survival rates and making sturgeon rearing at hatcheries more efficient. Initially, the main principle of reproduction of farmed sturgeons was to get more offspring and to release larger and more formed individuals into natural water bodies for optimal survival rates. It was assumed that a greater return on investments in sturgeon hatchery-rearing (i.e. amount of sexually matured specimens surviving in wild conditions) would be met in following a rationale that releasing juveniles of 1gram mass would correspond to a 1% survival success, 2 grams a 2% survival, 3 grams a 3% survival, and so forth (Mamedov, 2019; Ryu, Q. et al., 2017). From this rationale, releasing larger-sized juveniles to maximize returns on hatchery investments was favoured. It was assumed that larger juveniles returned to natural waters would encounter less predation pressure. However, this principle did not have a scientifically verified basis (Mamedov, 2019). Analysing several morpho-physiological and biochemical indices of hatchery juvenile sturgeon, the Institute of Physiology demonstrated that survival rate was dependent upon the ability to recognize predators. Importantly, this ability was correlated with fish weight, rather than age in terms of development maturation (Ryu, Q. et al., 2017).[101] From these studies, a fingerling body mass weight of 2-3 grams was demonstrated as an ideal release weight.

Since transitioning to market-based economies in the region, financial resources for maintaining these research areas have declined drastically. Despite significant findings which have contributed to the development of human cardiac medicine and informed wider Caspian ecology protection measures,[102] many studies by the Institute have been delayed or cancelled. Effectively, scientific

[101] The study was done by placing fingerlings in various development stages in a container divided into two parts with a predator in one. Predator identification response was demonstrated by passing the barrier into safety. The study found that reaching 3grams in weight, the fingerlings no longer identified the predator and passed into safety. Interviews of researchers at the Institute attributed this to the "sea stimulating important growth qualities" (AQCLTR12 Respondent, Neftchala, Azerbaijan, March 2019).

[102] This has also included studies on the effects of hydrocarbons in the ecosystem and muto-genetic changes oil has on sturgeon development. Most notably, it was shown that oil affects olfactory sensitivity in sturgeon, which is a primary sensory ability for spawning migrations. A hormone injection again using material from sturgeon brains in order to accelerate reproduction in hatcheries was also developed from this research. This was critical for hatchery resource allocation as sturgeons have very high fecundity rates, but very low survival rates. Hatcheries can release 1 million fingerlings a year but only 1% will survive. In fact, survival rates in the wild still outpace that of hatcheries at 3% (Mamedov, 2019).

research and conservation strategies increasingly justify their work such that financial resources can be recouped. This dilemma is shared by all of the former Soviet states in the Caspian.

5.2.2. Kazakhstan

Nine sturgeon aquaculture facilities were visited in Kazakhstan during the course of this fieldwork's research (eight commercial ventures and the state hatchery).[103][104][105] This section presents data from one commercial venture as its unique business model is the most significant for this study and relevant to discussions of market knowledge.

Connected to a hotel which opened in 2013, the venture adopted a unique approach to aquaculture and sturgeon conservation by integrating an aquarium into the hotel/conference centre based in Aktau, Kazakhstan (Figure 25).[106]

103 Of the three field sites, Kazakhstan's sturgeon hatcheries are the only ones that have not been privatized.

104 One of the two state hatcheries for sturgeon was closed due to reconstruction plans during the course of the fieldwork.

105 Sturgeon hatcheries were built much later in Kazakhstan than in Azerbaijan during Soviet times.

106 However, the hotel did not originally envision having an aquarium. After its investors learned of the sturgeon conservation issue in the Caspian, the aquarium component was quickly added to the business vision and was constructed in 2015.

Figure 25: Location of Kazakhstan sturgeon facility (Google Maps, 2021).

It is formulated around a multi-pronged business model that leverages Kazakhstan's growing tourism sector[107] and high-end events centre. The hotel offers specialized tours of the aquarium to tourists, as well as regular tours to local school groups. A restaurant specializing in sturgeon dishes is another important component of the hotel's business model (Figures 26 and 27).

107 Which has been designated as one of key importance for Kazakhstan since 2015 (EXPRT13 Aktau, Kazakhstan, February 2019).

Figure 26: Sturgeon meat dish specialty at hotel restaurant (Berman, C., 2019).

Figure 27: Main aquarium room with glass viewing floor. The aquarium room also offers premium dinner parties (Berman, C. 2019).

What best characterizes this venture's business model is that it draws on the symbolism and history of appreciation for sturgeon products. This is best demonstrated with the venture hosting the 2018 Caspian Legal Summit, which led to the historic signing of the Aktau Convention. After the signing of the Convention each of the five Heads of State of the Caspian littoral countries commemorated the occasion by releasing 500 sturgeon fingerlings into the Caspian from the hotel (Figure 28).

Figure 28: Heads of State at post-Caspian Legal Summit and signing of the Aktau Convention, which included a ceremonial release of sturgeon fingerlings (AZtekNews, 2018).

Not only is this symbolism being leveraged by the hotel for generating market interest, it is doing so to establish its role in sturgeon conservation efforts in the Caspian. A discussion of releasing sites and related practices for sturgeon fingerlings follows to contextualize this idea.

5.2.3. Release sites

As an anadromous fish species, sturgeon migrate across various habitats for overwintering, spawning, and breeding across the year. The Soviet approach established a practice of releasing sturgeon into freshwater tributaries that was based on numerous scientific studies. However, with the Caspian sturgeon conservation mandate becoming increasingly vague between littoral states with reduced restocking measures being carried out, the aquarium venture is presenting a new strategy to use its facilities as a release site directly into the Caspian.[108] Figures 29 and 30 below provide a layout of the two release sites.

[108] Pending acquiring funds for upgrading existing facilities and acquiring new ones, the aquarium aims to propose as much as 80% of fish raised on-site to be released into the Caspian.

Figure 30: Release site into freshwater Caspian tributary Kura River 30km upstream from former Xili State Hatchery (Berman, C., 2021).

Figure 29: Release site from hotel directly into the Caspian – Atyrau, Kazakhstan (Berman, C., 2019).

Aquaculture specialists at the aquarium present the hotel as a better release site for sturgeon fingerlings for two principal reasons:

1. Cost – no longer required to maintain ships for transporting sturgeon fingerlings to release sites
2. Better survival rates - based on limited number of returning sturgeon to tributaries and census data annually.[109] However, this is rationale was given anecdotally based on experiences in Astrakhan, the main release area for Russia:

"In Astrakhan they take 2 million fingerlings for release. In the 9-10 years that I was there this would have equated to 20 million fingerlings released. Yet, there were no sturgeon caught during monitoring and recording efforts because they are releasing directly into the Volga. Instead, the hotel can release 50,000 fingerlings with a much better chance for survival by releasing directly into the Caspian."
(AQCLTR3 Respondent, Aktau, Kazakhstan, February 2019).

The following quote is from the same interview and highlights the kind of evidence put forward to justify the proposed change to release sites:

"It is cheaper to release directly into the Caspian. Traditionally, boats would travel from Astrakhan and Atyrau, which are very far from the Caspian. Astrakhan is 230 kilometres up the Volga and

[109]Fingerlings typically require two days to reach the Caspian when released from Xili (70km from the Caspian). When they hatch from natural spawning, however, they take 30 days to reach the sea (b/c swim a distance of 400-450 km from natural hatching. This is for the Kura River (Berman, C. Field Notes, February 2019).

requires two weeks. Atyrau is also very far up the Ural….. These boats and personnel are very expensive to maintain" (AQCLTR3 Respondent, Aktau, Kazakhstan, February 2019).

This purpose of this discussion is to highlight the differences in rationales and information used to justify them, not to judge the approach or to qualify any as effective or not. Analysing the kinds of variables considered for conservation assessments and approaches gives important indication of their underlying logic. Certainly, diverse factors are implicated in the outcome of sturgeon conservation wild restocking measures. Yet, they are mainly financial in nature.[110] In contrast, the release site practices under Soviet times were based on scientific investigation. Tested through a variety of studies (ability to recognize predators, developing food-seeking abilities),[111] important development behaviours correlated with development in natural growth conditions (i.e. slow transition to higher salinity content waters, fed live feed such as *Artemis* worms as opposed to fish meal) were traced through the presence of neurotransmitter formation (Kasimov et al., 2016).

"This amount of time needed to swim allows them to grow and to develop cleverness. If fish are bred in farms and not raised in the right conditions, they do not develop behaviour to recognize and escape from predators after a certain age…. Also, the Caspian has unique ionic content, so the sea stimulates growth much more" (AQCLTR19 Respondent, Baku, Azerbaijan, March 2019).

From the perspective of the release site proposal, what this signalled is that scientific verification during Soviet times of particular early-life processes (insofar as how they established key processes for healthy development and higher survival rates) no longer acted as the sole authority in sturgeon conservation policy. One interview respondent highlighted the importance of these early development factors:

"Development processes for sturgeon rely on river systems. They require the rolling motion of water at certain depth in the [water] column and this shallower depth is crucial for providing the appropriate

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[110] For one, the mouth of the Volga River historically was dredged to allow ease of passage for sturgeon to spawning grounds. This required significant financing of vessels and personnel that were not maintained in the final years of the USSR and have not recommenced since. Growing ambiguity over state shares and responsibilities in wild sturgeon stock assessments has led to less investment in monitoring efforts overall. Previously, personnel were hired to catch and record the number and sex of sturgeon caught over a four-month period (June 1 – October). Wages and vessel upkeep was costly and with increasingly dwindling numbers of wild sturgeon recorded beginning in 2012, these monitoring programs effectively became defunded for sturgeon (some monitoring efforts for other Caspian species have been maintained) (Berman C., Fieldnotes, February 2019; Mamedov, 2019).

[111] One study placed fingerlings at different development stages into a 2-part divided container with a predator on one side and fingerlings express predator response capability by passing barrier into safety. The study found that after 3 grams in weight, they don't escape from the predator if not exposed to these conditions earlier in development. This was correlated with particular neurotransmitter presences in the brain (Kasimov et al., 2016).

temperature regime because this is what prompts sturgeon to lay their eggs" (AQCLTR12 Respondent, Neftchala Azerbaijan, March 2019).

While the river release technique remains in use in Azerbaijan and by Kazakhstan's State Hatchery, releasing directly into the Caspian is being considered by a growing audience at the highest levels (Berman, C. Field Notes, March, 2019). Although much of the aquarium's operations and infrastructure maintain Soviet practices and techniques, the new release site proposal marks a notable change with Soviet-based methods and verification no longer acting as the sole commentor in conservation design. From the perspective of this research, investing in the ability to partake in sturgeon restocking efforts signals a growing preference for market knowledge insofar as how it will enable the business to leverage its conservation contributions for wider capital gain.[112]

5.2.4. Turkmenistan

The only two state-authorized sturgeon farms in Turkmenistan were visited during this fieldwork. For the purpose of this writing, only one farm will be discussed as the first visited was transitioning away from sturgeon production due to the previously discussed challenges associated with sturgeon growing. Turkmenistan's sturgeon fishing and fish hatchery system were never as developed as for Kazakhstan and Azerbaijan under the Soviet system, leaving relatively less industrial infrastructure for sturgeon ventures to leverage post-1991.[113] However, this relative lack of industry development under Soviet times is primarily due to environmental and geologic factors of the Caspian.[114][115] Turkmenistan no longer has a tributary river for sturgeon spawning and wild

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[112] Generally, by being able to present its activities as significant to conservation measures to wider audiences. At the time of this fieldwork, discussions with large companies in the extractive industry were being had to allocate public relations and philanthropy funding for the aquarium to these ends.

[113] This research will highlight some of the environmental and geologic factors of why this occurred with respect to the aquaculture industry and fish hatchery infrastructure, but it does not intend to analyze Soviet-era administrative rationale behind these developments extensively.

[114] Attempts to expand Turkmenistan's sturgeon production were made during Soviet times with the construction of the world's largest artificial spawning ground – the Adzhiyab Spawning Ground (for the purpose of enhancing spawning grounds for a variety of endemic Caspian species with diadromous/anadromous habits, such as salmon, or herring). However, the Adzhiyab is dependent on the Atrek River and after declines in river runoff beginning in 1983-4, cycles of flooding for the spawning grounds increasingly fell later each year. The last recorded water supply occurred in 1997-98 with the Atrek River not discharging to the Caspian since. Completed in 1982, the Adzhiyab Spawning Ground is a 3,850-hectare complex with a water capacity of 19.3 million cubic meters. It includes an 18 km-long fish passage channel 20 km-long retaining weir and fish ladder (Negroni, 2012).

[115] Atrek River discharge declines happened in 1983-84, for the first time, repeated in 1985-86, before becoming highly noticeable in 1990s (1989-90, 1990-91, 1994-95, 1995-96, 1996-97). Although the Caspian

sturgeon were only present near Turkmen borders in relative abundance for a few months of the year during colder seasons.[116]

Once interest in aquaculture and financial capital was acquired, Turkmen national entrepreneurs constructed a new facility as a part of a Joint Stock Company with investments in a number of agriculture ventures. The facilities were constructed in 2015 (completed in 2018). Figure 31 shows the sturgeon factory location.

Figure 31: Location of primary sturgeon aquaculture production in Turkmenistan near the port city of Turkmenbaschi (Google Maps, 2021).

The state's sturgeon operations (and canning factory) on the coast in Turkmenbaschi were privatized in October 2018.[117] The farm purchased Billund Aqua RUS design systems and incubator

is fed by over 300 tributaries (the majority located in Iran yet almost all are small rivers). Sturgeon have been documented as not swimming upstream to spawn in cases of low water volume (2011 Kazakhstan Spawning Ground CBS Report for Ural River).

[116] Because of this ecological dynamic, Turkmenistan allocates their CITES quota to Russia or Kazakhstan (EXPRT5, Baku Azerbaijan, December 2018).

[117] The state retained some rights to operations, such as the maintenance of several vessels for monitoring purposes in the Caspian.

equipment from Denmark. The factory is staffed with ten engineers/technicians[118] and ten fish breeders, Figure 32.[119]

Figure 32: Entrance to new sturgeon factory in Turkmenbaschi (Berman, C., 2021). The plant features entirely new infrastructure through investments from domestic Joint Stock Companies in comparison with the majority of sturgeon commercial farms visited in Kazakhstan and Azerbaijan.

An important feature of the factory is the production of a variety of smoked and canned fish meat products. As these products are easy to preserve and to transport, they have received wide popularity domestically as well as elsewhere in the region, particularly in Uzbekistan (AQCLTR18 Respondent, Turkmenbaschi, Turkmenistan, August 2019). Figure 33 depicts the variety of such products.

[118] Those specifically with mechanical and/or electrical engineering backgrounds

[119] Those with technical aquaculture backgrounds acquired either from the technicum school in Turkmenbaschi (now closed) and several worked in the former state canning factory in Turkmenbaschi, or from international training programs.

Figure 33: Turkmenistan sturgeon factory smoked and canned products displayed during the First Caspian Economic Forum in Turkmenbaschi, 2019 (Berman, C., 2019).

Fieldwork for this case study consisted of a second trip to attend the First Caspian Economic Forum in Turkmenbaschi, Turkmenistan in August of 2019. The Forum marked the one-year signing of the Aktau Convention during the Caspian Legal Summit of 2018. As the first high-level international gathering in commemoration of the Convention, the Forum included a trade show which invited a variety of domestic and foreign companies to display primarily agricultural products. The sturgeon factory in Turkmenbaschi was the only company to feature sturgeon products at the trade show. Company staff members present at the trade show were approached by representatives of several new and expanding supermarket chains in the region and reached promising prospects for selling Turkmen sturgeon products.

A key factor in the factory's business model which allow such commercial proposals to be viable is in how the factory pursues a high-volume production model. Sturgeon feeding regimes are increased by 130% from traditionally recommended levels in order to achieve faster growth rates and higher production turnover. The approach has allowed the factory to become a prominent supplier of sturgeon meat products across the region.

"Last year [2018], we sold 35,000 kilograms of fish meat in Turkmenistan. This was mostly in the Balkan Welayat [region] actually, because we really like fish in Turkmenbaschi" (AQCLRT20 Respondent, Turkmenbaschi Turkmenistan, August 2019).

While the factory sells primarily to the domestic market, its exports (particularly canned) have been successful elsewhere in the region (primarily in Uzbekistan and Azerbaijan).[120]

However, these fast-growth rearing strategies are in stark contrast to hatchery techniques developed during Soviet times, many of which are maintained across sturgeon farms in Kazakhstan. As Section 5.2 noted, a key contrast in the Soviet conservation approach (unlike current market model) for sturgeon farming is to raise fish with greater likelihood for survival in the wild. This amounts to numerous differences in practice and the daily operations at farms/hatcheries. For example, farms visited across Kazakhstan continued to incorporate diet changes throughout the year in order to follow seasonal fluctuations of when sturgeon naturally reduce food intake. This was reinforced by altering water temperature levels in the tanks as well.[121] As one Kazakh grower who felt the importance of maintaining Soviet-era sturgeon rearing strategies remarked:

"We don't disturb natural rhythms… It is a technique from Soviet times and was so good because <u>it mimicked natural processes</u>" (AQCLTR3 Respondent, Aktau Kazakhstan, February 2019; underscore added).[122]

This feed regimen increase has important implications on the number of fish which can be maintained in each tank, or how this must be adjusted for through enhanced filtration and water circulation systems. With the highest rates of sturgeon mortality in aquaculture due to the quality of water, monitoring and making changes to water conditions in a tank can reduce the rate of casualties by 30 to 40 per cent (Berman, C. Field notes, March 2019). Maintaining water quality parameters within certain particular ranges (such as water temperature, pH, dissolved oxygen, ammonium and nitrate levels) is the most important, year-round task for farm operators. Investing in new water recirculating and filtration systems with appropriate tank design is one of the most expensive initial investment areas for aquaculture producers. In relation to feeding regimes, by mimicking natural cycles, sturgeon feed was reduced during winter months under Soviet methods. This resulted in lower waste output from each fish in a tank. Moreover, because the Soviet approach

[120] During the time of this fieldwork, there were no domestic canning factories for sturgeon fish meat in Azerbaijan. Arguably, this undergirded the viability of the Turkmen factory to meet the local Azeri market.

[121] Interview respondent from this farm feeds 100/200 grams of feed twice per day

[122] Another example of sturgeon rearing developed under Soviet research is the incubation wave process, where roe are kept in constant motion for 3-4 days after being harvested. "This is to keep the integrity of the egg" (AQCLTR3 Respondent, Aktau Kazakhstan, February 2019). This practice is well regarded and was in use across all farms visited which harvested their own sturgeon roe as a part of a breeding program.

was to release the majority of cultivated sturgeon, most specimens were not kept in farms for the full year and were released after reaching a particular maturation and before requiring greater feed inputs.[123] Under the market economic model of sturgeon cultivation, all fish are kept year-round, either until processed for meat[124] or enter into a breeding program.

While there was some variation between farms visited, a general bracket of farmed sturgeon age designations to correlate with development and feed regimes is listed (Berman, C. *Field notes*, 2019):

1. Young is until 50 grams
2. Growing until 2 kg
3. Pre-wintering until ultrasound age (typically around six months)[125]
4. Wintering is until 5kg and beyond

Across all study sites, the main objective of fish farm investments was to control water quality parameters. Chemistry limits for protecting fish health were applied to ensure the health of fish across all visited farms. This entailed daily testing of water quality in well-equipped laboratories by appropriately trained staff, as shown in Figure 34, and gives indication of the level of investment in terms of technology and skilled workers in order to maintain viable commercial sturgeon ventures.

[123] Based on the previously discussed studies conducted at the Institute of Physiology in Baku for establishing an ideal release weight of 2-3grams.

[124] Only 10% of males were kept as future breeders while the rest are processed for meat. This allows more females to be kept for breeding purposes. The factory visited in Turkmenistan processed 80% of males for meat products.

[125] Ultrasound testing is done to sort fish into tanks according to sex to allow for a controlled breeding program.

Figure 34: sturgeon aquaculture laboratory set up requiring skilled laboratory technicians, testing equipment and materials (Berman, C., 2019). Such requirements for maintaining a sturgeon commercial ventures have increased in recent decades given high production volumes to supply wider trade distribution networks.

Ammonium and nitrite, created by fish faeces, are the main indicators of toxicity in a tank. With more fish at larger sizes kept on-site throughout the year, this puts greater pressure on maintaining (or investing in new) water filtration and quality control systems. Ultimately, the return on investment for water quality monitoring capacities (laboratory facilities and filtration systems) reduces production costs and fish casualties, increases productivity, and equates to time savings. Figure 35 shows an image of a tank water quality display for monitoring such parameters. [126]

[126] One farm visited in Kazakhstan was forced to keep a number of their fish in 'suspended state' and not feed for six months so as to manage ammonia levels in crowded tanks. This was reducing the farms production goals and income generation.

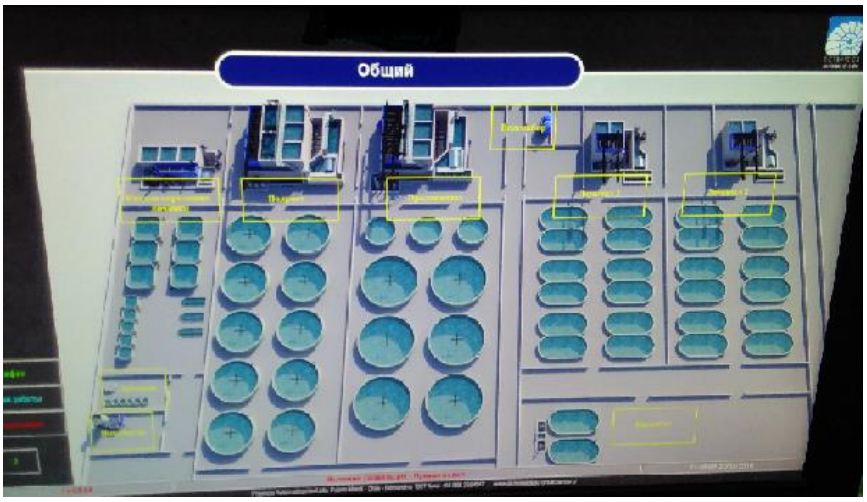

Figure 35: Fish tank water quality monitor (Berman, C., 2019).

The business model of optimizing fish weight gains in this factory under discussion resulted in increased levels of faeces. Thus, greater investments for the monitoring and control of water quality were required. While filtration systems and tank design considerations for removing waste were present under Soviet sturgeon cultivation, these requirements were not of a commensurate scale as those today. That is, Soviet techniques utilized natural processes and integrated them into sturgeon growing programs (i.e. by releasing fish into natural waters to grow and where waste is diluted naturally). The scaling up of production within artificial environments, therefore, amounts to increased cost to compensate for the lack of natural factors.

This dynamic of optimizing fish production turnover is brought on by a variety of factors: as the industry and overall production levels advance globally (Chapter 3), and as new industry technologies become established and accessible to more producers. Rather than investing in research and development[127] (whether for altering tank designs or, enhancing filtration systems and/or water recirculation processes), current Caspian sturgeon producers either built on existing Soviet-era capacities and know-how, or imported finished technologies from abroad.[128] Effectively, the resulting cost increase in operations has been addressed by the majority of Caspian producers through acquiring greater market knowledge. That is, investments are made either in the ability to

[127] Which is high cost and requires highly trained work staff

[128] The most common exporters of water quality monitoring and processing systems in the Caspian were from the Netherlands (Hessy Fish Farm Systems) or Denmark (Billund).

acquire new or emerging economic markets access, or through new business partnerships. In doing so, financial capital can be gained for the purchase of new production efficiency gains or technologies developed elsewhere.

This brief example is offered not to present one approach as better than the other, but to give texture to how Soviet-era versus current market practice conservation approaches translate into effects on the sturgeon farm floor. Most importantly for the interest of this research, this highlights how Soviet-based capacities are being leveraged today and integrated with market knowledge in order to develop sturgeon aquaculture business models. More examples of generalized changes under the two industrialized systems in terms of the sturgeon faming-conservation relationship are offered in the following section.

5.3 Farm Production Trends

The reshaping of Caspian sturgeon aquaculture in favour of market principles was apparent during visits to aquaculture facilities across all three study sites. These decisions at the level of daily operations (i.e. time and amount of feed, water temperature levels) to overall breeding and rearing programs reflected the market-based conservation logic discussed in Section 5.1.2.

This section elaborates further the effects of this market-economy conservation approach on sturgeon aquaculture production, and how this was evidenced across facilities visited during this fieldwork. First, Beluga sturgeon (*Huso huso*) were notably absent in all but one of the commercial fish farms visited. Instead, Russian sturgeon (*Acipenser gueldenstaedtii)* and particularly sturgeon hybrid species are being raised in commercial farms. The most common sturgeon hybrids were 'Bester' (a male Beluga [*Huso huso*] and female Sterlet [*Acipenser ruthenus*]) and Siberian (*Acipenser baerii*) with Sterlet (*Acipenser ruthenus*). Producing caviar by reaching sexual maturity at younger ages (around 3 years), as well as having been bred for faster weight gain potential makes hybrids of great practical importance for caviar sturgeon farming. However, current regulations prohibit sturgeon hybrid species from being released into the Caspian. Although sturgeon hybrids cannot reproduce naturally, they could outcompete native sturgeon to reduce wild sturgeon populations and the important genetic traits they carry (Boscari et al., 2021). The presence of hybrids making up nearly all fish specimens across visited sites demonstrates a clear commercial interest rather than conservation focus.[129]

[129] Alongside the industry's growth in the region, non-native (tilapia) and faster-maturing species (carp), increasingly are being produced or leading to phasing out of sturgeon several farms.

Second, and as mentioned in Section 5.2.4. discussions of visits to Turkmen sturgeon farms, aquaculture producers work to enhance sex-ratios that favoured females through special breeding strategies. Although caviar products were no longer the main pursuit of most producers, female sturgeon were preferred for their roe to be used as the next generation of breeders. Studies across fish species demonstrate that sex determination in fish species acts largely as a threshold trait and that reproductive organ development respond to a variety of genetic and environmental processes (Beukeboom & Perrin, 2014).[130][131] With temperature among the most important external factors that can determine or interfere with these early steps of sex differentiation, tank temperature modification techniques were used in several farms to enhance sex ratios that favour females. In stark contrast to breeding for farmed production, breeding for conservation through reintroduction into the wild favours the survival of male species members. Across aquaculture operations and growing research into applied genetics for industry, there was an emphasis on how to have selective breeding for increasing the ratio of females. This was recorded as an important indication of the contrasting Soviet and market-based conservation logics.

Lastly, the lack of mandate for restocking Caspian wild populations - either by a state, private entity, or joint venture - was a notable change in Caspian conservation. During Soviet times, the establishment of hatcheries was in direct response to concerns over sturgeon species population levels. It developed a clear model for release of sturgeon alongside a clear mandate for the state as the sole authority for overseeing conservation measures. While there was varying degree of carryover of this institutional practice by each new nation-state, the mandate for restocking not only had become politicized between Caspian littoral states, but also severely defunded and increasingly vague within each state government. With privatization of all sturgeon activities in Azerbaijan, and effectively all in Turkmenistan (aside from minimal regulatory fishing monitoring), all sturgeon-rearing infrastructure had been redirected for commercial purposes. While this research was not able to conduct follow-up fieldwork to inquire into the nature of this privatization process due to the Covid-19 pandemic, what was clear was that state farms would become new sites for commercial production without any kind of legal mandate for conservation restocking.

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[130] With males more frequently produced under warmer conditions (Baroiller & D'Cotta, 2016; Ospina-Alvarez & Piferrer, 2008).

131 Relatedly, mono-zygote fish (identical twins) only occur in artificial environments as a result of restrictions on important genetic diversity.

5.4 Sturgeon Breathing Patterns and Expertise Types in Caspian Aquaculture

The daily operations and capabilities of staff working on the floor with sturgeon fish is integral to the overall success of sturgeon aquaculture enterprises. Whether for in breeding phases, birthing, or growing phases of aquaculture, meeting the daily needs and ensuring optimal health conditions of farmed sturgeon is highly dependent on the presence of skilled and attentive staff. As one interview respondent noted:

> *"Sturgeon are very sensitive fish. They are difficult to grow and cannot grow in dirty water or with varying water temperature. We keep them in the indoor facilities – not in the outdoor ponds – and their tanks are supplied only with well water so that temperatures stay between 16-18 degrees C and there are no pollutants"* (Interview, 2019).[132]

Given the challenges associated with growing sturgeon, this research inquired into the professional backgrounds of staff working in close contact with sturgeon. In considering the specific skills and training deemed valuable and credible from the perspective of current producers in the region, this research could track changing preferences in terms of knowledge within the industry. This will be presented from the perspective of 'expertise' and 'expertise types' in the following section.

Across nearly all visits to sturgeon farm facilities, this fieldwork observed a peculiar behavioural pattern of the fish in tanks.[133] Raising themselves vertically, sturgeon would bring the entire portion of their snout (sometimes even their full head) out of the water whilst swimming along the tank. Figure 36 provides a better sense of this behaviour.

[132] As Section 5.2.4 discussed, the greater challenges associated with growing sturgeon was motivating some producers to transition to different, non-native species. In the case of the respondent cited above, the farm also raises African catfish, three kinds of carps, and red and black tilapia. "Tilapia is a very new and innovative fish species for us but they grow fast and locals enjoy their taste so it has been a good market. They are also much easier to raise than sturgeon" (AQCLTR14 Respondent, Ashgabat Turkmenistan, April 2019).

[133] The exceptions to this were when some pools/tanks or facilities had fish in the winter phase where water temperatures and reduced feed levels dramatically lowered fish energy levels.

Figure 36: Image of sturgeon breathing behaviour (Berman, C. 2019).

Provided the structure of interviews, preferred venue by interviewees, and to allow for ethnographic data to be collected, many interviewees were conducted within sturgeon farm facilities, often near the tanks. The regularity of this sturgeon behaviour prompted this research to ask for explanations and descriptions in interviews. The following description of responses is discussed not for the purpose of casting judgement of certain types of knowledge as better either in and of themselves, or insofar as sturgeon growing. Rather, they are presented to account for changes in the knowledge landscape shaping the nature of interactions between sturgeon (i.e. a 'resource') and people. However, the specific tasks this knowledge is directed toward is concerned with sturgeon production under scaled up, industrialized conditions. Therefore, it does not account for the pre-industrialized forms of resource understandings in the Caspian. What connects these resource meanings is how the knowledges arising from industrialized conditions are used to meet not only the economic realities and production requirements of those systems, but also are leveraged to connect to knowledge developed in pre-industrialized Caspian Eurasia. This pre-industrialized knowledge is created by and exists in culture. As a core line of argumentation within this writing, the ensuing paragraphs are offered by way of illustrating how knowledge takes concrete form even in mundane tasks in aquaculture.

Explanations for the breathing pattern were recorded for 16 interviews. Responses were categorized into three groups:

1. Breathing development
2. O2 Levels
3. Hungry

Figure 37 provides a breakdown of the distribution of responses.

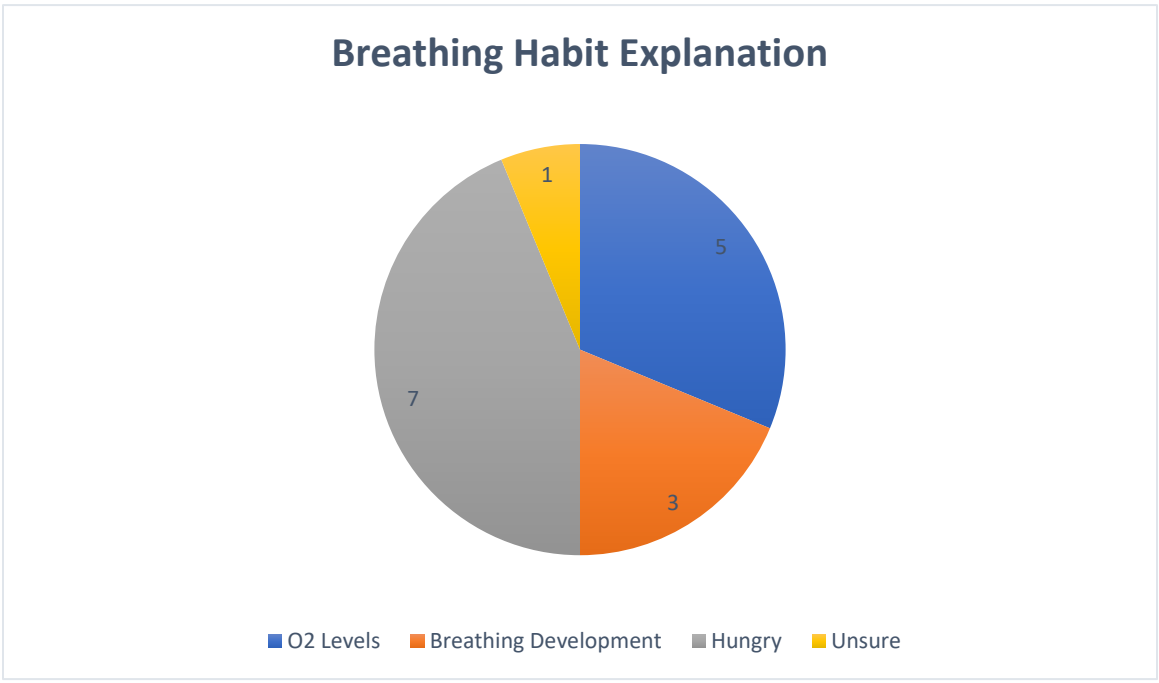

Figure 37: Response breakdown of breathing habit explanation from interviewees. Numbers in each breathing type category of the pie chart area represent the proportion from the sixteen total interview responses (Berman, C 2021).

From these three categories, responses are classified according to whether respondents' professional and training backgrounds were derived from primarily one of three categories:

1. Vocational Background
2. Scientific Background
3. Experiential Background

This research categorized responses according to the following rationale:

Market knowledge in this discussion is classified as 'Vocational.' Interviewees with responses classified in this category pursued some form of short-course to obtain the necessary skills for employment in sturgeon aquaculture.[134] They did not have professional or previous background either in scientific research, or as fisher women/men. Importantly, the training these interviewees acquired during these short courses specifically were to be able to work with the advanced, typically imported, new aquaculture systems. That is, vocational trainings emphasized the ability to work with the increasingly prevalent modern equipment for high-growth aquaculture production. Therefore, this category is most closely associated with what this research calls 'market knowledge' because of how this equipment was designed for meeting the high commodity output requirements to ensure commercial viability under market conditions.

Scientific knowledge in this discussion describes responses from interviewees with formal, academic training in the natural sciences at the graduate level or beyond. Interview respondents in this category typically were located in current or former Soviet hatcheries where there was a stronger research component to hatchery activities.

Experiential knowledge is knowledge developed outside of formal institutional settings, i.e. fisher women and men. Although this experiential knowledge can be supplemented with formal, vocational training, which this fieldwork recorded on several occasions, it was not the primary form of skill acquisition or base of competency for working in aquaculture. Typically, respondents in this category were from multi-generational fishing families and had moved into aquaculture owing to moratoriums on sturgeon fishing.

This fieldwork recorded responses not only according to what was explicitly said, but incorporated contextual matters in which interviewees gave their response as well. Table 1 provides the main responses when presented with the question:

"Why are they [the fish] doing that, or what is the reason for this behaviour?"

[134] These courses were approximately six to nine months in length and all were located outside of the states of this study (typically in Russia or in Eastern Europe).

Table 2: Response Categories

	Vocational Background	Scientific Background	Experiential Background
Hungry	"[chuckling] Maybe because they are hungry!"		"When you stand next to the tank, they expect feed." "Well, when you are next to the tank they think food will come!" "They associate humans with feed time."
O2 Levels	"Let's check the sensors." "We should see" [moves to monitor screen].	"It is likely because of the oxygen saturation content in the water."	
Breathing Development		"It is because of the nature of their gill formation and development. I can show you on a chart." "They have to surface when they are young. Moving up and down the water column is important for their physiology."	
Unsure	"No one has ever asked me that before. I'm not certain what it is."		

Figure 38 below offers a graphic depiction of the response breakdown according to the appropriate knowledge category.

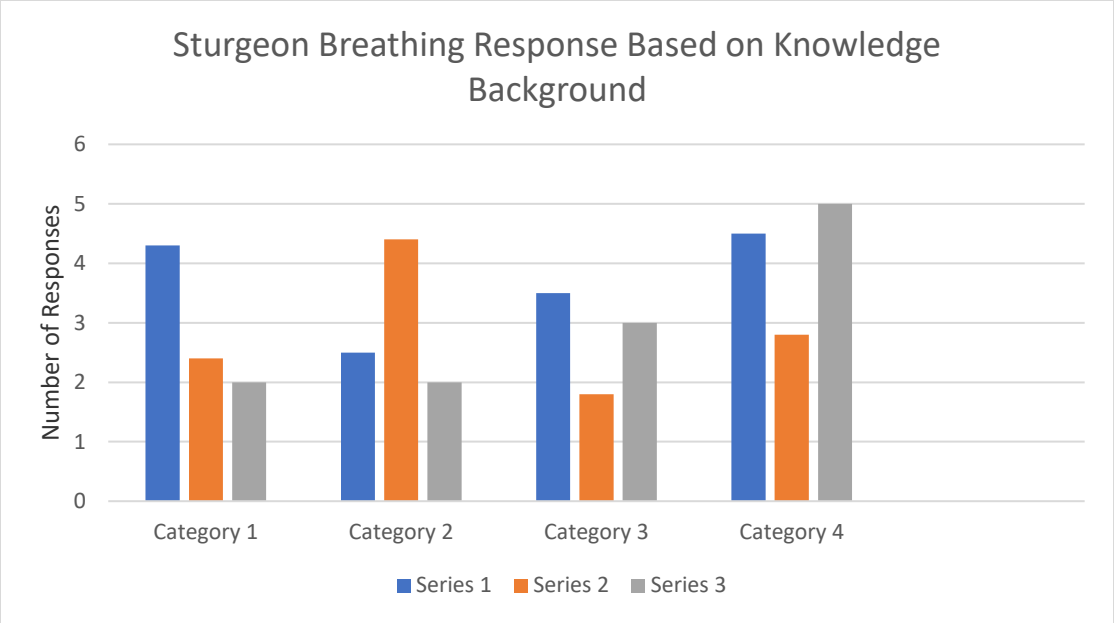

Figure 38: Interview response categories according to knowledge background types (Berman, C. 2021).

Crucial to the phrasing of responses was the manner in which interviewees incorporated aids in their responses. When posing the question to staff with vocational backgrounds, almost all responses involved consulting sensors and monitors (depicted in Figure 32). For those with doctoral degrees and backgrounds in scientific research, responses almost exclusively referred to sturgeon physiology. Two of these responses involved moving to laboratory rooms where there were diagrams and sturgeon development timelines to aid in explaining. For those with experiential (fishing) backgrounds, responses always were provided next to the tank and while continuing to observe the fish.

This brief example of fieldwork observations recorded across all sites of this study are offered to highlight the distinct ways in which knowledge takes form in Caspian sturgeon aquaculture. Providing more elaborated explanations and details of these response types was deemed to be unnecessary to the task of answering the main research question. Instead, this discussion was given for the purpose of demonstrating the range of strategies employed within Caspian sturgeon aquaculture today. While the knowledges incorporated into sturgeon farming activities were recorded as becoming increasingly oriented towards market (vocational) knowledge, there was no active dismantling or removal of pre-existing sturgeon production strategies and can best be characterized as accommodating of diverse knowledge types. Yet this form of accommodation was not intolerant of diverse knowledges. Rather, it was accommodating in its ability to *absorb* and to

incorporate a wider array of knowledges. At one level, this knowledge absorption was to establish a successful business model and to ensure commercial viability under current market conditions. Yet this pursuit of business viability was not a means to an end. As will be discussed at length throughout the remainder of this writing, business success (as a proxy for knowledge of markets) in Caspian sturgeon production ultimately is being leveraged by, and simultaneously works to facilitate, Caspian Eurasian culture. Chapter 6 Analysis will detail how this dynamic reflects an underlying investment structure in Eurasia to orient the goal(s) of knowledge according to a distinct and endogenous logic. This investment framework is embedded with its own resource understandings. To be elaborated further as a grounding theme in the following sections, this investment orientation and resource indication is evidenced by the nature of *which* sturgeon commodities increasingly are being produced by domestic aquaculture – sturgeon meat as opposed to caviar. Figure 39 below provides a general depiction of current overall product types from the sturgeon facilities visited during the course of this fieldwork.

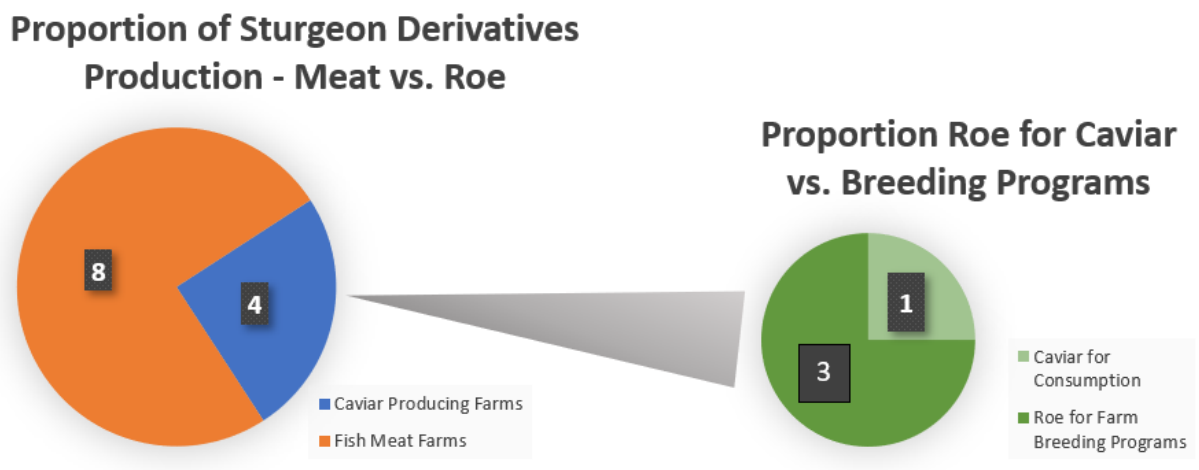

Figure 39: Sturgeon production commodity breakdown from visited farm sites. Pie chart numbers correspond to the sixteen interviews being discussed in this section (Berman, C., 2021).

Of the twelve aquaculture facilities visited, eight were producing sturgeon meat exclusively, while the remaining four were producing caviar *in addition* to sturgeon meat. However, of the caviar producing farms, only one was producing caviar for human consumption. The remaining three had invested in sturgeon roe harvesting for the purposes of breeding females. Therefore, of the twelve total sites, only one currently sold caviar. The caviar from this facility was for domestic purchase, although the farm intended to export to foreign markets in two years after sufficient profit could be allocated for necessary CITES certificates. The implications and significance of this aquaculture production trend from the perspective of culture will be analysed further in Chapter 6 Analysis.

5.5. Section 1 - Conclusion

Examining contemporary development matters which have come to be addressed through the sustainability prism reveal an advancing aquaculture industry that builds on Soviet infrastructure and institutional capacities. During the course of fieldwork, aquaculture facilities consistently demonstrated significant financial investments in modern equipment. Many had invested in training employees to acquire skills relevant for sturgeon production under market principles.

In spite of the Soviet experience which had cultivated considerable practical experience in rearing sturgeon, Soviet-era expertise was based in hatchery programs for the release of fish into the Caspian, not in meat or fish-based product aquaculture. As discussed over the course of the first part of this chapter, the principal difference in conservation practice was in maintaining wild sturgeon population levels from which to harvest, whereas aquaculture under market economies approached conservation from the rationale of removing incentives for harvesting wild sturgeon populations through a high output of farmed products. This fieldwork documented that the continued use of Soviet-era practices, then, were based on the extent to which they could be leveraged alongside, or as a supplement to, new market-oriented methods and conditions. This was most strongly evidenced in discussions of new release site proposals for fingerlings.

Changing strategies within the conservation imperative of industrialized societies were presented at the level of sturgeon farm operations in terms of water quality requirements, sturgeon hybrids, as well as sex ratios at sturgeon farms. These examples gave salience to the differing nature of conservation styles. In spite of contrasting techniques and overarching approaches, this section of Ch. 5 Fieldwork Findings demonstrated the nature in which diverse knowledge forms (vocational, experiential, and scientific) were integrated into the overarching goal of sturgeon aquaculture production. Rather than substituting or favouring one knowledge type over others exclusively, this accommodating structure ultimately works to make use of and enable a wider range of capacities

made possible by virtue of a diverse set of knowledge. While these knowledge types were integrated into an investment structure that operates within market economic realities, they were not leveraged for the purpose of merely acquiring market viability. Instead, they were directed towards enhancing culture. How these knowledge strategies orient sturgeon growing in the Caspian as a means of culture will be analysed in detail in Chapter 6 Analysis. In order to do so, the second part of this chapter presents ethnographic fieldwork findings to substantiate the importance and role of culture. Providing a distinct interpretive lens of the physical environment, culture also maintains a repository of resource meaning which derives from Eurasian people's deep history of interactions with the land.

Part II

5.6 Overview

This second part of Chapter 5 introduces the ethnographic work component of this research. Findings presented in the following sections reflect the significance of alternative resource meanings which derive from the ways in which the environment historically has been interpreted in the region. These suggestions will be developed further in Chapter 6 Analysis.

5.7 Ethnographic Fieldwork Findings

Eating is a biological need. Human experience of eating is articulated across an array of socio-cultural, political, ecological, medical, and economic dimensions. As a result of historical processes, food systems and customs are embedded in culture and reflect systems of knowledge. In an age of internationalization, food also allows us to see how local knowledge is becoming re-localized as well as what is changing.

The topic of this research is concerned with how the presence of sturgeon fish as a food carries social meaning within the Caspian's respective knowledge system. As Caldwell suggests in her work on post-socialist societies, food gives a base of values and norms for the re-telling of a culture's history (2002). Yet food also indicates the ways in which a land was resourced. More than a matter of meeting human biological needs, customary food practices point to the manners in which a landscape was related to. Institutions of food relations become archived in lived practices and customs that ethnographies can engage with. Building from the historical development processes discussed in Chapter 3, sturgeon fish as food can be analysed within the larger fabric of Eurasian human-steppe environment interactions. Starting analyses at this level gives light to the kind of template that Caspian society has emerged from. As the remainder of this chapter and Chapter 6

Analysis will argue, that template has endured to continue to inform Caspian resource understandings to direct sturgeon fish use and appreciation today.

To this end, this section of the thesis discusses the particular dishes in which sturgeon meat products were observed across all three sites of this study. The dishes of relevance for this thesis to discuss are 'Plov' (in Azerbaijan and Turkmenistan) and 'Beshbarmak' in Kazakhstan. Although now nationalized since independence, this fieldwork recorded a notable pattern of variation in these customary food dishes where red meat (beef, sheep, goat, or horse in the case of Kazakhstan) was substituted for fish meat as one approaches the Caspian.[135] The following Figure 40 depicts this meat substitution.

[135] While there are 130 endemic fish species to Caspian, sturgeon meat specifically was the most prominent fish-based variation of these dishes.

Kazakh 'Beshbarmak' with red (horse) meat

Kazakh 'Fish-barmak' with sturgeon meat

Azeri plov with red meat (beef)

Turkomen plov with red (sheep) meat

Figure 40: Caspian cultural food habits of substituting red meat for sturgeon fish when in proximity to the Caspian (Berman, C. 2021). Azeri and Turkomen plov are both rice-based dishes. Azeri plov typically consists of dried fruits (apricots, dates, or raisins) and chestnuts served with fresh herbs. It is often cooked in saffron, and can be encased in an egg, flour and butter crust for special events (*Gazmag*). Turkomen plov can be distinguished by thinly sliced carrots and onions. Kazakh 'Beshbarmak' is a wheat (noodle) dish with a gravy base. It also is noted for containing potatoes, caramelised onions and black pepper seasoning.

The aim of this chapter is not to make food meanings explicit, nor is it to put forward rationalist explanations of food's use. Instead, this section of Chapter 5 has a two-prong intent: a) to show how Caspian cuisine involving sturgeon fish gives a medium by which to engage with local knowledge systems and, b) to explore the cultural meaning of food with sturgeon *based on how these cuisines function*. Put another way, food offers indication of environmental understandings and the *modes* by which the environment becomes understood. From this, the question can be put forward: what are the ways in which we can see value be assigned to the environment by virtue of these food practices?

Ethnography allowed this research to take sturgeon occurrences during the course of this fieldwork as meaningful on local terms. Visits to fish farms near the Caspian unfailingly entailed partaking in meals of traditional dishes served with fish varieties. When not in proximity to the Caspian, insistent mention of the importance of trying local varieties of national dishes was recorded on a consistent basis. This research took these gestures to be telling in themselves and of significance when engaged with an effective methodology.

An important aspect of the Caspian food system is how cuisine names suggest more than just food components of a dish, they provide important instructions for how the dish should be prepared, which ingredients should accompany one another, and the manner in which it should be eaten. The brief discussion provided gives texture to these Caspian food system characteristics in the cases of the aforementioned dishes. Doing so highlights the presence of highly-developed local food understandings and social-ecological relations specific to Caspian Eurasia.

For the custom encountered in Kazakhstan, the name 'Beshbarmak' does not specify the food contained in the dish. Instead, it indicates the manner in which it should be consumed. "Besh," meaning "five," and "Barmak," meaning "finger" implies that the dish should be eaten with five fingers. As one respondent claimed, this technique was to "eat with hands in order to prime the body in anticipating the texture and temperature of the food" (NGO2 Respondent, Atyrau Kazakhstan, February 2019). This was the technique when the dish was served with red meat. When served with fish meat, the technique for eating the more delicate meat changes. Although the eating method is no longer stated explicitly in the name (as it is no longer referred to as 'Beshbarmak'), the presence of fish marks a change that carries cultural significance and local understanding.

This signposting in food practice methods is clear in the case of Plov (also known as *osh, palaw, pilaf, polo, or plov*) as well. Meaning "ploughman" or "cultivator" ("*Əkinçi,"* also transliterated as "Ekinchi" in Azerbaijani),[136] Plov related to "that which is planted" (EXPRT16, April 2020). Plov dish then, signified a dish which was cooked from 'planted' (ploughed) *(*Ibid*).* Similarly, cuisine naming conventions may be found in neighbouring states of Uzbekistan and Tajikistan as a dish made with meat, carrots, and rice.

In Azeri, "Plov shares the same lexical root with 'Ash'" (EXPRT16, April 2020). It is referred to as 'ash' because rice comes from the land (and land with sand grains = rice grains). 'Ash' is associated with special announcements, such as weddings, but it especially refers to the technique – how to cook it. In literal translation, ash means to 'take over'' and to 'decant' (through a colander). More common in rural areas, 'Ash' was the tradition for when the bride crossed the door of the new family – to decant (uncooked) rice over the bride's head: 'Ash-ir-maq.' In addition to technique, "Ash' was performed at the end of a wedding because the idea was that the 'best comes at the end" (EXPRT16, April 2020).

Plov then, occurs in overlapping semiotic spheres with 'Ash.' Much as elsewhere in the Caspian region, the dish occurs primarily in communities in relative proximity to the Caspian – for *Lankaran,* Masallı, Lerik, and Absheron 'rayons' (districts) and people in Azerbaijan, or the Yormut peoples of Turkmenistan.

The above discussions give an insight into the diverse nature of food ways which become conveyed through language and expressed via culture. From the perspective of this research question and in the case of Eurasia, food customs reflect a method by which the geography gains meaning. Yet, the nature of 'food meaning(s)' in Eurasia are poorly understood within academia. With much of Eurasian life and history remaining largely pre-theoretical, food 'meaning' must be engaged according to the dynamic and diverse possible forms it could take. To give some texture to this suggestion, food understandings often are approached or are treated as locational indicators by academic theory. That is, food represents information and acts a physical reference to a place which can be projected cartographically. While food meanings perhaps can be correlated with particular geographic coordinates (i.e. fish presence in dishes coinciding with proximity to the Caspian), this

[136] *Akinchi* (*Əkinçi*) was the first newspaper in Russia printed in a Turkic language, Azerbaijani. It was published in Baku between 1875 to 1877 when Azerbaijan was a part of the Russian empire.

could be misconstruing or not representative of how information was used historically to convey food meanings in Eurasia. That is, framing of food as physio-graphic information for the goal representing it cartographically may have little explanatory relevance based on the ways in which it interacted with other elements of the Caspian system.[137] Therefore, considering possible functions of information within a cultural system, and the nature of 'what could have been relevant or not,' are important elements for analysis.

The intention of this brief discussion is not to attempt to provide definitive or conclusive answers of Eurasian food meanings, but to give indication of the diversity food meanings that can exist within a cultural system. The absence of cartographic depictions or mapped two-dimensional projections of space in themselves do not imply that the Caspian geography was not understood by steppe inhabitants. Evidence for its understanding is demonstrated by virtue of human's prolonged habitation within Eurasia's lands. Instead, this absence indicates that ways for using and for transmitting information of the land developed according to the logic of the Eurasian system. Moreover, because this local knowledge was understood coherently, it carried collective significance. With this in mind, and for the purpose of this study, more appropriate theories and endogenously-informed concepts can be developed from assessments which start by taking a wider and more holistic engagement with the social landscape.

Customary food practices provide archival notes of historic value systems and points of continuity. Provided sweeping systemic change, both from the Soviet and independent nation-state eras, the consistency by which cultural practices have persisted suggests Caspian peoples are continuing to value these traditions. Interview respondents noting the growing presence of fish restaurants in recent years in all three states of this study is a form of valuing such customary food ways. One respondent shared their insights regarding the growing presence of fish restaurants:

> "Boundaries and places are understood in terms of food sources…. A lot of the growing preferred fish varieties coincide with familiarity with fish types" (*EXPRT6 Respondent, Baku Azerbaijan, December 2018*).

[137] That is, this kind of cartographic representation presupposes a tradition of mapping styles which require particular capacities (such as projecting and representing three-dimensional space on a two-dimensional plane) that were not in use in pre-industrialized Caspian Eurasia.

Ideas surrounding food and sourcing extend beyond questions of urban-industrial hygiene or quality control. Instead, they point more powerfully to perceptions of locality. The food makes the geography concrete. One respondent in particular articulated well the general cultural attitude towards food:

> "Food is still very regional in Kazakhstan, so you see people eating fish a lot more in West Kazakhstan near the Caspian or Aral Sea where they have 'fish' Barmak rather than 'Besh' Barmak" (EXPRT17 Respondent, Almaty, Kazakhstan, March 2019).

Although these restaurants are commercial ventures and ultimately aim to make a business by popularizing products, the reality of these start-ups mapping onto local preferences conveys significance. This phenomenon can be explained in terms of people's familiarity with food types and that a business is established for where there will be a reliable consumer base. Yet this is only a market explanation framed by efficiency logic and, more often than not, has been shown in the literature to mischaracterize or misconstrue the Eurasian knowledge and cultural system.

Oftentimes food topics are tied to or are analysed with regard to identity matters. They draw on themes of cultural authenticity, heritage protection, primordial senses of community, or issues of citizenship and rights in contemporary post-Soviet settings (McLean, 2017). This research acknowledges the academic debates on how the food of Central Asia has been articulated in terms of nations and as 'authentic' or 'traditional' since the Soviet times. As suggested by some scholars, "the Tsarist Russian administration reduced Central Asian food into two dishes that are emblematic of either nomadic or settled peoples, and that Tsarist representations were inherited by the Soviet state" (2020: 110).[138] Certainly, Tsarist and Soviet administrations formalized descriptions of food in Central Asian republics which continue to play out in national identity imagination and integration processes today.[139][140] Yet much of this debate is concerned with how food has been

[138] And established a vision of plov as a dish predominantly of Uzbeks and Tajiks, while Beshbarmak become primarily a Kyrgyz or Kazakh dish.

[139] Reinforced by an age of globalized travel and online exchange, contests over international recognition as 'owning' dishes such as Beshbarmak or Plov has increasingly nationalized cuisine in the region, epitomized by events such as the Kazakh Geographical Society's appeal to enter the Guinness Book of World Records in 2015 with the largest serving of Beshbarmak (Aaly Alymbaeva, Aida, 2020).

[140] While some recent scholarship presents the name of 'Beshbarmak' as a colonial attempt to distinguish and to impose artificial divisions between peoples of Eurasia (Aaly Alymbaeva, Aida, 2020), this research asserts that provided the abundant Turkic language concepts and words and related customary practices of

historically positioned in relation to nation and identity in order to designate local cultures from one another. This aspect of food history in the Caspian is not of primary concern for this research as it engages at the level of recent history and food designations in the sphere of politics and political history. Instead, this research engages with food from the perspective of culture as conditioned by the geography and the ways in which these food meanings developed, which long predate these political debates.

As a final note regarding customary food practices, their significance should be qualified based upon their occurrence within a culture of historically oral peoples. The majority of social analyses look to the material, namely texts and objects, as the most verifiable and robust way to examine social processes and characteristics constituting a culture. However, direct human agency and interaction, whether carried out with explicit intent or through diffuse mechanisms, give important shape and structure to culture and systems of knowledge. For millennia, the shear transport of people across Eurasia was of an order (in degree and intensity) that fundamentally shaped the trajectory of the region's history and the cultural understandings of that history. Whether this movement was forced (i.e. military campaigns) or natural (i.e. livestock pasture management, trade relations), this history of relations and exchange allowed ideas to accrete around particular understandings and thought frameworks. Rather than textual sources then, it was customs and traditional practices – whether performed daily or irregularly – as well as spoken language, which created the templates for maintaining collective understandings and social meanings. The weight of these interactions often is overlooked by analyses of the region. Even across widespread system rupture of the last hundred years in the region, as Chapter 6 Analysis will contend, the outcome(s) of such change did not equate to a displacement nor erasure of the ideas and institutions that came before.

Provided the archival problem[141] for oral peoples and the challenge of locating material evidence, the following discussions look to the archaeological record to demonstrate the persistence of fish in

Beshbarmak and Plov which predate Tsarist imperialism, they cannot be reduced to only colonial representations.

[141] Archival problem insofar as methodologies relying predominantly on material sources or based on available evidence which can bias imperial histories (Filippelli, R., 1976).

Caspian Eurasian diet. In so doing and as a corollary to the archival problem, these discussions establish the significance of sturgeon from the perspective of culture.

5.8 Archaeological Evidence

Archaeological findings help substantiate the ideas this dissertation develops with regard to resource understandings which arose within a cultural-geographic system relying on mobile life ways. Considerations of fish in Eurasian diet from the archaeological record will be presented to help contextualize the significance of sturgeon food acts as markers of environmental meaning-making modes recorded during fieldwork. The following discussions are not to make an archaeological argument per se. Rather, they intend to provide an overview of the current archaeological literature on aquatic food sources in Eurasia, and to give a more rounded perspective for how, and by what means, research theorizes the food ways of Eurasian culture. These discussions also make clear the bias that has been introduced in understanding Eurasian food strategies on account of research traditions and persistent narratives of low complexity[142] in Eurasian societies which historically have overlooked the importance of fish protein.

Caspian Eurasian people's relationship with their surrounding ecologies and patterns of resource use long pre-date both the modern nation-state and Soviet eras. A brief overview of early settlement in the region will follow to highlight the precursors by establishing paths for food ways to develop in the region.

5.8.1. Early Steppe Settlement History

Early hominids colonized Eurasia in two stages beginning roughly one million years ago (Christian, 1994: 184). First, they inhabited warmer and more fertile lands of Outer Eurasia, similar to their former African homeland (Paine, 2008). Evidence of early colonizing of Inner Asia is very limited from 800,000 to 600,000 BC. Settlement on a considerable scale was confirmed in Inner Asia only after the last Ice Age 100,000 years ago (Christian, 1994: 185). Having evolved in the tropics and semitropics, hominids developed subsistence strategies that were not well adapted to the harsh steppe and desert environments of Eurasia where the majority of food energy was stored in

[142]Low complexity in the sense of specializing only in livestock. As will be elaborated in Chapter 6, specializing in livestock did not mean specializing in only this. Instead, this specialization form entailed specializing in the *ability* to raise livestock.

indigestible grasses.[143] Consequently, hominids had to learn how to harvest animals able to make use of the energy stored in the biomass of Eurasia's grasslands. While hunting herbivores that could access this grassland energy became a technique for supporting human populations 500,000 years ago (perhaps as late as 200,000 BP), refining these strategies until they were efficient took a long time (Christian, 1994: 186). For viable settlement of Inner Eurasia, technologies based on the exploitation of other animals only began in roughly 100,000 BP with the arrival of *Homo sapiens Neanderthalis.* While they were the first hominids in Eurasia with strategies that relied more on hunting than foraging, many of these early hunting strategies were closer to scavenging or harvesting sick or old animals (*Ibid*). Although hunting techniques became more refined, the need to spread more widely to harvest game animals kept human populations relatively scattered and proved challenging insofar as ensuring self-supporting population levels. Eventually, and as Chapter 3 discussed, this led to domesticating animals and relying on livestock food sources rather than fixed field agriculture.

While this interpretation of Eurasian early settlement has good merit and wide support from archaeological findings, it overlooks the plausibility of a more diversified toolkit. Human beings have had an intimate relationship with water from the beginning. In prehistory, recreations illustrating the human journey out of Africa do not follow empty savannahs, but trace coastlines, lakes, deltas, and river systems (Paine, 2008). Following water sources offers a more diverse supply of food - from fish, bird eggs, turtles and turtle eggs, tree fruit, and stolen predator kills.[144] As Scott points out in his revisionist history, the earliest city-states arose out of these "forager wetland paradises" and as a consequence of "drainage rather than irrigation-based systems" that could utilize increase in fertility after high water flooding periods (2013: 194).[145]

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[143] Initially, hominids relied primarily on subsistence by gathering plant foods rather than relying on hunting (Klein, 1987).

[144] Marine foods are rich in essential fatty acids (DHA) and are critical to human brain development. It is now suspected that DHA and other similar nutrients, which abound in seafood, played a critical role in the evolution of the human brain, and that an exploitation of marine resources triggered a sudden evolutionary leap that coincides with a dramatic spread of humans across the planet, made possible only by being able to construct boats. Navigation by sea and waterways most likely was not possible without experimentation in and some degree of experience in fishing (Crawford et al. 2014, Marsh, 2001).

[145] Indeed, Thevs et al. discuss a catalogue of Central Asia's historic cities, settlements and trade routes which mapped onto earlier established use along river systems and water sources (2013).

Despite the vast number of studies of prehistory of Eurasia, papers are almost entirely devoted to discussing relationships between various kinds of hunting, farming, pastoralism, semi-pastoralism, and nomadism. Almost none are dedicated to fishing. Yet the region's vast geography is home to abundant water resources, including the world's largest inland waterbodies. Massive lakes such as Balkhash and Baykal, with its network of river systems: Dnestr, Dnepr, Don, Volga, Amu Darya (i.e. the Oxus), Syr Darya, Ob-Irtysh, Tarim, Yenisey, and Amur, in addition to the extensive shorelines of the Black Sea, the Sea of Azov, the Caspian, and (historically) the Aral Sea (Paine, 2008). These rich hydrologic regions offered abundant food potential. Moreover, only three of these ten river systems are distant from the sea[146] with the largest ones: the Volga and the Don, emptying into the 'sea' within the region (i.e. the Caspian) (*Ibid*).

As described in Chapter 3, the Volga is one of the most important sites for several sturgeon species and supports rich deltaic ecosystems for food sourcing, ranging from high-fat waterfowl birds, deer, and wild boar. Yet with hunting large game animals posing considerable risk of injury, developing fishing strategies from river systems becomes both logical and practical (Christian, 1994). Provided the magnitude of the Volga's network of food potentials which are on the order of other great global river systems, such as the Nile and the Tigris-Euphrates, it becomes highly improbable that early inhabitants of Eurasia's Volga region did not invest in strategies to learn to harvest from this rich aquatic ecosystem (Paine, 2008).

5.8.2. Changing Research Traditions in Eurasian Archaeology

Indeed, much of the lack of archaeological work on marine resource exploitation in Eurasia can be attributed to research traditions. In a region that has long been narrated both within academia as well as in popular discourse with tropes of low-complexity of exclusively livestock-dependent peoples, aquatic resources historically have been treated with little weight in analyses. As Powell points out "very few archaeologists make the effort necessary to find on-site evidence of fish consumption and few are properly trained in recovery techniques" (1996: 5). Shellfish, for one, will leave remains in middens,[147] "but fish bones disintegrate quickly" (*Ibid*).[148] Moreover, most fishing

[146] Waterbodies with the necessary characteristics to be regulated under the 1982 UNCLOS Law of the Sea.

[147] Old dump sites for domestic waste

[148] Often, the only surviving remnants are otoliths, which are small particles of calcium carbonate which fish use to orient themselves. These can only be found with screen sieving. While more relevant to sedentary populations but worth mentioning, some scholars have suggested that a recovery bias arises from the

equipment - nets, lines, baskets, weirs - either is unlikely to survive or is disposed of at the harvest sites (i.e. at sea, on a lake, or a river) (Paine, 2008). Also, fishing materials often are indistinguishable from equipment used for non-fishing purposes (knives, tongs, spears, scoops, rakes) (Thomson et al., 2016).[149]

While shifting attitudes in archaeological work are taking place amidst wider re-readings of Eurasian history, the process of overturning long held traditions and narratives to make researchers more routinely aware of overlooked aspects in historical Eurasian life will take time (Sneath, 2021). Renfrew summarizes well the shifting orthodoxies of archaeology, especially those studying prehistory in Eurasia.

> "We *shall have to devote more attention to the role of fish in the diet. It is pertinent to ask whether communities with fish playing a more significant role in the diet than meat are likely to have been nomadic… it could be argued that the heart of nomadism is seasonality (usually in relation to pasture lands). But the fish in question are not likely to have been the anadromous fish which have a marked seasonality, since most of the rivers in question are presumably too far from the sea for migratory patterns like those of salmon. Whether there was seasonality in fish resources sufficient to promote mobility is a matter for discussion*" (2002: 4).

The 2003 bio-archaeology study by Tasmin O'Connell et al. study spurred critical revisitation of early human history in Eurasia during the Eneolithic (4300 – 3800 BC) and Iron Age (1200 – 600 BC). Using stable carbon and nitrogen isotope analyses of bone samples, "the diverse forms of caloric and nutritional intake" of early steppe inhabitants demonstrated choice in dietary habits (2003:254). Owing to the numerous lakes and rivers of the region, "the apparent of fish in the diet…with freshwater fish perhaps supplying up to 50 per cent of their total protein intake" was important confirmation of the resourceful capacities and attunement to various steppe ecologies (O'Connell et al., 2003: 268). Although decades of scholarship continually supported large scale models emphasizing diet homogeneity in Eurasia, the breakthrough study by O'Connell et al. concluded that "it would be difficult to accept the view that the inhabitants did not exploit this easily accessible and abundant food resource" (2003: 268).

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possibility that early farmers might have recycled all their fish waste into their fields, as the Indians of New England did. That would leave no noticeable trace in domestic sites. Algonkian agriculture in New England was fully integrated with a large-scale fishery, but its sites would probably leave no clear evidence of this in domestic middens.

[149] See Appendix 4. Image C shows a "cheek piece" originally thought to be the cheek piece of a horse bridle. Later analysis reconfirmed it was a fishing hook instead (O'Connell T.C., et al., 2003).

Eurasia is a region with amply documented trade networks. For mobile populations, skill in fishing to make use of aquatic food sources along trade or livestock herding routes would have played an important role in functionalizing long distance trade and livestock herding. With diet leaving an "isotopic fingerprint" in bone collagen and bone carbonate,[150] isotope analyses of recovered samples are becoming a growing archaeological technique for assessing past human diets (O'Connell et al., 2003: 246). Stable nitrogen and carbon isotopes are the main isotopes investigated with each indicative of different diet elements. With the C_4 photosynthetic carbon cycle representing an elaborated addition to the C_3 photosynthetic pathway for plants in higher temperature and greater light intensities, stable carbon isotope ratios ($\delta^{13}C$) can discriminate primary plant types in diets (Lightfoot et al., 2017; Gowick and Westhoff, 2011).[151] Stable nitrogen ratios ($\delta^{15}N$), meanwhile, offers valuable insight into protein types of an individual's diet (Ambrose and Norr, 1993). Typically, aquatic food sources result in higher $\delta^{15}N$ values than land-based protein sources as 3-5% increases in $\delta^{15}N$ have been documented with each rising step in trophic levels (O'Connell and Hedges, 1999).

Although there remains little archaeological work on fish and aquatic food resources relative to other Eurasian prehistory topics (hunting, animal husbandry, pastoralism, nomadism, etc.), new techniques are enabling a more nuanced approach to analyses of early steppe life. Recent examinations from several Bronze Age (3300 – 1200 BC) communities across central Kazakhstan found similar diversity of protein sources with "the inclusion of fish in the diet of these 'pastoral' populations…showing these 'pastoralist' economies engaged in fishing throughout the Bronze Age (Lightfoot et al., 2015: 232). The results of this study built on the findings from Miller et al. of isotope and dental analyses confirming freshwater fish as a significant protein source during the Middle Bronze and Late Bronze Age with little variation in diet between the two periods (2014).

Recent paleoenvironment analyses combining analyses of Carbon 13 ($\delta^{13}C$), Nitrogen 15 ($\delta^{15}N$), and Carbon 14 ($\delta^{14}C$) in bone[152] of Eneolithic (4300 – 3800 BC) and Bronze Age cultures by Shishlina, have also made significant advance in understanding the role of fish for peoples of the Pontic regions in the Caspian (2007; 2008; 209; 2017). Steppe pastoral groups "were assumed to have

[150] As well as hair, although this typically is not well preserved.

[151] Wheat, barley, rice and potatoes, are C3 while maize, millet, sorghum and sugar cane use the C4 photosynthetic pathway (Lightfoot et al., 2017).

152 including paired dating of human bone and terrestrial materials (herbivore bone, wood, charcoal, and textile).

exploited not only steppe grasslands but also maritime and North Caucasus piedmont pastures" (Shishlina et al., 2017). While Shishlina used palaeoecological, subsistence and chronological records in order to examine events and variations in climate of the Caspian steppes, results also revealed that "stable isotope data also indicate that a large part of the everyday diet of all Eneolithic and Bronze Age groups consisted of aquatic products" (2009).[153] Additional excavations from the late Copper Age to Early Bronze Age (3000 – 2450BC) in the Caspian Pontic region, supported populations occupying "various ecological areas where river fish bones and shells of river molluscs and bird eggs were recovered as food sources" (Shishlina et al., 2017: 1249). Moreover, findings from Shishlina's studies found aquatic food as important protein source across male and female samples (Shishlina et al., 2017). Although many rivers and lakes became dry during summer months and decreases in groundwater levels increased mineralization, Shishlina's earlier studies, found trout from the Konstantinovskoye plateau (Markovin 1994) and carp from North Caucasus found in graves of the Kuban region remained important protein sources even across environmental fluctuations (Shishlina et al., 2007).

Lastly, the analyses by Kohl et al. from a site in Dagestan, on the western shore of the Caspian Sea, between 3600 and 1900 BC found "a sophisticated community practicing agriculture and raising livestock on the coastal plain that also exploited the sturgeon and shellfish resources of the Caspian" (2002: 27). Ethnographic data from mat weaving techniques and knotless nets used to catch fish from the last twenty years supports material recovered from burial sites that suggest the abundance of fish in steppe river systems (Rybina 2003; 2007; 2008).[154]

In spite of a limited number of studies, isotopic data show that fish were a regular component of steppe diets which previously were thought to rely entirely of livestock protein. Sampling of the published work on the subject demonstrate this fish protein pattern from many sites across the steppe. The consistency of fish and aquatic resources across seasons, age groups, sexes and pre-history eras shows that fish were not food sources for dire circumstances. Instead, they integrated in important ways into steppe cultural life. As Lightfoot et al. recently have noted, the input of time and energy alone to learn and to carry out fishing prompts a reconsideration "of our understanding of what it means to be a pastoralist" (2017: 245). This growing evidence attesting to the ability to

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153 Catfish (*Silurus glanis*) bones and special fishing tools (hooks and harpoons) were found at Eneolithic sites excavated during Soviet times (Agapov et al. 1990).

154 similar items have been identified in Yamnaya graves as well (Shishlina 2008).

maintain varied diets and to opportunistically inhabit diverse steppe ecosystems points to a distinct capacity for resourcefulness in Eurasian culture. Indeed, from the perspective of this research, this dynamic signals a distinctiveness insofar as the very nature of what constitutes the resource.

5.9 Chapter 5 Conclusion

The first part of Chapter 5 Findings presented empirical data collected during interviews with sturgeon aquaculture industry workers and Caspian sustainability experts. This data strongly demonstrated the growing preference for and pursuit of market-based knowledge as a supplement to technical and scientific abilities endowed by the Soviet system. Specific examples of fieldwork data were presented to highlight the contemporary realities of a market-based economic system for sturgeon aquaculture, both in terms of species conservation approaches and sturgeon commodity production, and how these circumstances create the need for acquiring market knowledge. Yet this research's analyses do not take the pursuit of such market knowledge (as a supplement in varying degrees to aquaculture and conservation capacities developed during Soviet times) as a means to an end. Rather, this research looks further to consider the particular kinds of sturgeon use ways to which this market knowledge increasingly is being directed. Fieldwork data of Caspian sturgeon aquaculture increasingly aligning around a market for sturgeon meat prompted this research to consider the conditions for enabling such a market. While economics (whether under market principles or a centrally-planned system) are important insofar as sustaining the market for sturgeon meat, economics alone did not create the market. As prompted by fieldwork data of the changing orientation of Caspian sturgeon aquaculture, this research asserts that culture provided the conditions for economics to plug into.

The second part of Chapter 5 discussed ethnographic fieldwork data. Through the phenomenological approach to fieldwork (Ch. 4), this research recorded instances in which resource understanding conveyed by the sustainability concept provided little explanatory ability for social use practices of Caspian sturgeon. Post-fieldwork analyses demonstrated the need for alternative conceptual bases. Culture and the physical geography are innate aspects of the landscape in which this research was conducted. While change and evolution are undoubtedly a part of both (particularly on account of the two historical moments sweeping systemic change over the last century), neither is exclusively imported nor derived exogenously. Market-oriented economics can plug into culture (and indeed create new forms) and effects from industrial processes become encoded into the geography, but neither emerged in their own right from the

region. Therefore, culture and geography (and the distinct social-ecological systems they produce) are reliable and salient features by which analyses can engage with the Caspian system.

A review of the archaeological data on the aquatic component of Eurasian diets highlighting Caspian peoples enduring and important relationship with fish demonstrate two considerations: a) its relevance to this research's resource analyses. This consistency by which fish/aquatic resources featured in diets of pre-modern cultures, particularly *across* climate and environment change events, gives insight into the nature of pastoral economies and, b) how this 'specialized adaptiveness' allowed change to be navigated. Implications of these considerations from the perspective of 'multi-resource' resource strategies enabled by Eurasia's historically livestock-predicated economy will be discussed in Chapter 6.

The fieldwork findings and initial discussions of their significance within Caspian Eurasian culture, both as modes for interpreting Eurasia's geography and integrated spheres by which distinct resource understandings have developed and been transmitted, will be discussed in the following Chapter 6.

Chapter 6 – Analysis

6.1 Introduction

This fieldwork investigated the nature of sturgeon use in the Caspian in order to uncover resource ideas. The core ideas described in the preceding chapters are analysed to demonstrate the nature of Eurasia's highly integrated culture-geographic system which gives rise to a distinct knowledge system and resource mechanisms. These dynamics are depicted in Figure 41 below.

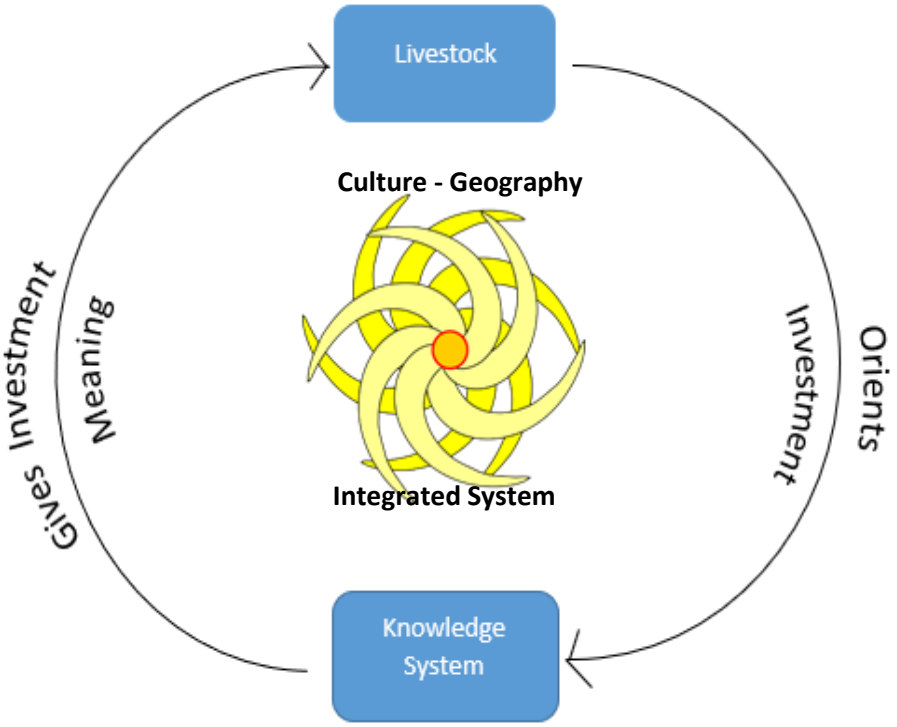

Figure 41: Caspian Eurasia's culture and knowledge system dynamics where livestock give the mechanism for value creation, which then integrates culture and geography within a distinct system of knowledge (Berman, C. 2021).

Modern infrastructure, scientific expertise, and market competency were recorded in abundance over the course of this research's fieldwork to Caspian sturgeon aquaculture facilities. Yet these capacities did not function to imitate external objectives and a pursuit of knowledge produced outside of the region. They worked as supplementary elements within a larger system design. The phenomenological approach attuned fieldwork to customary food practices involving sturgeon fish to be significant within the cultural landscape of this research. The pre-theoretical nature of Caspian Eurasia led this research to explore alternative conceptual bases to offer explanations for these sturgeon phenomena. Accordingly, this research looked to the innate within the Eurasian system – culture and geography. As stated in the Chapter 5 conclusions, these aspects are not imported and give reliable bases for engaging with endogenous features of the Eurasian system.

While the Caspian and Eurasian steppe may be one thing physically, humans confer "multiple symbolic meanings to natural spaces" (Greider and Garkovich, 1994: 1). Human interpretations and socially- or biologically designated requirements transform components or dynamics of an ecosystem into a form that is meaningful for a culturally defined purpose (Schmidt, 2013; Greider, T. and Garkovich, L., 1994; Zobler, 1962). Beyond meeting basic physiological or nutritional requirements, fish therefore can act as culture-makers and represent components within environmental meaning-making processes. However, when considering these meaning-making processes, they do not necessarily rely on an abstracted understanding of the environment as this presupposes intellectual frameworks and thought systems which may have little bearing on Eurasia's premodern knowledge ways. While sturgeon fish uses can be correlated to terms and ideas across a physical environment that have been removed from their social making, these explanations may not be what give the 'resource' (sturgeon) meaning. Introducing a perspective where the environment is decoupled from its cultural context for analysis could bias interpretations or misrepresent endogenous features. Therefore, this research approached sturgeon as embedded in understandings and value systems co-constituted within a constellation of mechanisms according to how a culture has come to know the world.

Provided the preconceptual nature of Eurasia, identifying value creation mechanisms - where they occur and the manner in which they historically have engaged land and people - offered a reliable starting point for analyses. Illustrated by the geographic realities that have directed Eurasia's civilizational development towards non-agrarian subsistence strategies (Chapter 3), the land itself

carried value only insofar as the livestock it could produce.[155] Grazing regimes and movement between pasturelands to achieve the overarching goal of livestock production generated diverse value creation mechanisms and directions for investment.[156] The archaeological and historic records show there was significant investment in livestock/pastoral nomadism and mobility in Eurasia (Scott, 2013; Spengler et al. 2013 in Honeychurch, 2014; Frachetti, 2008; Frachetti and Mar'yashev 2007; Gatto 2011; Honeychurch 2010). If livestock were taken to be a worthwhile investment and became the primary point of value creation, then, accordingly, the system required the capacities to specialize in livestock. This entailed cultivating the ability to specialize in flexibility so as to adjust to fluctuating resource availabilities across Eurasia's diverse ecosystems and seasonal dynamics (Anderson and Johnson 1988: 10-11; Salzman 1971: 105-106 in Honeychurch, 2014*).* Honeychurch writes extensively on the historic investment model in Eurasia as specialization in adaptiveness. Functionalized by mobility, this specialization in adaptivity enables what Salzman describes as 'multi-resource' and 'multi-purpose' nomadism (1972). In distributing basic resource requirements across multiple food webs, mobile groups of people could pursue diverse specializations and make wider use of an array of landscape ecosystems (Scott, 2013).

With adaptiveness identified as a prominent feature of the Eurasian system, investments which cultivated flexible capacities necessarily meant investing in the knowledge system to do so. To go further, specializing in adaptiveness meant specializing in change. By emphasizing the intrinsic dynamism of the environmental geography, rather than its limitations, change could be treated as an inherent feature of the system. In foregrounding change, specializing in livestock did not mean that the knowledge system was oriented singularly around livestock. Instead, it meant collectively investing in diverse knowledge and skills in support of the primary livestock economy.

Mobility strategies require information about the land across a wide geography and create a proclivity to network. Exchange of social knowledge was given high value as it was understood to be necessary for identifying land uses and potentials within an ecosystem in the first place. As

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[155] However, this style of land relation does not necessarily mean one that is highly extractive (in the sense of Hardin's 'Tragedy of the Commons' thesis) or transactional in nature. We can determine this to not be relevant by virtue of return and cyclic use of pasture areas. Indeed, winter was the most difficult season for livestock management in terms of survival rates and increased caloric necessities, winter pastures were "usually saved from generation to generation as something hereditary and precious" with winter range lands considered "investment property and only changed in cases of extreme necessity" (Masanov, 1996: 134).

[156] Investment in terms of where human energies and attention were guided. Investment can be analyzed according to the direction of human appreciation and attention and does not inherently mean investment must be understood in terms of financial outcome or material results.

Bonte suggests, it “increases knowledge and experience of geographic and cultural variation and promotes cultural contact” (1981: 46). A particular adeptness and competency in land use ways became distributed within Eurasia’s knowledge design structure to facilitate "collaboration, learning and awareness of foundational conditions (plant communities and governance structures) to ensure collective preservation" (Manzo et al., 2021: 653). The resulting arrangement of social knowledge vested in Eurasia’s landscapes generated a cultural map. Transmitted through social memory and the enactment of cultural practices, these maps retain information of vast geospatial diversity and cultural meaning.

The idea of a ‘map’ goes beyond a cartographic representation of a physical landscape to which location coordinates can be assigned. For Eurasian peoples, the map becomes the knowledge of the land *through the narration of it*, and (in the case of this research) how sturgeon (or fish more generally) enable that narration. The thought here is not to make this knowledge explicit by tying the use of a particular ‘resource’ (i.e. sturgeon) to a precise set of GPS coordinates, nor is it to timestamp their use to definite historical moments. Again, this assumes theoretical formulations of the environment which are not appropriate for this analysis. Instead, the intent is to engage with the knowledge exchange dynamics of the livestock economy and the subsequent nurturing of human relations which facilitated further dispersion and valuing of this map. Yet, because this map is not depicted holistically in material form, organized linearly, or even discussed locally in terms of a ‘map’, it can be difficult to identify. Indeed, the current social organization in Eurasia as a consequence of sweeping systemic changes over the last century give the impression that such a map would not have the bases to endure.

Yet the cultural map and structure of Eurasia’s system generated by the historic livestock economy and mobile social organization was made possible not by the elements themselves, but by the ways in which elements became connected through dynamic and flexible strategy (Manzo et al., 2021). As Salzman suggests, specialization arising under pastoralism is better understood when approached by the diversity of its productive practices and not as a threshold condition with constant characteristics (i.e., particular livestock breeds, herd size, degree of mobility, or supporting community structure composition) (1978). Although seemingly small or insignificant, food practices involving sturgeon with a known history in Eurasia give indication of this enduring system. In knowing of sturgeon fish use – and maintaining this knowledge through social exchange – knowledge of fish (sturgeon) becomes woven into a tapestry of collective information and values

blended with land use practices. Rooted in a common-pool understanding of the ways in which the physical geography gains meaning, sturgeon fish reflect and give entry for reading this cultural map. Approaching sturgeon fish as an isolated variable in and of themselves is not what allows them to be read within this cultural map. Instead, they must be located according to the knowledge, value processes, and how the valuing of those value processes give social cohesion and meaning.

As previously stated, Eurasia's specialization in flexibility meant Caspian Eurasian culture was designed to specialize in change. This specialization in change was necessary given seasonal variation and the multi-resourcing requirements of the livestock economy. Yet this specialization went beyond a mechanical specialization in livestock cultivation. It endowed the Eurasian system with a distinct perspective and logic wherein specialization is dynamic. Adjusting according to changing conditions, specialization becomes a process of identifying the relevant value and framework for the circumstances. Salzman describes the nomadic capacity for contextual change as a cultural phenomenon through time where the propensity to shift between states of organization creates a diachronic pattern of rearranging relationships (Adams 1978). The capacities required to enable this change specialization strategy were mapped into Eurasia's system such that culture could retain the existing while incorporating new knowledge to enact under appropriate conditions (Salzman, 1978).

With flexibility as an inbuilt feature of Caspian Eurasia whereby the new (the exogenous) could be incorporated along with the existing (the endogenous) in order to make best use of changing realities, then shifts in Caspian sturgeon aquaculture (the new) towards meat derivatives (the endogenous) is an expression of the underlying system's innate pursuit of adaptation and capacity for change navigation. That is, in preserving what was in existence and with a proven history (sturgeon meat), then the continuation of sturgeon as food allows the land and geography to continue to exist in the value framework of culture, while incorporating new economic frameworks (with its own land and land use interpretations) such that they can be leveraged to exploit new production methods. This accommodating strategy within Caspian sturgeon aquaculture allows the land to continue to be known according to the kind of valuation of it that emerged under the pre-modernized livestock economy (where sturgeon were valued according to their location within the cultural map), while permitting the land to be known via the production methods generated by industrialized systems (those of both the market and centrally-planned economies).

The previous discussions demonstrated how Eurasia's flexible design strategy created an investment structure whereby the process of designating the necessary knowledge, capacities, and frameworks for specializing in change meant investing in culture. In this way, sturgeon aquaculture can be shown to be a form of investment in culture (culture as a proxy for change strategy). Sturgeon meat produced by Caspian aquaculturists contributes to the maintenance of the cultural map because the ability to give narration of the map (food and cultural practices) is preserved. That is, sturgeon meat from aquaculture works to ensure that the potential for social memory-making of the cultural map remains possible. Seen together, supplementing Soviet-era techniques and expertise with market-oriented production onto the pre-modern livestock layer is evidence of adhering to the region's investment structure template. By updating with modern skillsets and incorporating new capacities, sturgeon aquaculture demonstrates a localized process of culture being enhanced with modern elements, not being dismantled.

Some scholars describe Eurasia's investment structure and adaptive capacities in terms of a philosophical system:

"A*ncient customs and more contemporary concepts have not contradicted one another…. rather they have supplemented one another and formed layers… creating a wonderful blend of different concepts and approaches which present in their totality a certain well-structured philosophical system to explain the world"* (Laumulin, 2009: 69).[157]

Engaging with the manner in which Caspian aquaculture integrates market knowledge with Soviet-era technical capacities and infrastructure to make them meaningful within the value framework of culture, the modern and the traditional can be shown to be mutually reinforcing and self-enhancing, rather than made inconsistent. This signifies the work of a philosophical system whereby the arrival of external inputs does not lead to dismantling of existing structures.

[157] The archaeological record gives good evidence in support of this pattern when seeing how pastoral nomadic traditions coalesced with the state across parts of the Eurasian steppe zone, such as the Mongol and Timurid empires where "functional derivatives of pastoral mobility and culture, such as long-distance trade and transport networks. In these states, nomadic technologies, values, social relationships and ideologies *were not incompatible* with new formats of organization which often included urban centers and intensive agriculture" (Honeychurch, 2014: 292).

This philosophical outlook endows the system with a distinct logic by affirming culture as the underlying template. The following section will look to the idea of narration as a mode for highlighting how the resource notion is understood and engaged across different systems, as well as how systems level misconceptions can result from theoretical frameworks that decontextualize social experience in one setting and recontextualize them under different conditions.

Extensive post-fieldwork analysis revealed discrepancies arising around ideas pertaining to food and its connection to the physical environment. The inconsistencies in Caspian food meanings under the umbrella of sustainability were well-expressed by one interview respondent:

"There is a philosophy to how Kazakhs actually feel when we eat traditional foods… these feelings have become reduced or framed to make sense to modern sustainability sensibilities by explaining how things are used in terms of an individualized resource." (AQUCLT3 Respondent, Aktau, Kazakhstan, March 8, 2019).

The trouble is in how the sustainability concept gives a language and concepts for speaking of and thinking about the environment in a certain lexicon. Despite being spoken of in terms of feelings, the sensibilities referred to in the above quote are embedded and become significant when viewed from the cultural and knowledge systems to which they are conditioned. Following on from the previous excerpt, another interviewee underscored how the context of learning about the physical environment has been radically altered in the region's recent history.

"We were technocrats trained as scientists. But we feel an environmental connection in our bones. It is in our genetics to have this awareness because we are nomads, but Russia took Kazakhstan and made it industrialized. When we eat sheep, we even use the faeces for fire fuel, the skin for clothes, and bones for soup" (AQUCLT13 Respondent, Aktau, Kazakhstan, February 10, 2019).

More than a matter of efficiency and survival, the interviewee's comment on the importance of sheep products highlight not only the place but the *mode* by which one engages with and learns the natural world. Yet, because both of these quotes are spoken of in terms of feelings, they become difficult to place within the bounds of sustainability theory, which relies on the scientific method and objectiveness. The Eurasia culture map, which instilled and directed meaning according to the system's innate investment structure, becomes disassembled and obscured when viewing Eurasian social phenomena through an external lens.

With the culture map residing in customary practices, traditions, and in the narration of them, knowledge is recorded and transmitted through social memory. The logic of this knowledge structure premise gains validity when appreciated as occurring in a culture of historically oral peoples. History does not exist in footnotes or textual sources for oral societies. It is archived in collective memory and through the enactment of cultural customs and practices. The narrating of this history through these traditional practices preserves the cultural map which is embedded with its own land and land use understandings.

Although the sustainability concept is relatively new to the Caspian region, it is growing in prominence by being reinforced and transmitted through diffuse social, economic, and political mechanisms across global and national levels. Therefore, the sustainability concept and its interpretation of the resource notion tend to be understood as they do in Eurasia because they remain narrated according to external ideas.[158] Given the persistence of conventional resource understandings and sustainability discourse, the challenge of engaging with local Caspian resource interpretations is because of how exogenous meanings become narrated internally, subsequently rearranging internal understandings based on imported discourse.

The growing prominence of biodiversity-oriented projects recorded over the course of this fieldwork offered direct exposure to the issue of applying sustainability-based resource principles and ideas as inherent or all-encompassing. Biodiversity has emerged as the newest concept for coordinating environmental conservation work around industrial processes. Additionally, heritage preservation efforts have become well-established features of post-Soviet development in the Caspian as a crucial strategy for preserving cultural practices and memory. Yet these projects in themselves can often take a very particular and narrow view of the environment (i.e., biodiversity) and the qualities that connected people to it (i.e., heritage).[159] From the perspective of current

[158] These ideas are largely economic in nature with conservation discussions structured predominantly within an IPCC-led discourse (Janković, 2020). The default mode of conservation has commonly emphasized protecting nature *from* people, particularly through protected areas. Elaborate systems have been set up to govern who has access to (all or parts of) protected areas and how these (parts) ought to be used (see the IUCN classification system). This puts the focus on marking and emphasising the boundaries between human and nonhuman nature rather than building from the many inherent links between them (Sandbrook et al., 2019).

[159] The intrinsic value of biodiversity and nature are appreciated along culturally distinct epistemological lines and indeed, oftentimes are not stated explicitly. Biodiversity is a western, contemporary term highly linked to conceptual limitations involving the resource notion discussed in this writing.

development projects in the sphere of biodiversity conservation, a UNDP consultant in Baku astutely noted:

> *"The issue comes in when you try to categorize project aims and actions and have to explain them as a single thing [for example]: in order to justify the project"* (EXPT8, Baku, Azerbaijan, January 30, 2019).

In this way, notions and practices of 'traditional knowledges' and 'biocultural heritage' become target points for socioeconomic advancement according to particular visions of modernity. Understandings for what even constitutes these terms coalesce around narrations and particular models for interpretation. In particular, these models emphasize the land relation histories of sedentary peoples. While this allows for concepts to seem less arbitrary for the sake of projects, it can introduce false distinctions and overlook the role of how society historically has been organized. Ultimately, culture and 'traditional knowledges' become separated from the environment of their making and framed as different domains, rather than as co-constituting and integrated systems.

The sustainability concept developed as a corollary for meeting the environmental conservation imperative arising in industrialized societies (Chapter 5.1.2.). Consequently, sustainability became formalized along lines that facilitate thinking about the land in certain terms. As Kothari et al. write, the land is spoken of in utilitarian language and increasingly framed in production terms with relations defined according to particular rationales.[160] Therefore, the sustainability concept allows for identifying modern features of the Caspian's human-environment relationship, which arrived through industrialized processes. Explaining phenomena predicated in the Caspian's premodern history of human-environment relations, however, becomes limited provided sustainability's deductive premises. Representing the significance of Caspian Eurasia's culture-geography phenomena according to sustainability principles becomes problematic because the framework lacks the conceptual capacity for engaging Eurasia's incentive structure and modes by which the environment acquires meaning.

[160] While outside the scope of this research to discuss directly, productivity can exist in cross-cultural forms. Given the historic livestock economy of Eurasia, productivity could have been how the livestock made the land productive by specific grazing habits, not how the land was productive in and of itself (Köhler-Rollefson, I., 2007).

Concepts need not be commensurate across systems in order to be true. From the perspective of sustainability, the challenge that arises is how to devise the conceptual tools for charting and interpreting patterns of human-environment relations based on local realities without assimilating to exogenous interpretations. Vis-a-vis the Eurasian system, the logic and capacity for a polymodal, multi-framework fundamental design is already innately in existence. The integration of aquaculture production processes alongside Caspian sturgeon food uses demonstrates the frameworks of industrialized production processes existing and being directed by the value framework of culture.

Explanations for sturgeon meaning in the Caspian exist within the culture map of Eurasia. Reading the map of the region reveals how the highly integrated culture-ecological system produced its own template for enduring by specializing in change. The aquaculture actions of today show that production choices are following the template of culture along an investment structure motivated by a pursuit of change navigation capacities. Seeing entities in Eurasia as the outcome of dynamic exchanges mediated by co-conditioned land use and livestock production within a shared cultural system reveals this underlying logic. While the Caspian Eurasian system has been organized under industrialized models of development, contemporary phenomena have roots in and take meaning from the region's pre-modern mobile life ways.

While the precise form of narrative remains pre-theoretical in Caspian Eurasia, this fieldwork's empirical evidence can posit that food is what gives the narrative. While theory has yet to confirm how narrative functions in Eurasia's social settings, sturgeon fish discussed coherently across all three sites of this study indicated a significance. The collective experience of sturgeon fish which carried a shared understanding and appreciation (i.e., that red meat in national dishes is substituted for fish, particularly sturgeon, when in proximity to the Caspian), signalled a pattern of meaning. Therefore, tentative and preliminary connections between narrative and food can be made whereby food acts as a proxy for social memory, and this social memory enables the narrative. These micro phenomena connect to the deeper culture map which carries its own resource interpretations.

Previous discussions showed that investing in change meant investing in diversified knowledge in order to evolve with the change. Culture houses the knowledge for these change strategies, which are transmitted through narrative and lived practice. This could have been change on the order of seasonal variations, or wider perturbation in the social or ecological systems. Such a highly integrated and holistic system amounts to non-linear interactions between its parts. As Laumulin,

and Laumulin write, “there is not the kind of model or discourse for engaging with or capturing these kinds of systemic relations, at least within the social and political sciences” (2009: 69). As opposed to the many social theories which build on systems understandings by relying on fixed and rigid social and environmental categories, this chapter contends that emphasis must be placed on the embeddedness of social-ecological acts.

Culture endures by maintaining the qualities that preserve collective understanding such that it can be carried forward (narrative). Making these qualities explicit is not a requisite for understanding. Although seemingly distant in concept and practice from the perspective of contemporary sustainability theory, Caspian sturgeon aquaculture producers’ investment in culture (in the form of sturgeon meat by-products), in effect, is an investment in the knowledge system. This is because Eurasian people’s historical relationship with the geography endowed the culture with an investment structure which makes knowledge the resource. While Caspian sturgeon aquaculture producers did not state directly nor explicitly that their production choices to move to meat products was done on the grounds of supporting/enabling culture, the point in this discussion here is that they did not have to. The collective understanding (in terms of sturgeon meat having local value) was there implicitly.

Provided the value placed on knowledge exchange and the incentive to network and to exchange, knowledge becomes embedded in process and social learning. Scott describes this form of knowledge as “embedded in local experience (*mêtis*)” (2009: 311). Rather than knowledge remaining general and abstract to become "a way of contemplating, reflecting or communicating” (Latour, 2002: 108), *mêtis* puts a premium on practical knowledge, experience, and stochastic reasoning such that knowledge in no longer "a way of representing the unknown but of interacting with it” (Pimbert et al., 2018: 54). The traditional practices encoded into the cultural map act as signposts of the social knowledge into which the group should invest. In enduring, these cultural acts are made valid[161] because they become understood as archives of knowledge relevant to the needs of that system. Not stating the purpose or logic of these acts explicitly[162] does not equate to an absence of understanding. Instead, it reflects the conditions of the culture’s knowledge structure.

[161] Their validity does not need to be derived empirically
[162] Indeed, requiring explicit explanations presumes a rationalist logic which is a knowledge approach to particular civilizations and not innate to the region.

Eurasian knowledge embedded in experience and stochastic processes facilitates direct participation and underscores a narrative culture wherein knowledge need not be made categorical. Indeed, as oral peoples there was little function for abstracting knowledge which could be represented textually. Extending this logic, resource meanings are not necessarily categorical as they exist in process. Moreover, discussions in Chapter 5; Section 5.7 on food naming and designation practices underscore how there was no logical purpose for representing knowledge explicitly when it was encoded into language and practice. Rather, food and food practices act as the narratives themselves. Therefore, Caspian sturgeon aquaculturists need not state that their production choices are for culture, but in producing the items that enable narrative, it becomes for culture.

As a consequence of the conceptual gaps in the sustainability framework, key features which give the system its logic and incentive structure and to which the resource notion is applied become misplaced or overlooked. The lack of formal institutions for gathering and disseminating information on the Eurasian experience and history of land relations makes it challenging to incorporate and to represent Caspian regional knowledge in the spheres of resource, global biodiversity, and/or sustainability discussions. Moreover, this builds from a deeper lack of comprehensive engagement with pastoral peoples (past and present). Many scholars claim that research of pastoralist/nomadic peoples "tends to be compartmentalized… [and] most research on pastoralism so far has been isolated and fragmented across disciplines and geographic regions with few efforts cutting across them" (Manzano et al., 2021: 653). In spite of its widespread extent, there remains no global appraisal of pastoral people's contributions to agricultural sectors, socio-cultural life, nor of the highly-coupled nature in which pastoralism produces social-ecological systems as alternative models of land use ethics and practices (Sloat et. al, 2018; Reid et. al., 2014; Reid et al., 2008). The resulting critical gaps, in addition to the bias toward sedentary people's land history relations, creates inbuilt assumptions in sustainability research and resource interpretations.

Sustainability carries its own highly formalized resource definitions developed for addressing challenges particular to industrialized settings. Typically, methods for evaluating these challenges emphasize production-consumption based assessments and financial valuation. Capturing Caspian Eurasia's change specialization strategy and knowledge resource modes within a production-consumption spectrum becomes problematic because while outputs from the livestock producing economy can be measured, mobility and knowledge generating interactions between livestock-

people-landscapes are not accorded a value.[163] Moreover, with Eurasia's knowledge ways developing under pre-industrialized conditions, they do not provide immediate answers for sustainability's preoccupations as they do not fit into the categorical distinctions used by the concept. In the context of such a highly integrated system with an extensive history of interactions between Eurasian peoples and geography, land use understandings give the investment orientation; culture gives the investment in knowledge meaning, and the resulting organization around those meanings give them value.

6.2 Updating the IPBES Framework and Alternative Resource Definitions

Prompted by this research's fieldwork findings (Chapter 5) for examining the deductive limitations of the current sustainability formulations (Chapter 2), the following section updates the IPBES model to better engage with human-environment relations in cross-cultural settings.

In spite of a current lack of a systematic procedure for identifying cultural features, this case study's ethnographic component and phenomenological methods gave powerful insight into cultural variables which produce meaning around the resource notion. Ethnographic observations of sturgeon as a food product enabled "speculative possibility by engaging cultural thought and practices as the analytical starting point itself" (Chandler & Reid, 2020: 490). Coupled with growing research on the need for representing pastoral people's highly integrated social-ecological systems and land use perspectives in order to be represented in sustainability discussions, an expanded IPBES model for alternative resource meaning framework can be proposed. Specific to the conditions of Eurasia, this supplemented IPBES model foregrounds livestock as the modes by which humans have engaged with a geography and acted as repositories of culture, Figure 42.

[163] Conventional resources assessments in the food sector generally focus on one trait from a species in terms of yield (i.e., milk or meat). These are then evaluated against supply and logistics delivery considerations. From the pastoral perspective, breeding can be not only according to high growth rates, but diverse criteria based on which individuals and breeds are best able to endure variability (Köhler-Rollefson, I., 2007). The environmental services performed by grazing animals within such a productivity spectrum are not accounted for (Köhler-Rollefson, I., 2007.; Lewis, M. 2003). More studies are documenting additional and wide-ranging biological effects from grazing across ecosystems, from lower albedo in forests to vegetation height, higher ecosystem primary productivity, and understory growth resilience (Huang et al., 2018; de Wit, H., et al., 2014; Bonfils, C. et al., 2012).

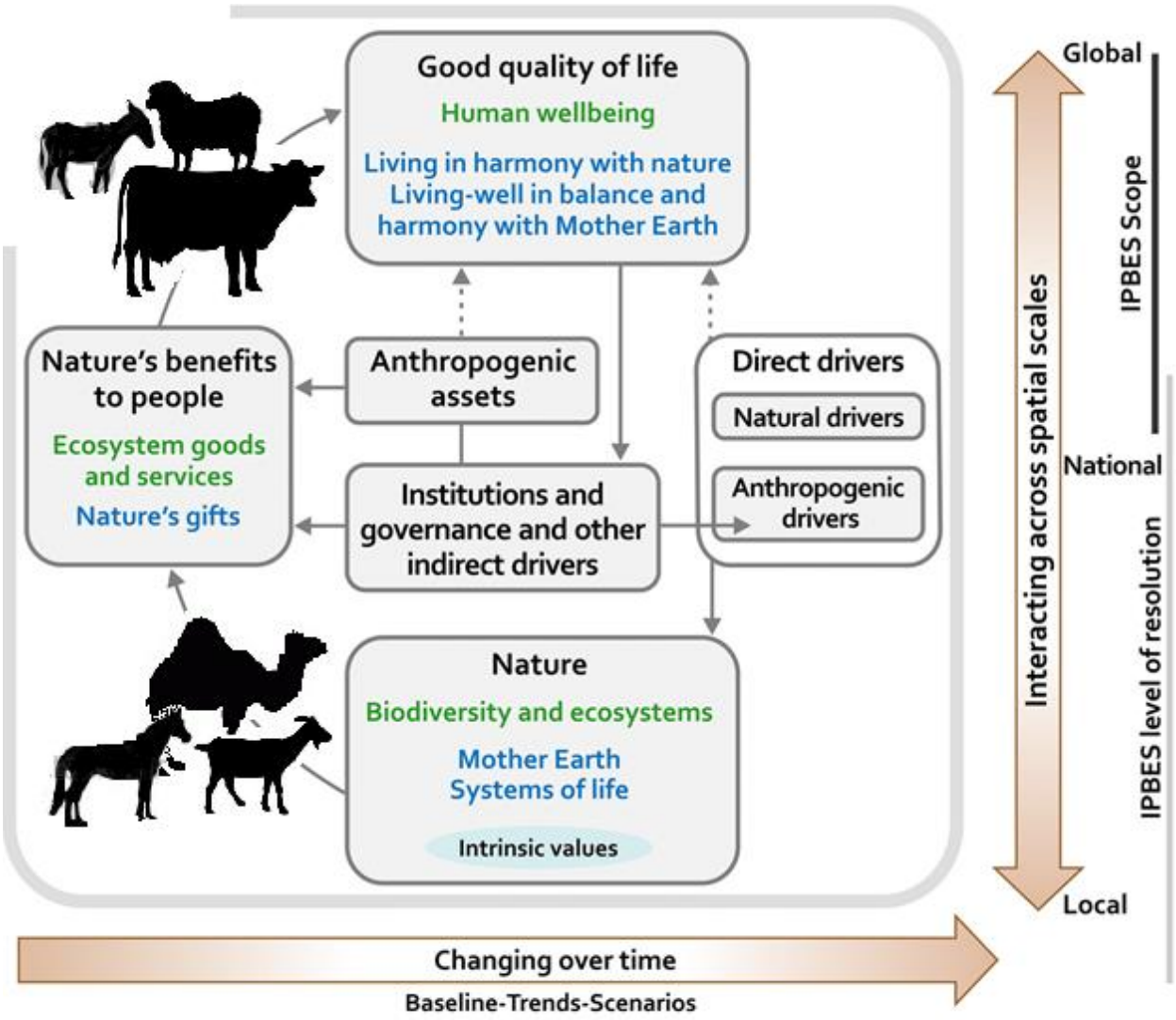


Figure 42: Expanded IPBES for representing land use and value creation mechanisms (Berman, C., 2021). Incorporating the livestock element into the IPBES framework allows the primary link between land and Eurasian peoples to be foregrounded within the processes of resource making and the ways in which the environment acquired meaning. The presence of livestock in the IPBES model allows for engaging with the highly integrated and holistic nature of Eurasia's system such that local phenomena (i.e., modifications to customary food dishes as in the case of this research) can be treated non-linearly and explained according to the conditions of Eurasia's knowledge system.

The IPBES Framework seeks to address conventional sustainability and environmental discourse which overlooks or omits relevant cultural understandings and interpretations of the natural world. Yet in viewing human-environment relationships along a single conduit, rather than as relations triangulated between land-livestock-people, it misses the unifying factor of knowledge. Eurasia's historic value creation mechanism did not exist exclusively in the land in and of itself. Instead, it was functionalized based on what could be cultivated from the land according to the needs of the livestock economy.

As discussed in Chapter 2 Section 2.4 (Figure 6), the IPBES presents human-environmental relational processes along conceptual lines and/or categories which omit or overlook important steps in how the environment has acquired meaning in Eurasia. Categories such as "Nature's Gift" continue to naturalize categorical distinctions of society-economy-environment (Figure 3) by "Nature's Gift(s)" remaining a quality given *to* humans, rather than gaining value through the process(es) of relating through humans, ecosystems, and livestock. By representing livestock within Eurasia's human-environment interactions, important qualities (e.g. mobility) which enable and form distinct characteristics of the region's knowledge system can be accounted for.

Resources allow us to cope with the basic facts of the human condition – that we are finite beings. Yet different forms of societal organization result in different strategies, methods, and possibilities for contending with this condition. With a distributed knowledge design structure to facilitate collective learning and a flexible foundation that profits from change, Eurasia's resource of knowledge becomes housed in culture and enacted through the narration of the cultural map.

Locating sturgeon fish within the cultural map connects it to the region's endogenous resource meaning - the knowledge system - because it enacts narrative. That narrative prompts the pursuit of change strategy, whereby the new (market-based and technical industrialized knowledge) is incorporated to enhance the existing. From the perspective of the sustainability concept, sturgeon fish occur in an abstracted physical environment and exist within a value landscape characterized by quantitative production and consumption values and threshold levels. Marked by cultural customs such as sturgeon food practices, following Caspian Eurasia's cultural template and embedded land interpretive framework gives reason for opportunism, because it has a history of demonstrated success. Resource understandings become resource understandings to the extent that they are articulated in a narrative credible within the knowledge system from which they were derived. By recognizing the diverse modes by which a resource can come to be, more systems of meaning can come to be represented.

6.3 Chapter 6 and Final Conclusions

Sustainability comes to mean different things to different people because the resource principle is functionalized by different social and bio-geophysical realities. This research traces the idea of 'resource.' It does so through building a case study using a commodity of known and enduring human value, sturgeon fish in Caspian Eurasia. The case study follows the intellectual history and discourse of the resource notion alongside historical and present use practices of sturgeon fish. This allows for identifying the nature of change and continuity of sturgeon use, as well as analysing what has informed and shaped the nature of such change or continuity.

The empirical data acquired from seven months of fieldwork in Kazakhstan, Azerbaijan, and Turkmenistan demonstrate that there is more that informs sturgeon use in Caspian Eurasia than captured by resource understandings conveyed by the sustainability concept. These non-sustainability-based resource understandings derive from interactions transpiring between the Eurasian steppe geography and mobile, livestock-based peoples. Evolving over the course of millennia, Eurasia's geography-culture relations emphasized capacities such that natural availabilities could be optimized in support of livestock cultivation despite continually changing circumstances. This history of steppe-culture relations beget modes of understanding wherein the question of 'what is to be sustained' was the knowledge to endure across change, an innate feature of natural systems. This knowledge was transmitted through and endured via culture. Rather than pursuing a land use relationship which worked to preserved natural elements around fixed levels or forms, an investment structure in Eurasia emerged such that the land could continue to support livestock by virtue of capacities enabled by the culture's knowledge system.

The persistence of this investment structure in the region's cultural knowledge system is evident in Caspian sturgeon fish use and production today. Using modern industrial means and techniques, Caspian sturgeon products are produced across an advanced regional aquaculture industry. Infrastructure and capacities from the Soviet-era have been integrated alongside expertise in market economy principles to support a growing industry. Taking a historically informed perspective to social analyses revealed that neither market nor modern scientific expertise are pursued as a means in themselves. Instead, they have been directed as investments in culture. Empirical evidence of Caspian sturgeon production in Azerbaijan, Kazakhstan, and Turkmenistan trending towards fish meat commodities, as opposed to caviar, signalled the existence of a domestic market for such products. This market arises out of culture and the region's history of land relations.

By incorporating a broader temporality into this research's analysis, from pre-history to the present, pertinent variables were identified. Doing so permitted an approach that makes use of trandisciplinarity and greater data insights. As such, diet diversity now being quantified in greater measure through bone isotope analyses can offer greater insight not only into how a landscape was physically resourced, but insight into how to locate the endogenous features that give sturgeon meaning.

The findings from this research give alternative definitions of the resource notion. These definitions supplement the current sustainability concept by demonstrating that the Caspian Eurasia resource meaning arises out of the distinct knowledge modes embedded in culture. This research's findings make contributions in two directions. First, by emphasizing modalities, it expands sustainability resource definitions to shows that resource lies in process. These processes are culturally embedded and carry their own systems of meaning. Second, with much of Eurasian life remaining pre-theoretical, this research gives indication of direction for future studies in order to generate more informed conceptual bases for Eurasia.

The motivation for this dissertation is the growing question being posed across public discourse and academic research: what are the appropriate paths in our search for theories and actions for sustainable futures? As a collective-action problem, the high cost of exclusion and provisioning of unequal resource use creates dilemmas which can be challenging not only for theory, but for the pursuit of social good. Examining resource issues as functional mechanisms and across conceptual dimensions, rather than exclusively on spatial or temporal levels for analysis, makes the wide variety of social-ecological phenomena meaningful to sustainability endeavours. Moreover, and as a consequence, culture can be recognized for the important role it can play for crafting sustainable futures. With its inbuilt biodiversity and relation-building mechanisms, culture creates pathways and bases for alternative land use relationships and resource outcomes. While not always commensurate across systems, cultural thought and values offer points for knowledge transmission and generation across scale and time. It allows for emergent phenomenon which may not be recognizable to current theory. The approach that systems must be nearly decomposable for the goal of being translatable must consider that what may be appropriate analyses and/or methods for some settings or questions, may not be ideal for all purposes. Allowing for the coexistence of theories and human values for describing and relating to the same phenomenon at multiple levels requires abandoning the principle of monism, or "that there is a single best way of understanding (Marshall, 2005: 10). Confronting the enormous complexity of the present-day challenges, ensuring

that knowledge creation potentials embedded in culture for emergent possibilities remain viable, creates a value in itself worthy of any investment.

Appendices

Appendix 1 – Interview Coding

Anonymous code	Type of aquaculture activity	Location	Position	Interview date
AQUACLTR1	Aquaculture training and course developer – Western University	Baku, AZ	Professor in Biological Sciences and aquaculture specialist certification developer	December 13, 2018
AQUACLTR2	Aquarium and Aktau Convention Conference Centre	Aktau, KZ	Conference Centre Manager	February 9, 2019
AQUACLTR3	Aquarium and Aktau Convention Conference Centre	Aktau, KZ	Aquarium Manager	February 9, 2019
AQUACLTR4	Sturgeon Aquarium Auxiliary Farm	Aktau, KZ	Farm Technician	February 10, 2019
AQUACLTR5	Aquarium and Aktau Convention Conference Centre	Aktau, KZ	Aquarium Engineer	February 10, 2019
AQUACLTR6	Aquarium and Aktau Convention Conference Centre	Aktau, KZ	Aquarium Manager	February 9, 2019
AQUACLTR7	Kazakh Sturgeon Scientific Research Centre	Aktau, KZ	Farm Director and Founder	February 13, 2019
AQUACLTR8	Caspian Royal Fish Farm	Atyrau, KZ	Farm Director	February 15, 2019

AQUACLTR9	Kazakh State Farm	Atyrau, KZ	Farm Director and Principal Researcher	February 18, 2019
AQUACLTR10	Western Kazakh State University and ONKPOA Caviar Plant	Uralsk, KZ	Biological Sciences Department Head, Sturgeon Ichthyology specialist and ONKPOA Plant Developer	February 20, 2019
AQUACLTR11	Aqua Alliance	Almaty, KZ	Deputy Director	February 25, 2019
AQUACLTR12	Azerbaijan Xili State Fish Hatchery Farm	Xili, Neftchala, AZ	Hatchery Director	March 5, 2019
AQUACLTR13	Yenicat Fish Farm and Baku Caviar (Pirallaheli)	Baku, AZ	Lumun Project Director for Holding and Financial Analyst	March 7, 2019
AQUACLTR14	Elin Balyk	Ashgabat, TK	Fish Farm Manager	April 19, 2019
AQUACLTR15	Hazar Balyk	Ashgabat, TK	Fish Farm Engineer	April 24, 2019
AQUACLTR16	Hazar Balyk	Ashgabat, TK	Director of Hazar Balyk	May 13, 2019
AQUACLTR17	Hazar Balyk	Ashgabat, TK	Owner of Hazar Balyk	May 13, 2019
AQUACLTR18	Hazar Balyk	Turkmenbaschi, TK	Caspian Ecology Researcher and Director at Hazar Balyk Factory	May 20, 2019
AQUACLTR19	Lumun Holding and Baku Caviar	Baku, AZ	Fish Farm Program Manager	June 3, 2019
AQUACLTR20	Hazar Balyk	Turkmenbaschi, TK	Caspian Ecology Researcher and Director at Hazar Balyk Factory	August 9, 2019
AQUACLTR21	Lumun Representative	Turkmenbaschi, TK	Lumun Fish Farm Manager	August 9, 2019

	visiting Hazar Balyk			

Intergovernmental Environmental Organizations

INTGOV1	Eurasia Foundation	Baku, AZ	Azerbaijan Program Coordinator	November 27, 2018
INTGOV2	UNDP	Baku, AZ	Kura River Basin II Project Manager and genetics researcher	December 13, 2018
INTGOV3	UNDP	Baku, AZ	Kura River Basin II Project Manager and genetics researcher	December 13, 2018
INTGOV4	UNDP	Baku, AZ	Kura River Basin II Project Manager and genetics researcher	December 13, 2018
INTGOV5	WWF	Baku, AZ	Azerbaijan Office Program Manager for WWF Caucasus Region	March 7, 2019
INTGOV6	Caspian Environmental Programme	Ashgabat, TK	Former Representative for Turkmenistan	April 24, 2019

Analysts and Experts

EXPRT1	Fisherman	Baku, AZ	Caviar trader	December 8, 2018
EXPRT2	Ministry of Ecology and ECOTours	Baku, AZ	Founder and lead guide for ECOTours, Caspian Environment	December 13, 2018

			Ministry of Ecology	
EXPRT3	Central Asia University Researcher and Regional Expert	Baku, AZ	n/a	December 6, 2018
EXPRT4	Tourism University	Baku, AZ	Environmental Tourism Course Director	December 11, 2018
EXPRT5	Ichthyology researcher and AZ Ambassador for Commission of Bioresources for Tehran Convention	Baku, AZ	Baku State University Biology Professor	December 19, 2018
EXPRT6	Azerbaijan State Tourism Ministry	Baku, AZ	Program Researcher	December 20, 2018
EXPRT7	British Petroleum	Baku, AZ	Environmental Assessment Officer	January 28, 2019
EXPRT8	UNDP	Baku, AZ	SDG Project Officer	January 30, 2019
EXPRT9	ADA and AERA	Baku, AZ	Project Coordinator and Chief Specialist in Strategic Planning and Innovations Department at Azerbaijan Energy Regulatory Agency (AERA), Adjunct Environmental Science Professor	January 31, 2019
EXPRT10	Ministry of Energy	Baku, AZ	Energy Minister	January 31, 2019
EXPRT11	GIZ	Baku, AZ	Environmental Assessment Researcher	February 1, 2019

EXPRT12	ADA	Baku, AZ	Adjunct Environmental Science Professor	February 4, 2019
EXPRT13	Aktau Mayor and Ecology Professor	Aktau, KZ	Mayor and university course director for ecological sciences	February 10, 2019
EXPRT14	KaspNIIK	Atyrau, KZ	Volga River Program Manager	February 16, 2019
EXPRT15	Fisherman	Atyrau, KZ	Caviar trader, fishermen business coalition representative fish restaurant owner	February 16, 2019
EXPRT16	Baku Slavic University	Baku, AZ (virtual interview)	Literature and Culture Studies Professor	April 29, 2020
EXPRT17	KIMEP University	Almaty, Kazakhstan	Oriental Studies Professor	March 2, 2019

Local NGOs and Civil Society Environmental Actors

NGO/CVLSC1	Baku IdeaLab	Baku, AZ	Sustainability Program Presentation	January 24, 2019
NGO/CVLSC2	Tugan Zher Program	Atyrau, KZ	Program Activist and Kui Music Expert	February 16, 2019
NGO/CVLSC3	TrekkingClub	Almaty, KZ	Trekking Guide and Company Founders	February 26, 2019
NGO/CVLSC4	Hiking Azerbaijan	Baku, AZ	Hiking Guide and Company Co-Founder	March 8, 2019
NGO/CVLSC5	UN Young Ambassador for SGD 14 – Life Underwater	Turkmenbaschi, TK	UNDP Young Ambassador/ fish farm entrepreneur	May 21, 2019

Appendix 2: Introductory letter to interview participants

"Sturgeon Aquaculture Production and Caspian Sustainability"

Dear Sir/Madam, my name is Callie Berman, I am a postgraduate student at the Centre of Development Studies, University of Cambridge, UK, conducting research on Understanding Sustainability and the case of Caspian Sturgeon Aquaculture Producers.

I am respectfully asking for your participation, which will involve in-depth interviews and discussions on the matters related to the topic of my research. Your valuable opinions will make a significant contribution to the understanding of modern days reality of sustainability in Caspian sturgeon conservation and commodity production. I will be happy to share my findings in exchange for your participation.

Specifically, the interview will contain questions on what you think and feel about sustainability in business settings, how you perform the tasks necessary to produce sturgeon, and what motivates you to undertake any sustainability measures. The interviews are aimed to take about an hour. This research is entirely anonymous both for interviewees who participate as well as organisations. Neither your personal details nor individual answers and other identifying information will be disclosed. Your participation in the study is voluntary which enables you to withdraw from the project at any point you wish. Should you have any questions, please do not hesitate to contact me.

I sincerely hope that you will have some interest to participate in this project!

THANK YOU!

Sincerely,

Callie Berman,

PhD candidate,

Centre of Development Studies,

The University of Cambridge,

Mob: +44(0)7422972472

e-mail: cmb226@cam.ac.uk

Appendix 3 - PRELIMINARY QUESTIONS

Title of the project: The Caspian caviar narrative – an investigation of post-Soviet environmental governance and understandings of sustainability

Name of Researcher: Callie Berman

1. What kind of technologies do you use or are you trying to develop to make your fish farm more successful?

2. What do you personally remember about caviar when you were younger and growing up? Was it something that you remember having often? Was it more important during certain times than others? Do you remember any times people discussed sturgeon fishing in the Caspian?

3. Do you collaborate with any other aquafarms in the Caspian region, either in Kazakhstan or with other Caspian states? If so, do you work together for scientific research purposes, infrastructure technologies?

4. Are you working with universities in Kazakhstan to have more young people trained in aquaculture management? Are most of the people working at your farm educated in Kazakhstan or abroad? What kind of training do they receive about ecology?

5. In your opinion, how has the management of the Caspian changed from the Soviet era to today? Is there a difference of how is the concept of ecology/environmental management is discussed today from Soviet times?

6. How does your work relate to larger state biodiversity conservation efforts? If at all, how does your work relate to Kazakhstan's addressing the UN Sustainable Development Goals (SDGs)?

7. Are you working with local population at all in terms of education or spreading awareness?

8. How do you develop your brand and logo? What are the ideas that you want to tourists to understand when they visit the fish farm? Is there any kind of spiritual or aesthetic ideas of the Caspian or sturgeon that you are trying to promote? Are you trying to market yourself by using historic elements like the 'blue tin' Caspian caviar or are you trying to establish yourself as something new?

9. What kind of contributions do you make to restocking the Caspian/biodiversity conservation in the Caspian? When do you release sturgeon fingerlings and what is your survival success rate? What sort of state ministries and/or regional organizations do you work with (i.e. Ministry of Tourism, Ministry of Agriculture, Ministry of Environment?)

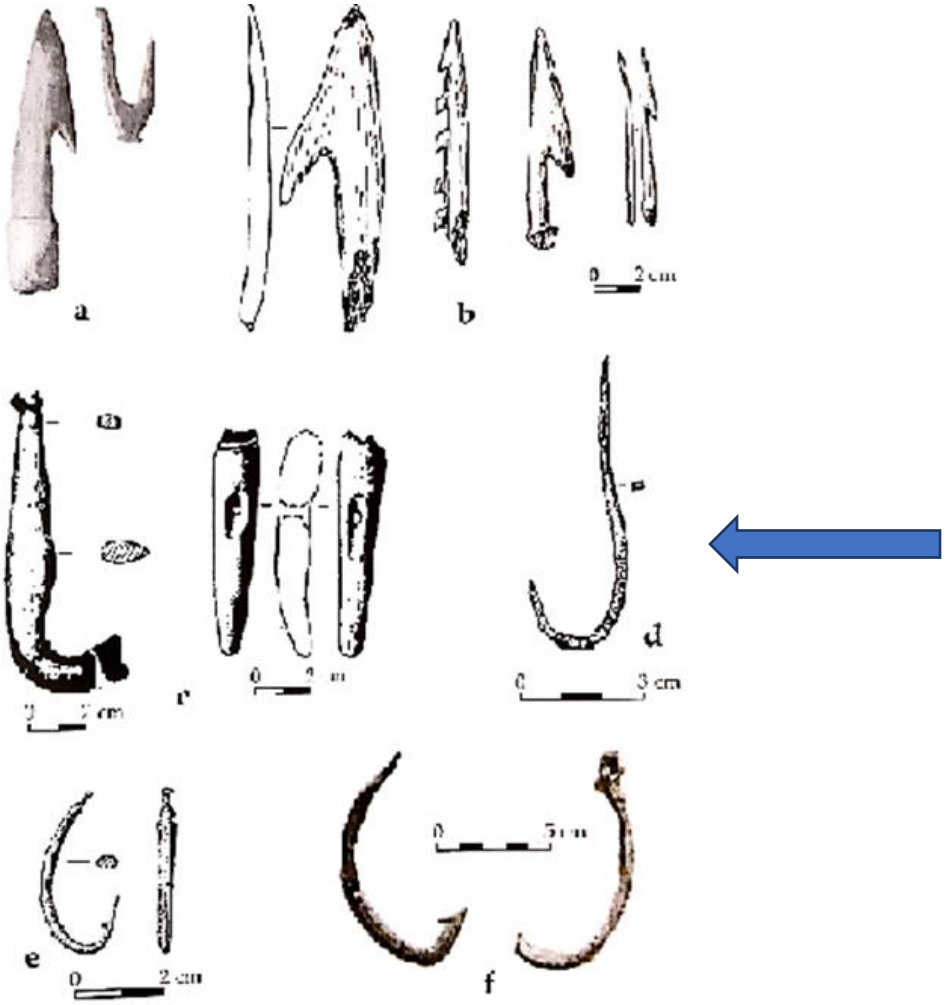
10. Do you currently or have your previously collaborated with any international organizations for your activities, either for skills training?

11. How does tourism fit into the development of the hatchery, in terms of spreading awareness of sturgeon breeding?

THANK YOU VERY MUCH FOR PARTICIPATION!

Appendix 4

Horse bridle component later confirmed to be a fishing hook instead (O'Connell T.C., et al., 2003).



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