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INDIVIDUAL DECISION-MAKING AND COOPERATION IN FRESHWATER FISHERIES MANAGEMENT AT THE SOMME RIVER, NORTHERN FRANCE

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ABSTRACT

Are altruistic individuals more likely to cooperate when exploiting common resources? This research study asks whether or not rates of human altruistic behaviour expressed by individual recreational fishers in interpersonal contexts at the Somme River, Amiens mirror those rates of altruism expressed in collective contexts concerning local fisheries resources. In a natural resources context, altruism manifests as a willingness by fishers to incur personal cost for common-pool resource benefit. Accordingly, it is understood that altruistic behaviour reflected collectively expresses itself as cooperation. The research study takes place in Northern France with the stated objectives to: 1) observe individual fishers' altruistic propensities in interpersonal contexts involving other fishers, 2) observe individual rates of altruistic behaviour in collective contexts involving common fisheries resources and compare with those expressed interpersonally, and 3) investigate whether or not a local (informal) management system existed in the town of Amiens to better understand if informal tenure of water space influences altruistic behaviour or not.

The research design consists of two components, one quantitative and one qualitative. The former employs two economic games; a Dictators Games (DG) and a Public Good Game (PGG) in service of the first and second research objectives, and the latter employs cognitive mapping and free-listing exercises in service of the third. Here economic games stand as proxies for real-world situations involving individual (DG) and collective (PGG) decision-making whereas the exercises seek to uncover local ecological knowledge (LEK). The results found that while individual recreational fishers demonstrated lower rates of interpersonal altruism overall, in a collective setting involving local fisheries resources the rate was higher, implying a greater willingness to incur personal cost. Ecological knowledge was high among experienced fishers, yet no knowledge pertaining to parallel management and or informal rules of exclusion or resource subtraction were observed, suggesting an informal management system did not exist. The study additionally documents freshwater biodiversity, providing an index of fish species present in the river collected from the free-listing exercises, categorized into native and non-native as the latter can negatively affect trophic systems and ecosystem processes.

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Abbreviations Defined

AAPPMA	Associations Agréée pour la Pêche et la Protection du Milieu Aquatique
BAR Scale	Basins at Risk Scale
CBM	Community-Based Management
CMT	Communal Marine Tenure
CPR's	Common-Pool Resources
DG	Dictators Game
DRFIP	Direction Régionale des Finances Publiques
EE	Experimental Economics
EU	European Union
EU WFD	European Union Water Framework Directive
GT	Game Theory
IKS	Indigenous Knowledge Systems
IUCN	International Union for Conservation of Nature
LEK	Local Ecological Knowledge
MI	Methodological Individualism
PGG	Public Good Game
UN SDG's	United Nations Sustainable Development Goals
WEIRD	Western, Educated, Industrialized, Rich, Democratic

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Chapter 1: Introduction

Freshwater fish stand among the most threatened vertebrates worldwide due to overexploitation and mismanagement, factors that foster negative and sometimes fatal effects to aquatic ecosystems (Jackson et al., 2001; Allan et al., 2005; Arlinghaus et al., 2015). The French Republic, like most of the world, has also seen declines and extinctions of its freshwater fish primarily due to changes in land use as affected by physical, economic and demographic factors (Bayramoglu et al., 2019). Organic contaminants from municipal and industrial wastewaters (Nets et al., 2014), agricultural activities and pollution (Bayramoglu et al., 2019), and the introduction of non-native flora and fauna (Arlinghaus et al., 2015) have all contributed to habitat changes causing a reduction of freshwater biodiversity in the nation. Endemic diseases stemming from similar changes also present a growing concern worldwide as well as in France (Okamura and Feist, 2011). As evidence, the International Union for Conservation of Nature's (IUCN) Red List currently indicates that 15 of 69 freshwater fish in France are threatened, four are critically endangered, and two have become extinct at the metropolitan level (Bayramoglu et al., 2019). Resulting, the European Union (EU) and its member states currently seek solutions and strategies geared towards better conservation of freshwater ecosystems.

Fishing activities, from a management perspective, can be divided into many distinct but related categories. My study focuses uniquely on recreational fishing and governance, to ask if individual rates of cooperation expressed through altruistic behaviour in interpersonal contexts mirror rates expressed in collective contexts related to recreational fisheries resource exploitation (Lesorogol, 2007; Dorian and Vallois, 2017). Altruistic propensities, these are proclivities to make decisions at cost to oneself for the benefit of another are here considered proxies for cooperation and by extension adherence to management rules pertaining to fisheries integrity. I focus my attention on recreational (or leisurely) anglers at the Somme River, located in the Northern French region of Hautes-de-France because of a desire to see how anthropological insights may be applied in industrialized contexts. Recreational fishing, in contrast to its commercial counterpart remains understudied as a result of logistical difficulties involved when conducting such research (Font and Lloret, 2014). However, what is clear from the available literature is that recreational fishing also contributes to ecosystem degradation despite a tendency by academics and laymen alike to attribute degradation solely to commercial fishing (Font and Lloret, 2014). Poor fishing practices

withstanding, individual fishers' propensity to comply (or not) with management rules directly affects degradation (Lee, 1972; Summerville et al., 2010). In my study I make use of both quantitative and qualitative methods to investigate aspects of recreational fishing pertaining to management and LEK.

First, I rely on a dictator′s game (DG) to observe the rates of individual altruism expressed by participants in interpersonal settings (two unfamiliar players who are both Somme fishers) using surveys that present a hypothetical scenario prompting a choice to act either altruistically, or not (Lesorogol, 2007). I then rely on a public good game (PGG) framed around the Somme's ecological health and employed amongst the same participant sample to examine whether or not similar rates of altruism (or lack of) are present within a collective context (Dorian and Vallois, 2017). Fisheries governance and management presents in multiple forms, namely: centralized and decentralized, as well as formal and informal (Ruddle et al., 1992; Cinner, 2005; Acheson, 2006 among others). Following, I seek further to understand the nature of recreational fisheries governance in Amiens. Is the present management system formal, referring to one mandated by the state or informal, referring to one independent of the state (Acheson, 1975; Font and Lloret, 2014)? If an informal management system is in place, does this system operate parallel to a formal counterpart or is it the exclusive system in operation? Consequently, is the management system or systems present centralized or decentralized, assuming a gradient? Here I rely on cognitive-mapping and free-listing exercises amongst experienced fishers with deeper knowledge of both local ecology and governance in Amiens and the Somme to investigate (Bernard, 2006).

I further wanted to understand how Amiens' management system had developed historically. Here I used *in situ* observations, where I could given covid restrictions, as well as historical research to provide ethnographic context (Aswani, 2020). Just how unique was Amiens' management if at all? While differences in context between agrarian and industrial societies exist, some management strategies appear broadly uniform cross-culturally (Basurto and Ostrom, 2008; Aswani, 2020). Differences also exist between subsistence and recreational fishing, namely whether or not the activity fulfills important nutritional requirements or not (Font and Lloret, 2014). In addition to tenure relations limited to four kinds alone (private, common, state, open access), one also finds the exclusion of outgroups, punishment of free-riders and interlopers, and provisions for in-group subtraction rights present in all management systems spanning the research literature irrespective

of context. Some play exists, and the aforementioned examples exist on a spectrum however, broadly recognizable similarities can be observed likely due to physical and economic constraints or laws in addition to broad similarities in human behaviour (McGrath et al., 1992; Acheson, 2006, Aswani, 1998; Campos-Silva and Peres, 2016 among others).

As such, I consulted the research literature on fisheries resource management strategies across the cultural spectrum with examples from Southern Africa, Latin America, Southeast Asia, and Oceania for a wide set of systems. I then assessed all of the examples for their similarities and differences, looking for broadly universal patterns that could be reflected in theory. Although the contexts are radically different for historical and cultural reasons, comparison of each unique management approach helped me better understand why France′s system had developed as it had. The literature itself suggested that a tight relationship exists in human-environment systems between action, be it individual or group, and the integrity of a local ecological system (Brook and McLachlan, 2008; Aswani et al., 2013; Beller et al., 2018). This value-action relationship depends on value judgements, and is central to understanding my objectives in relation to resource use (von Mises, 1998). Individual decision-making, a product of human action, is contingent on subjective value judgments including ones propensity or aversion towards cooperation (Miller, 1978; von Mises, 1998).

The literature also posits that common-pool resources (CPR's) are best conceptualized as fictions of untapped potential actualized into 'real' (actuality) resources by human action, a transformation that occurs within the boundaries of a tenure system (Basurto and Ostrom, 2008; Vaccaro and Beltran, 2019). Resources only become such when human action interferes. CPR's are further costly to exclude from subtraction (Lee, 1972), and the system of tenure that arises within a society is a cultural phenomenon emerging from a given societies historical progression and means of managing the subtraction and consumption of the available natural resources (Aswani and Hamilton, 2004). Henrich (2020), shows empirically that differing cultural milieu have an effect on the modes of action both individuals and groups engage in, and as it turns out culture shapes perception and value in the most profound sense. Bridging the gap between the value-action problem has occupied both anthropological and economic theory for decades and, from a management standpoint holds tangible impact on managing resource exploitation going forward (Graeber, 2005; Sommerville et al., 2010). As for France, the nation adheres to public and state

tenure relations (Bayramoglu et al., 2019). The literature had hinted that private property required unique attention, particularly given its now global ubiquity and the unique challenges posed to conservation (Kamal et al., 2015; Calvo-Medieta et al., 2017). This aspect turned out pertinent in the French context which adheres to a particular management strategy on private and public property alike called common patrimony (Calvo-Medieta et al., 2017).

Chapter 2: Theoretical Context

Experimental Economics and Game Theory

Experimental Economics (EE) is the application of experimental methods to the study of economic questions (Roth, 1995). EE has been used in various fields of the social sciences, including anthropology (Henrich et al., 2004; Lesorogol, 2007; Aswani et al., 2013) where experiments are designed to suit a wide breadth of topics ranging from decision-making and markets to games, among others. EE attempts to analyze emic perceptions of fairness, cooperation and modes of reasoning and their behavioural consequences. In anthropological research, fieldwork is conducted, data collected, and knowledge documented to test the validity of certain aspects of experimental economic theory (Croson, 2005). Questions related to decision-making and games such as the present study typically refer to game theory (GT). GT helps model strategic interactions among decision-makers in situations with set rules and outcomes providing behavioural insights (Parker, 1984). Different strategies result in different outcomes, therefore in iterated multiplayer social interactions individuals must coordinate themselves off partial knowledge pertaining to the potential decisions to be made by others, as well as shifts in their physical and social environments. EE allows researchers to design research experiments informed by GT as a proxies aimed at understanding and analyzing decision-making within populations and the influence of independent variables (age, gender, education, occupation among others) on the decision-making process.

Anthropological research of multiplayer games and resource exploitation has tended to focus on cooperative and non-cooperative games (Henrich et al., 2004; Lesorogol, 2007; Aswani et al., 2013). These games seek to better understand cooperative and non-cooperative behaviour, particularly as played out in decision-making. Two relevant examples for this study's purposes are the Dictator's Game (DG) and the Public Good Game (PGG). With DG's, players are paired with one assigned the role of 'dictator'. This player is given power of choice, alone deciding if and how to split an endowment with the other (Lesorogol, 2007). The key concept in DG's is altruism, the willingness to incur personal costs for the benefit of another (Barr, 2003). Interestingly, DG research findings continue to undermine economic assumptions of narrow self-interest in traditional theory by providing evidence for the role of altruism, fairness, and norms in decision-making (Lesorogol, 2007). On the other hand, with PGG's, players are equal. Players are paired

and individually given an endowment to be doubled at the end of the game (Dorian and Vallois, 2017).

The players are then given the choice to either contribute tokens to a public investment yielding collective gains or a private investment yielding individual gains (Dorian and Vallois, 2017). Here the dichotomy in decision-making between personal cost and external benefit appears different only in that a PGG concerns itself with matters of the collective whereas a DG those of the individual. From the standpoint of traditional economic theory, the total payoff is maximized when all players contribute all of their tokens to the public investment. The Nash equilibrium, that is the strategy chosen by a rational agent seeking to maximize individual returns and expecting that other players will not change their chosen strategies is a contribution of zero 0 (Dorian and Vallois, 2017). Additionally, players who contribute below average or not at all are understood as defectors while those that contribute at average or above are considered cooperative (expressed though altruism). In practice however, the Nash equilibrium is rarely seen (Kurzban and Houser, 2005; Henrich, 2020). Much like DG findings, PGG findings too undermine narrow self-interest as a theoretical concept as players evaluate the utility of cooperation based off social and environmental factors that influence their decision-making during the game (Anderies et al., 2011). The use of EE in anthropology has thus been assessed for both useful and questionable contribution.

Criticisms of EE have generally expressed concern relating to the assumption of the 'selfish rational agent' which underpins much of economic theory (Henrich et al., 2004; Chibnik, 2005; Croson, 2005 among others). Historically, economic experiments have emphasized the notion of 'Homo economicus', a portrayal of individuals as consistent agents using purely rational assessments to maximize utility (Soren, 2004; Croson, 2005, Graeber, 2005). Henrich et al., (2004) in their cross-cultural behavioural studies of 15 small-scale societies found that the canonical model of self-interest failed in those contexts. Instead, what was discovered was that the greater the degree of market integration and payoffs of cooperation in everyday life, the greater was prosociality expressed in experimental games (Henrich et al., 2004). Further their research found greater behavioural variation than was present in the research literature particularly as it related to analytic reasoning, fairness and cooperation. The discrepancy is explained by the selection bias of almost all prior research, where 96 % of research participants were usually students from Western, industrialized societies (Henrich, 2020). People of this cultural background only account for about

12 % of the global population, a culture which produces in many respects psychological outliers bringing into question the universality of the researchers' findings (Henrich, 2020).

Research participants from Western, Educated, Industrialized, Rich and Democratic or WEIRD societies are argued to exhibit fairly radical behavioural differences to those from small-scale societies, these differences having large effects on individual decision-making and cooperation (Henrich, 2020). The literature not only suggested Western participants on average exhibit greater prosocial behaviour, the addition of interpersonal punishment to game design positively affected cooperation as opposed to small-scale populations where on average no effect was observed (Henrich, 2020). Further, concepts of self among Western populations exhibited greater independence and more positive self-views, personal choice and motivations to conform (Henrich, 2020). Lastly, Western populations showed a greater propensity for analytical thinking, whereas small-scale societies displayed more holistic thinking (Henrich, 2020). Given that the present research study was conducted amongst Western peoples' these specific problems do not apply given the population emerged from the same WEIRD cultural milieu and are thus favoured by the historical research bias. Regardless, a treatise of the issue is appropriate for theoretical clarity. Criticisms of Henrich's work generally accept the points made regarding participant selection bias in behavioural research but express other varying concerns discussed below.

First is the lumping of 'small-scale' societies as though they themselves are homogenous (Asuti and Bloch, 2010). These authors further argue that comparative research can do away with the distinction between Western and non-Western with proper research design aided by ethnographic context. Second, some reviewers argue that the issue lies not in the depth of psychological differences but rather the interpretation of phenomena (Baurnard and Sperber, 2010; Danks and Rose, 2010). Uniformity among human populations is argued to be present in learning processes and some mental contents, Gaertner et al., (2010) thus ague that Henrich's work overlooks underlying genotypes and fails to detect these universal processes. Lastly Rochat (2010), argues that the issue is rather one of sampling and measuring instrument validity when assessing claims of universality. Of recent, researchers and theoretic literature are suggesting that 'rationality' is bounded by uncertainty and that cultural heuristics greatly aid the navigation of this uncertainty and choice (Brocas et al., 2014; Taleb, 2014; Henrich, 2020). Chibnik, (2005) in his review of Henrich et al., (2004) argues that such findings are consistent with the theories of economic

anthropology of which EE oriented anthropologists have traditionally paid little attention, arguing further that the evolutionary psychological foundation of much of this research does not help in the understanding of its findings. Henrich has also been critiqued for ignoring imperial histories and structural prejudices, however those criticisms pertain to his claims about wealth creation and accumulation in Western societies, whereas the present study is interested only in behaviour.

Decision-making (human choice) cannot be studied without understanding value and action. Decisions entail preferences. Preference is not necessarily what one wants to do, but rather what he or she chooses to do (for whatever reason) given available options (von Mises, 1998). What is the relationship between values and action? A contentious academic debate, there is no clear answer. However, the cognitive sciences offer arguably the most developed theories: perception and action are processes dependent on matching sensory inputs with expectations and predictions (Clark, 2013). Far from a blank slate, the human mind appears to be an amalgam of species-specific cognitive structures that give us our peculiarities, chief among them symbolic expression, language, and elaborate culture (Levi-Strauss, 1963; Hoffmeyer, 1993; Clark, 2013; Henrich, 2020). According to Clark (2013), individuals treat desired goals (what they value) as inferences to find actions towards attainment of a state closer to those goals. Further still, Clark argues that perceptual processes exhibit similarities to motor action processes, in this way a valued goal maps on physiologically literally generating motor commands (2013). Individuals make choices based off subject value judgments which augment real-world action. The deep link between value and action are active inferences where agents move their sensory faculties to generate sensory consequence (Clark, 2013).

Clark refers to this as the hierarchical generative model, arguing that the model is set up to minimize prediction error given inherent uncertainty and human fallibility (2013). It is my contention that the value-action problem as explored in anthropology and economics alike corresponds with Clark's thesis. Human action and choice concern the bringing about of a state desirable to that of the present, what is preferable being individually discerned through subjective valuations (von Mises, 1998). The proposition is functional, not moral. What factors into human valuation is socioeconomically, politically, culturally and biologically influenced, among others and difficult to formalize (Graeber, 2005). Theories of value have however been attempted by economic anthropologists. My study follows the observation that value is symbolic, denoting

meaningful differences that animate individual and group preferences (Graeber, 2005). Speaking deductively, within a social system a value system arises from the hierarchical ranking and ordering of different value concepts ranging from most desired to least (von Mises, 1998; Graeber, 2005). This process eventually leads to goal-oriented action. Action can therefore be understood as sequential strategies by which individuals and communities, that is physical or imagined groups who share interests in common (Gudeman, 2005) achieve valued goals. The method of praxeology as elaborated by the Austrian school of Economics tackles the value action problem from an *a priori* assumption of human action, serving anthropological research well.

Praxeology advances a subjective theory of value where it is neither the inherent property, amount, nor labour that gives something its value but rather the importance placed by an individual on that thing to meet his or her desired ends (von Mises, 1998). An actor based approach such as this explains behaviours that diverge from those expected given enculturation where people perhaps sway around norms (von Mises, 1998). These behaviours are inevitable given individual variation. Purposive (goal directed) action concerns employing a means-ends rationality between different value concepts, thus making 'rationality' in GT terms the adoption of strategic choices given uncertainty, towards the achievement of fuzzy or specified goals (Parker, 1984; von Mises, 1998). Praxeology is however loath to specify what it is that is specifically valued due to the subjective nature of the formulation that occurs consciously, subconsciously and unconsciously. According to von Mises' (1998) elaboration of the method, understanding people's value judgements can only be done historically. This is consistent with a proximate level of analysis, that is, socioculturally. However, from an ultimate level of analysis, that is biological predispositions and drives, more rigor is conceivable (Linsbichler, 2019). Valuation is further complexified when considering there is often interplay between the proximate and ultimate levels of causation (Friedman and Singh, 2004). Therefore, sometimes 'irrational' economic choices are perfectly rational within the context of those making them, the inverse also holding (Croson, 2005).

The second problem with EE in anthropology is the growing replication crisis psychology and economics have been experiencing, disciplines whose theoretical assumptions underpin the approach (Henrich et al., 2004; Croson, 2005; Dorian and Vallois, 2017). Replication is the repeatability of a test with the expectation that like conditions will produce like results. Estimates vary, so too do bibliometric (use of statistical methods to analyze publications) methodologies,

albeit one study in the journal *Science* found a replication rate of 61,11 % in EE (Camerer et al., 2016) and another 38 % in experimental psychology (Dorian and Vallois, 2017). Unlike the previous discussion on discrepancies in behavioural research cross-culturally, these studies tended to focus on WEIRD participants effectively controlling for extreme cultural variability and still showed issues of rigor. While not be taken at face value due to methodological blind spots, these studies do allude to a broader problem found within these disciplines (Dorian and Vallois, 2017). Troubling as this is, the PGG literature has shown greater rigor in baseline replication, that is, control results in control conditions compared across studies, as well as replication overall (Dorian and Vallois, 2017). Further, the PGG as a subfield is relatively well homogenous and easier to replicate benefiting this research study (Dorian and Vallois, 2017).

The third problem bases on criticisms of methodological individualism (MI), argued to be the theoretical basis of experimental economic approaches. Like systems theorists, critics of MI observe that social forces play a role in molding 'individual' decision-making (Miller, 1978; Aswani, 1998). Akin to the Aristotelian dictum 'man is a political animal', critics argue that individual action does not occur in a vacuum and that external social pressures paired with power differentials often limit individual choice. Accordingly, MI's detractors view the social 'whole' as more than the sum of its parts (Miller, 1978). MI has additionally been criticized from a psychological perspective, critics observing that interpersonal dynamics often play a role in individuals' overall sense of self, filtering decision-making (Miller, 1978). Following, it is argued that the individual is not only an 'I' encased within his or her own head, instead his or her individual life is bound to broader social dynamics and strictures. The above-mentioned points are salient; however in this paper I remain committed to MI. In von Mises' (1998) words, every 'we' is uttered by an 'I', therefore, while it is true that social forces play a role in individual decision-making, the individual agent cannot be erased from the process because individuals alone have aims and interests (Clark, 2013). Social 'interests' themselves arise from competing individual interest, they do not occur independently. Organizational interests are emergent from the individual domain. What we call 'society' is composed of individual actors at the institutional level engaged in a tug-of-war making decisions we as members of those societies attribute to juristic persons (the institutions) as opposed to natural persons (individuals) (Miller, 1978; Popper, 1978; von Mises, 1998).

Following the Austrian school of Economics, there are also issues with framing MI as central to economic theory. Instead, it may be more useful to view MI as commensurate with historical analysis aiming to explain the rise of social phenomena as products of human (individual) action (Hülsmann, 2006). Economic theory must necessarily propose time-invariant relationships between cause and effect. To illustrate, take the theoretical assertion: when persons x divide their labour amongst themselves, their work is more physically productive than if these same persons produce the same products in isolation. Or, under indirect exchange the division of labour is greater than under direct exchange. Both assertions make no reference to MI, their theoretical power derives instead from what are referred to as economic laws (Hülsmann, 2006). My study does not require MI in its investigation of altruism and cooperation under game theoretic conditions given the existence of these behaviours are also time-invariant. Instead, MI's utility comes when attempting to explain the link between human behaviour and economic laws as signaled by choice, and the concurrent social effects (von Mises, 1998; Hülsmann, 2006). As such, the study takes it as a given that social phenomena (including social institutions) are byproducts of individual action, contingent upon an aggregate of individuals' subjective value judgments through space and time (von Mises, 1998; Hülsmann, 2006).

Driving the point home theoretically, Karl Popper's (1978) three-worlds model observes that social institutions are better conceived as collections of minds informed by traditions and norms (constraints, along with individuals' inclinations). James Acheson (2006), elsewhere cited in this chapter makes a similar point recognizing that institutions are better characterized as units of information upon which persons interact to meet their individual needs given a deficit of knowledge and ability. These points mirror Malinowskian arguments that acknowledge agents' manipulation of institutions to meet desired ends. In this way, individuals in a social setting are only ever interacting with other individuals or collections of individuals. Society as a 'whole' is always the product of individual interactions, be they strong or week. The individual is necessary, there can be no society without the individual and his or her actions. Therefore, while society's role may be better conceived as constraining possibilities whether it be through traditions, norms, or physical constraints etc. it is within those boundary constraints that individual agency manifests. From a human ecological perspective Aswani (1998), warns that systems or holistic approaches are more conducive to the study of major biotic and abiotic components on which ecological and social systems function depends. Failure to recognize these distinctions have meant systems

theorists have tended to ignore the daily behaviours of actors, resulting in impoverished behavioural analyses (Aswani, 1998). Lastly, theories of behaviour must concord with observations recorded in the conservation literature if this thesis is to be successful.

Social Science and Conservation

Social scientific research plays a prominent role in conservation (Ruddle et al., 1992; Aswani and Hamilton, 2004; Calvo-Medieta et al., 2017 among others). Accordingly, it is understood that human action affects the physical environment by changing process interactions, feedbacks and control mechanisms within the totality of human-environment systems (Aswani et al., 2007; Wu, 2008; Beller et al., 2018 among others). Ecosystem processes develop through the interaction of biotic and abiotic components, regulating the flux of matter and energy, sustained by organisms and their unique life histories (Masson-Delmotte et al., 2018). Healthy ecosystems provide important ecosystem and cultural services, environmental provisions that ensure human health and well-being including clean air, temperature regulation, and food production in the former and landscape aesthetics, cultural heritage, recreation, and tourism in the latter among others (Daniel et al., 2012). For humanity's continued flourishing, ecosystems integrity must be a priority. With that said, 'integrity' as an ecological concept up to this point has been understood with reference to another, resilience (Holling, 1973; Folke et al., Dornelles et al., 2020). However, some fairly recent developments in ecology may change how these terms are conceptualized and is discussed.

The present paradigm in ecological management is one of 'resilience' (Beller et al., 2018). Resilience refers to the persistence of a structure in the presence of stressors, essentially retaining the same functions, identity and feedbacks in post-perturbation as it did pre-perturbation (Beller et al., 2018). Integrity as the ability of an ecosystem to maintain structure and function has hitherto been understood in this light. Equihua et al., (2020) using information theory propose a shift, arguing that 'resilient' ecosystems are more susceptible to entropy exhibiting little to no change in what is called Fisher information after perturbing events, rendering them less adaptive to shocks and stressors. Fisher information is a mathematical function of information retention negatively correlated with variability (Karunanithi et al., 2008; Konig et al., 2019; Equihua et al., 2020). From this premise the authors introduce the concept of 'antifragility' to ecology as a paradigm shift (Taleb, 2012; Equihua et al., 2020), arguing that an antifragile system is preferable to a resilient one in that the former shows incremental gain in Fisher information when perturbed thus self-

organizing, positively adapting and coping with adversity and uncertainty whereas the latter merely returns to pre-perturbation levels. Given the novelty of the paper criticisms and rebuttals are as yet scarce however there has been discussion in the ecological literature about the nature of information systems (MacArthur, 1955; May, 1973; Ulanowicz, 2002 among others).

Karunanithi et al., (2008) discuss Fisher information in the context of ecological regime shifts or changes. Regime shifts are long-term system reorganizations, these systems ranging from socioeconomic to environmental and or ecological ones (Karunanithi et al., 2008). Systems are characterized from an information point of view by dynamic order and may shift in response to internal and or external pressures (Karunanithi et al., 2008). During transitional phases between broadly recognizable regimes there is typically a loss of information, information understood as a resolution to uncertainty (Karunanithi et al., 2008; Konig et al., 2019). It is from this premise that Equihua et al., (2020) argue for antifragility, stating that net information loss and or stagnation is less desirable to net information gain. Therefore, 'sustainability' from this perspective would entail the finding and maintaining of an adaptive ecosystem regime suitable for the socioeconomic and physical environments alike (Karunanithi et al., 2008). Karunanithi et al. (2008), develop a form of Fisher information that could potentially measure dynamic order in complex systems having themselves applied the model to marine ecological regime changes. As it relates to the health of human-environment systems, 'information ecology' is a relatively new and promising interdisciplinary field uniting biosystems function and integrity with human communities, and their physical, psychological and social well-being (Eryomin, 2000).

A steady stream of research over the last two decades has expanded on the link between ecosystems integrity and human health. Lee and Maheswaran (2011), for example reviewed the available literature a decade ago concerning urban green spaces and human physiological and psychological health. Their work found a weak direct correlation between the two attributed to weak research design and difficulties in measurement. Nevertheless, the available evidence did suggest a positive association between green spaces and health (Lee and Maheswaran, 2011). Dadvand et al., (2015) more recently for example have found a positive association between exposure to green spaces and cognitive development in children, mediated by air pollution whereas van den Berg et al., (2016) have found that green space exposure is associated with mental health and vitality. Food production, leisurely activity and temperature regulation among others, all crucial for human

societies depend on ecosystems functioning as well (Debbage and Shepherd, 2015; Cooke et al., 2017; Kuehn, 2018). Therefore, owing the economic, environmental and potential health implications it is fair to consider unsustainable human-ecosystems relations as risks to human well-being. Land use patterns and changing landscapes are basic to most human-environmental interaction, providing a starting point for potential solutions.

Land use concerns the management and modification of the natural environment to meet needs. Affected by physical, socioeconomic and demographic factors, land use systems can and do impact the biosphere by changing global carbon cycles, since 1850 roughly 35% of anthropogenic CO2 emissions have resulted directly from land use for example; changing land-cover resulting in changes to regional climate by interfering with surface energy and water balance; transforming hydrologic cycles; anthropogenic nutrient inputs; and loss, modification and fragmentation of habitats leading to declines in biodiversity among others (Reynolds, 2010; Foley et al., 2005). Land use directly affects coastal and freshwater fisheries too. Irrigation, intensive agriculture, and urbanization are three human processes that degrade water quality and affect freshwater supplies through water withdrawals and diversions (Foley et al., 2005; Bayramoglu et al., 2019). Fisheries biodiversity loss in particular has largely been affected by degradation of soil and water, overexploitation of native species and the introduction of invasive flora and fauna (Foley et al., 2005; Bayramoglu et al., 2019). To better understand the relationship between environmental degradation and resource use and governance, examining property systems and tenure provides a better understanding of local land use strategies and patterns as tenure systems often arise as a means of countering over exploitation (Lee, 1972).

Anthropology and Tenure

'Tenure' are the conditions under which property, in this case land, marine waters, and freshwaters are utilized (Hardin, 1968; Basurto and Ostrom, 2009). As an independent, comparative discipline focused on socio-cultural variability (Levi-Strauss, 1963; Deacon, 2003; Aswani, 2020), anthropology and anthropologists have noted that different societies often have differing tenure organizations at the basis of their socioeconomic and environmental activity (Lee, 1972; Henrich et al., 2004; Hann, 2005 among others). Later interdisciplinary work mostly from economics and political science has attempted to elucidate the relationship between tenure, resource management and ecological consumption offering a clearer theoretical framework applicable to study human-

environment systems broadly (Hardin, 1968; Colloredo-Mansfeld, 2005; Basurto and Ostrom, 2009; Vaccaro and Beltran, 2019). Beginning, the framework suggests that it is best to understand 'tenure' as the result of historical socio-ecological antecedents rather than a disjointed, isolated system (Hann, 2005). In France like other Western societies for example, a general philosophy based on 'possessive individualism' influenced the development of specific tenure relations leading to private property (Hann, 2005).

For early researchers however, this notion entangled property with uniquely Western economic organization making research in non-Western societies nearly impossible (Hann, 2005). Early anthropologists documented greater variability in how property was conceptualized amongst societies where different socioeconomic organizations were studied (Hann, 2005). This discovery required further development of property as an analytical tool. The observation of tenure's variability strongly suggested the existence of what has been dubbed the 'cultural-ideological' layer of socioeconomic organization, where the system of tenure present is as much a cultural vestige as the social institutions that preserve it (Hann, 2005; Vaccaro and Beltran, 2019; Henrich, 2020). Later research and theory additionally recognized a 'legal-political' layer referring to regulations of objects that can be owned and the nature of that ownership including whether or not these objects were susceptible to alienation, for example, and the 'social relations' layer referring to the particulars of inheritance, for example, and potential ties of property with kinship and the distribution of resources, or common patrimony in France's case (Hann, 2005; Calvo-Medieta et al., 2017).

Refinement of these conceptual tools made cross-cultural investigations of property and its differing regimes possible. Interest in the management of CPR's however requires an understanding of consumption. Consumption presents in different forms from conspicuous consumption where in some societies prestige is displayed and gained through expenditure rather than saving, to categorical consumption where, for example, food taboos are argued to preserve the human need for clarity of cultural categories (Colloredo-Mansfeld, 2005). Ecological consumption, approaching the emergence of consumption patterns as regulatory strategies between people and their local ecosystems ensuring continued ecosystem and cultural service provision serves this study well (Colloredo-Mansfeld, 2005; Daniel et al., 2012). Ecological consumptions' theoretical assumptions are derived from systems theory where feedback loops are

argued to develop between the infrastructural, structural, and superstructural strata of a society to safeguard against systems degradation. This cultural ecological approach has been rightly criticized by symbolic anthropologists as overly functional and reductionist due to its assumption that every aspect of a society develops in unilinear fashion as a response to the surrounding material conditions (Colloredo-Mansfeld, 2005).

Four property regimes appear universal in the research literature: private property, common property, state property and open access regimes (Basurto and Ostrom, 2009). Hardin's (1968), seminal paper 'The Tragedy of the Commons' shows the relationship between tenure and resource management, a model later developed by Elinor Ostrom, among others, who showed, that common property regimes differed from open access regimes (Basurto and Ostrom, 2009). The research literature focusing on common property and open access regimes in non-Western societies ranges from descriptive to explanatory (Berkes et al., 1989; Hulme and Murphree; 1999; Aswani and Hamilton, 2004; Henrich et al., 2004 among others). The theoretical contribution of much of this research broadly has been to confirm some assumptions held by cultural ecologists in their systems thinking regarding the operation and stability (or not) of local human-environment relations. On the participatory end, this research has also introduced and developed the concept of Local Ecological Knowledge (LEK), part of broader Indigenous Knowledge Systems (IKS) which is knowledge that matures as an individual and or cultural skill base resulting from years of experience within a local environment including natural resource exploitation, as well as generational cultural transmission (Caniago and Siebert, 1998; Baird and Flaherty, 2005; Brook and McLachlan, 2008).

Common-pool resources are resources within tenure regimes that are subtractable and costly to exclude from consumption (Basurto and Ostrom, 2009; Vaccaro and Beltran, 2019). Tenure systems attempt to manage access to CPR's by regulating exclusivity, denoting those who can benefit from the consumption of CPR's and at what cost. Exclusivity is achieved in hunter-gatherer, agrarian, and industrial societies in two primary ways; guarding the exclusivity of membership to groups with consumption rights, and or controlling spatial boundaries (territory) as well as subtractability (Lee, 1972; Berkes et al., 1989; McGrath et al., 1993 among others). Common-pool resources can also be conceived of as 'fictions' of untapped potential actualized into real resources through human action, a transformation that occurs within the boundaries of a

stated tenure system (Basurto and Ostrom, 2008; Vaccaro and Beltran, 2019), true of all human societies as well. The value-action problem previously mentioned attempts to address the specifics of this phenomenon. Noteworthy, the complexity of dynamic systems is best displayed here through the multidirectional influences of tenure relations, culture, and ecological conditions, which appear to strongly impact the development of societies and their people.

Looking specifically at conservation on private property, it poses two challenges; its integration into conservation management is complicated by the nature of the social and economic interrelatedness of landownership generally, and the lack of a system for classifying conservation based on management objectives (Kamal et al., 2015). This is important as France adheres to public property. These challenges are partially why privatization as a broad-scale management strategy may not always be effective (Acheson, 2006). Biodiversity exhibits public good characteristics resulting in little incentive for conservation at the individual level where there are no perceived benefits (Basurto and Ostrom, 2008; Kamal et al., 2015). This has led to greater external intervention by governments and bodies through voluntary, involuntary and mixed methods (Kamal et al., 2015). These methods concern the degree of private participation permitted in the decision-making process, voluntary being where locals participate in decisions, involuntary where decision-making is deferred to a central authority, and mixed some mélange of both (Sommerville et al., 2010; Kamal et al., 2015).

Voluntary methods include formal and informal private reserves, conservation easements, incentive-based actions such as conservation contracts and programs, voluntary non-binding conservation activity, and conservation networks while involuntary include total acquisition and or compulsory displacement, and imposed restrictions and regulations (Kamal et al., 2015). The main challenge lies in defining the scope of both voluntary participation by landowners and involuntary action by external bodies. From a research perspective, conservation is dependent on planning and implementation, planning requiring ecological knowledge and understanding (Brook and McLachlan, 2008; Kamal et al., 2015). The utility of participatory approaches in research is the production of local ecological and coordination knowledge, allowing for better planning. Research that has approached conservation from a participatory perspective include Caniago and Siebert (1998), Aswani and Hamilton (2004), Baird and Flaherty (2005), Charnley et al. (2007), and Acheson and Gardner, (2010). These studies' findings suggest that communities having legal

or *de facto* control or access over ecosystem services but no incentive for their continued protection are less likely to cooperate towards resource-use and management. By the same token, informal or formal recognition can incentivize locals to manage their resources.

The IUCN Protected Area Categories is an internationally recognized global standard for defining and recording protected areas according to their management objectives (2012). Seven categories exist; strict nature reserves; wilderness areas; national parks; natural monument or features; habitat or species management area; protected land or seascapes; and protected areas with sustainable use of natural resources (IUCN, 2012). Thus far a private alternative does not exist, increasingly presenting a problem due to demographic and development pressures limiting available land for protected areas (Kamal et al., 2015). Kamal et al. (2015) propose a system for private lands regardless of conservation strategies based off a four-factor framework; conservation security; permanence of protection; property rights; and management purpose. The proposed classification system falls beyond the scope of the present research study but remains an important heuristic concerning future trends regardless of the challenges presented by, including but not limited to data collection, adoption into national strategies, and monitoring status (Kamal et al., 2015). These factors intersect in freshwater fisheries management and recreational fishing, and understanding the different forms of governance and the impacts on aquatic resource management is of key importance.

Aquatic Systems of Tenure: Some Case Studies

Starting with marine tenure, according to Aswani (2020), customary sea tenure systems are often context dependent, defining human-environment relations via customary right over seascapes. Territoriality often extends beyond the seascape into land boundaries all in service of regulating membership of individuals and groups permitted to subtract and consume fisheries resources as well as defining the geographic boundaries upon which such activities are permitted to occur (Aswani, 2020). The most intensive studies of communal marine tenure (CMT) have taken place in Oceania and Southeast Asia due to the survival of traditional tenure structures in those communities despite centuries of colonial and postcolonial intervention (Aswani, 2020). Cinner's (2005), work for example found that communities with the strongest CMT were located further from markets, had lower rates of migration, and had higher rates of dependence and consequent conflict over fishery resources. Access to marine resources in such systems is typically determined

by kinship-based institutions including social units ranging from individuals to clans and villages and differ in their complexity and organization (Cinner, 2005).

Exclusivity in CMT's is important, particularly among high dependence communities who make use of it as a means of increasing livelihood security (Cinner, 2005). Communities with exclusive CMT often use confiscation, intimidation and violence to enforce their ownership (Cinner, 2005). This well documented phenomenon has even been described in the case of lobster fishing in Maine, United States (an industrial society) by Acheson (1975), and later Berkes et al., (1989) of which James Acheson is a co-author over four decades ago where, while no license limit was placed by the government cultural limits existed where a hopeful fisher had to be accepted into the community by other fishers and could then only fish within that communities specific territory. Interloping was strictly forbidden. In the case of Maine, fisheries have remained relatively stable since 1941 (Berkes et al., 1989; Acheson, 2006; Acheson and Gardner, 2010) along with other CMT examples in the Pacific (Aswani and Hamilton, 2004) however, there rests no consensus on which kinds of management system configurations are the most effective for resource preservation (Acheson, 2006). Aswani (2020), argues that perhaps management institutions are resilient when they are flexible enough to allow for adaptive capacity and information flow across different levels of governance. Assuming once again that information is a resolution to uncertainty as suggested in information theory, such a position makes theoretical sense as a starting point (Eryomin, 2000; Karunanithi et al., 2008; Equihua et al., 2020).

Skepticism over the efficacy of CMT systems have been based historically on the notion that as globalization increased, exposure to market forces would cause CMT institutions to collapse into open-access regimes (Acheson; 2006; Cinner; 2006). It was argued that this collapse would cause rampant overexploitation; and that privatization offered the best model for management regimes (Acheson; 2006; Cinner; 2006). However, these trends do not necessarily appear to be the case as: CMT systems are the antithesis of common open access regimes (Ruddles et al., 1992), the exact impact of markets on CMT's remains unknown (Cinner, 2005), and for the reasons previously discussed on the challenges of conservation on private property (Kamal et al., 2015). These assumptions appear the product of academic theories of rationality discussed previously where users of common property resources are believed to be unhampered by social sanction and motivated by selfish rational choice (Ruddle et al., 1992). Acheson's position (2006), makes the

most sense in this regard: resource degradation in human societies is to a large degree institutional as individuals very rarely exist in isolation. Therefore, get the institutions and their governing rules right and the issues should ameliorate. Easier said than done indeed, however if his assumption is incorrect it becomes difficult to see what positive role the social sciences could play. A one size fits all approach is unfortunately too simplistic to assume with regards to fisheries resource management and, depending on the merits private, state and local-management approaches can prove useful (Berkes et al., 1989; Acheson, 2006).

While Ruddle et al., (1992) for example, argue that CMT systems are composed of people managing and negotiating access to valued marine resources, political ecological research in fishing has attempted to address asymmetries in decision-making capacity as products of power imbalances in governance and the possible negative effects therein (Sommerville et al., 2010; Robbins, 2012; Aswani, 2020). As previously mentioned, communities having legal or *de facto* control or access over ecosystem services but no incentive for their continued protection are less likely to cooperate towards resource-use and management (Baird and Flaherty, 2005; Charnley et al., 2007; Acheson and Gardner, 2010). Incentives can come in the form of both formal and informal recognition of tenure rights and Cinner (2005), anticipating Sommerville et al., (2010) observes and argues that in some cases long-standing tenure rights that are not been legally recognized by states can cause conflicts with neighbouring communities who refuse to acknowledge resource exclusivity as legal. Power imbalances are not in and of themselves detrimental, but rather the actions that those imbalances lead to (Robbins, 2012). Further, as it concerns privatization and state regulation, inability to assess local-management systems especially where they have been well established on their merits as well as flaws can and does lead to ineffective fisheries resource management.

According to Cinner's work (2005), population and settlement patterns did not demonstrate significant relationships with the presence of CMT systems. He does however state that his observation may be due to research design, specifically potential issues with the sample size. Regardless, many CMT systems are currently under pressure from efforts to commercialize local fisheries, tourism and development, and land-based activities such as logging and mining (Ruddle et al., 1992; Aswani, 2020). If these systems are preserving some level of sustainability, and it remains inconclusive as to what managerial system configuration is most affective, it may be

advisable to air on the side of causation before undermining them. Thus, Ruddle et al., (1992) take the position that a proper analysis of CMT systems must pay close attention to macro-level contexts and the broader dynamics that both aid and hamper local fisheries management. In this way, the authors take an approach similar to that of world-systems theorists. Acheson (2006), assesses the utility of CMT with reference to other management strategies and concludes that it depends on the specifics. It is on this basis that Aswani (2020) argues for interdisciplinarity in research into ecological history, ethnographies of human-aquatic interactions, aquatic territoriality and IKS, and adaptive systems to better understand biosocial and ecological interaction as this knowledge remains in short supply relative to how much needs to be known.

The most intensive community-based management systems (CBM, hereinafter referring exclusively to freshwater systems) in the research literature by contrast have come from Latin America (Cordell, 1975; McGrath et al., 1993; Campos-Silva and Peres, 2016 among others), more especially the Amazon. These studies often find exactly the same broad management strategies as those involving marine tenure. Unlike Oceania and Southeast Asia, this part of the world has been heavily influenced by colonial and postcolonial intervention resulting in a weakening of much of the traditional tenure systems once prevalent there (McGrath et al., 1993). Both formal and informal riparian (situated on a riverbank) reserves have developed over the last century to address overexploitation and conserve fishery stocks, and a greater degree of heterogeneity regarding management organization is observed in the region stemming from their relatively independent nature of development whether it be through immigrant populations importing traditional forms from their homelands or fishing accords between local communities, governments and cooperatives (McGrath et al., 1993; Campos-Silva and Peres, 2016). These rivers play an important role for many communities' livelihood and nutritional needs.

Historically, rivers and lakes have helped catalyzed the development of most of the great ancient societies including Mesopotamia, Egypt, Peru, China and India (Benvenista, 1996). From the record, it does not appear that powerful centralized authority was a prerequisite for the optimal use of water resources but instead cooperation based on mutuality and shared interests (Benvenista, 1996). Centralized authority was however required to recruit workers for labour intensive tasks such as digging and maintaining irrigation canals, important for food security and development (Benvenista, 1996). Interestingly, in the early Middle East tight kinship relations and diffused

decision-making distributed amongst group members mirrored the situation in contemporary equivalents based on similar decentralized management strategies (Benvenista, 1996). The variety of societies suggests something near universal about freshwater resource management. Repeating, due to colonial and postcolonial influence similar tenure systems once present in the Amazon, as well as Southern Africa for example have either collapsed completely or changed resulting in the presence of state management regimes in addition to local, informal ones (Pollard and Cousins, 2008; Campos-Silva and Peres 2016).

Exclusivity, like in CMT systems is the basis of CBM systems (McGrath et al., 1993). For many communities in the Amazon livelihood has traditionally depended on four main activities; agriculture, forest products including oil seeds and palm fruits, small-scale stock raising, and fishing (McGrath et al., 1993; Campos-Silva and Peres, 2016), each varying based on a multitude of seasonal, geographical, and or political factors, among others. A consistent trend in the research literature suggests that as the first three collapse commercial fishing intensifies, increasing pressure on fisheries resources (McGrath et al., 1993). A case study from McGrath et al., (1993) involving the Ribeirinho people of Brazil illustrates the point who. Over a few decades the Ribeirinho have turned almost exclusively to commercial fishing as their primary economic activity making use of the varzea forest, a seasonal floodplain. The collapse of their agriculture was caused by a gradual downturn post-war (1960's) in their local jute-based economy. Jute is a plant native to Japan that was introduced to South America. The introduction of synthetic fibers eroded demand for jute, and consequently its purchasing power (McGrath et al., 1993). Commercial fisheries concurrently saw a rise in activity because of revolutionized fishing technology and transportation and storage products from insiders and outsiders alike (McGrath et al., 1993).

Unable to depend on neither agriculture nor small-scale animal raising, the local Ribeirinho known as Varzeiro were no longer able to exploit the various resources of the varzea. In addition, they faced pressure from outside, urban-based commercial fishers due to their lack of exclusionary rights, often leading to violent conflict (McGrath et al., 1993). The Varzeiro successfully took control of several lakes through application of a CBM system with a particular kind of tenure in some ways similar to that of general CMT systems based on LEK. Their tenure is based on ownership of lake shorefront property by community members in a system of collective ownership where no single holder has a large enough portion to establish any meaningful fishing territories

(McGrath et al., 1993). Noteworthy, in this way ownership of lakes and rivers tends to be a function of land ownership (McGrath et al., 1993). Several communities within the territory prohibit the selling of product outside of the community further limiting fishing pressure (McGrath et al., 1993). Further, outsiders are excluded from the subtraction and consumption of fisheries resources where communities have established control, and insiders are restricted in the equipment permitted indirectly limiting catch allowing fishing stocks to recover (McGrath et al., 1993). Much like Acheson and Gardner (2010) in their study of Maine lobster fishing, McGrath et al., (1993) stress that while these systems may not be 'traditional' they are based on an intimate understanding of local ecology and thus believe they may be of benefit in natural resource management broadly as adaptive strategies.

In contrast, Campos-Silva and Peres (2016) describe three different tenure agreements recognized within a formal reserve called the Juruá Extractive Reserve established also in Brazil in 1997. The authors describe: open-access lakes permitting free-for-all access for any fishing interest, subsistence-use lakes permitting only subsistence artisanal fishing for the resident community guarding the lake, and protected lakes excluding both commercial and subsistence fishing (Campos-Silva and Peres, 2016). Freshwater ecosystems in the Amazon face additional challenges where the majority of protected areas are designed to protect forest biodiversity primarily, further hindered by political resistance to create or expand protected areas (Campos-Silva and Peres, 2016). In fact, Campos-Silva and Peres, (2016) state that its likely riparian protected areas in Brazil will grow out of favour with time and believe signs of this happening can already be seen. In the Southern African context by contrast Pollard and Cousins' (2008) report on water resources, specifically those of rivers, lakes, estuaries and wetlands observing that confusion often exists at the community level over tenure rights and that this is not helpful for freshwater resource management.

The confusion stems firstly, from the inability of the state to appreciate that some water-based systems lie on communal land and are accordingly managed through community derived rules and norms, and secondly a lack of government regulatory policy (Pollard and Cousins, 2008). The authors identify three central issues in the South African context specifically: a surprising lack of CBM systems despite governance vacuums and dwindling natural resources, an overemphasis of research literature on terrestrial resources and consequent lack of research on inland water

resources, and the transformation of once communal territories managed by local chief's and *induna* (traditional headsmen) to open access regimes believed to be hindering progress on initiating effective CBM systems (Pollard and Cousins, 2008). Interestingly, the last point appears to contradict one made earlier by Cinner (2005), regarding the collapse of communal property into open access. However this is most likely due to the fragility of these freshwater systems in the Southern African context in contrast to the robustness of similar ones in Oceanian marine systems resulting from local history and politics. There may be other endogenous and exogenous factors that explain this discrepancy. Regardless, the effects of colonialism in Southern Africa and apartheid in South Africa specifically forever changed management strategies in these regions and, like McGrath et al., (1993) as well as others working on aquatic socio-ecological systems state and local-level governance have their place and the move seems to be towards integrated systems.

In France Calvo-Mendieta et al., (2017) argue that a communal tenure-like management approach exists based on the concept of 'common patrimony'. Common patrimony entails the transmission of resource management capacities through time to a community with holding rights (Calvo-Mendieta et al., 2017). Resources or assets can take either a symbolic form or be actual means of existence that a community depends upon (Calvo-Mendieta et al., 2017). Common patrimony depends on the identity-bonds of agents with natural resources and interestingly allows for heterogeneity among those with holding rights, as opposed to the general emphasis in the communal systems literature on users and use rights (Calvo-Mendieta et al., 2017). Much like CPR's, common patrimony is not necessarily dependent on common property and could apply to private property where rights are held by that heterogeneous community, or even multiple regimes where for a single resource there are different legal systems, stakeholders, and rights intertwined (Calvo-Mendieta et al., 2017). Calvo-Mendieta et al., (2017) give the useful example of a wetland which may be common patrimony for hikers, foresters, hunters and local residents alike, a category that transcends mere users, owners, and appropriators. What makes this concept further different from those previously discussed (communal property and CPR's) is the view that common property is an institution rather than a mechanism of collective action via individual choices.

Calvo-Mendieta et al., (2017) discuss the seemingly contradictory position taken by some researchers and the literature on communal property, usually based on a non-transferable use right while simultaneously explaining how group membership which affords that use right in the first

place is inherited. The sense one gets after reading the research literature is that the point originally made about transferability refers to the ability for an individual to transfer his or her use right to another more so than the concept of inheritance broadly. However, the authors make an equally interesting point in their own right pertaining to fishing in France. They describe how the right to exploit fisheries resources is an institutional right inherited through time, held by French residents, but actualized into a real right through fishing licenses (Calvo-Mendieta et al., 2017). That is to say, fishing as an institution is heavily baked into the French cultural identity opening up 'holdership' rights to a heterogeneous group who do not necessarily have use rights. Calvo-Mendieta et al., (2017) define this difference as one between *being* and *having*. This clarification of transfer distinguishes common patrimony from communal rights of exploitation as described by Ruddle et al., (1992), McGrath et al, (1993), Aswani and Hamilton, (2004) and others. While the concept provides lots of analytical value, some of its fundamental assumptions inspire further investigation.

Historically, thought in ecological economics can be classified into three broad trends; new resource economics; new environmental pragmatism; and social ecological economics (Calvo-Mendieta et al., 2017). In order, each of these three trends; use the approaches of standard economics applied to natural resources; adopt utilitarian concepts such as ecosystem services and individual well-being to sway decision-makers; and view nature as having intrinsic value while prioritizing social equity (Calvo-Mendieta et al., 2017). Importantly, the CPR-informed analytic approach of the aforementioned authors cited in this research study falls into the second trend whereas that of common patrimony the third. As such, intrinsic to the common patrimonial approach is value pluralism, viewing the utilitarianism of the CPR approach as one specific and narrow ethical system and thus 'value conflict' as logical and inevitable (Calvo-Mendieta et al., 2017). This issue has already been addressed in the first section of this chapter, however as a refresher; value must be approached from both a proximate and ultimate causal perspective simultaneously when studying human-environment systems.

Individual and cultural variability will inevitably exist due to the nature of complex systems including individuals who are composites of their own individual nature as well as their experiences. The value of common patrimony as a concept, as far as I understand, is its recognition of institutions such as fishing as transferred 'cultural heritages' to be, and often accounted for by

decision-makers concerned with resource management. However, the CPR approach in contrast attempts to address local (and increasingly global) issues that depend upon the satiation of ultimate needs best captured by ecosystems services including but not limited to food and nutrient provisions, water quality, air quality, temperature regulation and a functional biosphere. One sees no good reason why these concepts have to be in opposition. As argued by symbolic anthropologists against cultural ecologists and cultural materialists, functionalism and the material conditions do not constitute the entirety of human life nor is societal development unilinear in nature from the material conditions. But it does constitute some of it. 'Utility' is not and should not be narrowly construed, possibly most evidenced by the existence and value of art which has no 'utility' in the same way a hammer or apple do but provides tremendous richness and meaning (very possibly a kind of utility, maybe too meaning is primal) to individuals and cultures alike. Perhaps modern people take for granted the existence of universal conditions required to encourage life because of our relative comfort, five weeks under the conditions most of humanity has had to endure since the beginning of our existence would likely prove a powerful lesson.

Freshwater resources are important not only for their fisheries but for the water itself, often an important resource for agricultural and energy pursuits (Benvenista, 1996; Yoffe et al., 2003). International rivers and lakes as public goods carry an additional layer of complexity in that they face national level collective-action problems where different states, enjoying access to shared waters may subject neighbours to Pareto-inferior outcomes (Benvenista, 1996; Yoffe et al., 2003). These are outcomes less preferred by impacted parties than at least one other potential outcome. This is particular true of the Somme River, the river running through this study's research area which drains northern France towards the English Channel, an area ecologically connected to many other neighbouring European nations (Bahain et al., 2007). Regarding decision-making, intra-state action is further complicated by the existence of internal as well as the external political interests currently in discussion (Benvenista, 1996; Yoffe et al., 2003). From the perspective of international law, Benvenista (1996), argues that two possible solutions to this issue exist: designing rules of reciprocal obligation over riparian's concerned, or reducing collective-action problems by providing riparian's with individual property rights as opposed to treating them as CPR's.

Referring again to Calvo-Mendieta et al., (2017) a slightly different approach is advanced under French national governance of the commons. While afforded as an institution, the commons are continuously transformed over time through patrimonialization. The heterogeneity of right holders in the patrimonial sense transcend a purely individualist perspective, maintaining a joint collective and individual view that is socioeconomically holistic. In a way, common patrimony acts as a cultural heuristic specifying the parameters around individual action as previously discussed earlier in the chapter when discussing the value-action problem and the human universal of uncertainty. The origins of common patrimony in French governance are traced to the already mentioned Civil Code of 1804 (Calvo-Mendieta et al., 2017). While the code strongly supported private property post-feudalism, fear of the degradation of French forestry's if left under the exclusive control of private stakeholders led to the 1827 Forestry Code which brought large sections of Forest under state control (Calvo-Mendieta et al., 2017). The argument went that those forests formed part of France's national heritage and required management according to specific standards (Calvo-Mendieta et al., 2017).

The common patrimony position is adopted into French water management through the Water Act of 1898 doing away with the strong privatization of the civil code. The legislation stipulates that watercourses are 'things common to river dwellers', later transmitted into the Water Act of 1964 (Calvo-Mendieta et al., 2017). The territorial as well as temporal dimension of water management is accounted for in the socioeconomic context by successive water laws beginning in 1992 which affirmed that water formed part of France' common patrimony and thus required balanced management (Calvo-Mendieta et al., 2017). Master Plans for Resource Managed (national scale) and Local Water Commissions (local scale) exist, created to manage water in the spirit of patrimonialization (Calvo-Mendieta et al., 2017). Local water commissions bring together different stakeholders from the state level all the way through to civil society and are further testament to France's highly hierarchical but relatively decentralized approach to resource management. Communities have a large say, at least theoretically regarding the establishment of objectives. Further, 'communities' are generally conceived not only as those with property or use rights but rather holders of common patrimony more generally (Calvo-Mendieta et al., 2017).

More broadly, water tends to be poorly distributed, subject to seasonal, regional, and geographic ebbs and flows (Benvenista, 1996), however according to the work of Yoffe et al., (2003) between

1948 and 1999 international relations over water were 17% conflictive, 78% cooperative, and 5% neutral. The authors' research develops what they call the BAR scale (Basins at Risk) testing existing theoretical claims concerned with the relationship between geography and international conflict over water. Yoffe et al., (2003) hypothesize that the likelihood and intensity of conflict in a basin increase as the magnitude of change in physical and or institutional systems exceeds the capacity to change, finding that to be the case after analyzing infrastructural developments and international mechanisms in selected countries. A nations GDP per capita and population density showed association with conflict, rich countries with lower population densities tending towards cooperation more often than poorer, more densely populated ones and the overall friendliness or hostility between riparian nations significantly associated with cooperation or conflict (Yoffe et al., 2003). A large portion of multilateral agreements usually emphasized joint management, economic development, and water quality strongly whereas bilateral ones water quantity and hydropower appeared more important (Yoffe et al., 2003). Water quality strongly affects both human and environmental health in industrial societies where agricultural and industrial projects deposit greater amounts of pollution into national waters with often disastrous consequences (Ali et al., 2019).

Recreational Fishing in Industrial Societies

Repeating, fishing is recreational when it does not constitute an individual's primary means of meeting basic nutritional needs or livelihood (Cooke et al., 2017). In industrialized societies recreational fishing occurs in inland, estuarine and marine waters (Cooke et al., 2017). Recreational fishing is also the dominant user of inland fish populations (Cooke et al., 2017). Although difficult to generalize, saltwater anglers appear to be more harvest-and-consumption motivated than their freshwater counterparts however, studies on the motivations of recreational fishers tend to underplay harvest and catch as motivational dimensions, leading to an overemphasis of the leisurely aspect of fishing activity (Cooke et al., 2017). The misconception persists due to the activity usually occurring during non-work hours; regardless, the motivations of fishers vary according to culture, location, species and fisheries (Cooke et al., 2017). Typically, research findings suggest that there are five sets of basal motives: temporary escape, achievement, exploration, income or 'expense', and experiencing nature. Context-specific research finds a sixth

motivation; consumption or meal-sharing oriented anglers whose harvest rates typically mirror those of other anglers, and who generally comprise the minority (Cooke et al., 2017).

Heterogeneity is a well-documented phenomenon amongst freshwater fishers (Cooke and Cowx, 2004; Smith, 2005). Economic, demographic and geographic factors impact whether or not a fish will be harvested (Smith, 2005). Further, there is little to no uniformity in preferred gear amongst fishers (Cooke et al., 2017). Western and central European communities tend to have relatively consistent access, between <1% to 6% of the total area, to freshwater (Cooke et al., 2017). Though fewer examples exist, trophic or ecosystem-level degradation can be observed in recreational fisheries despite the habit of attributing bad practice solely to commercial fisheries (Cooke and Cowx, 2004). Discarded fishing lines, the accumulation of lead sinkers, increased nutrient loading through ground baiting, boat traffic, and post-release mortality are some examples of bad recreational activities that negatively affect freshwater ecosystems (Cooke and Cowx, 2004). On the whole, recreational fishing in freshwater fisheries is believed by some researchers to be better managed than saltwater recreational fishing where tools such as lotteries and annual big limits have not been fully utilized (Arlinghaus et al., 2005).

Leisurely pursuits mean different things to different people. In the context of recreational fishing, a driving factor behind different meaning associations to the same activity among different demographics result from the significance of place and the development of subcultures (Toth Jr and Brown, 1997). Sources vary, however recreational fishing appears to be more prevalent in industrial societies than it is non-industrialized societies (Wadiwel, 2019). Further, recreational fishing accounts for between 1 and 10% of all fish captures in those industrial societies (Wadiwel, 2019). The different rates in participation from different demographics suggest underlying factors that influence recreational fishing activities. This observation has been made by several researchers including Hunt and Ditton (2002), and Burger et al., (1999) among others. Burger et al., (1999) in the North American context found that ethnicity affected information sources concerning fishing, leading to differences in perception and complaints to fishing regulations. The trends observed by Burger et al., (1999) appear to follow disparities in groups informed by years of exposure to fishing, belonging to a fishing club or other such entities, and living in a household with access to relevant equipment (Hunt and Ditton, 2002).

Differences have been documented between female and ethnic minority participation in recreational fishing in Western nations (Toth Jr and Brown, 1997; Hunt and Dillon, 2002). It is important to note that ethnicity and sex are very different concepts and should be treated as such. Sex interests exhibit both a biological and a cultural dimension. Psychological differences in temperament and interest appear present in human beings, including the 'interest' dimension split between interest in things and interests in people roughly (Su and Rounds, 2015). Interest in things refers to interest in objects, whereas interest in people is self-explanatory, roughly. According to the relevant literature from different ends of the behavioural and cognitive sciences, on average, accounting for sociocultural factors males and females prefer spending their time differently as a feature of primate evolutionary history (Beltz et al., 2011; Lonsdorf et al., 2014; Su and Rounds, 2015 among others). Generally, males show a marked interest in things whereas women a marked interest in people. While not a steadfast division, average differences are observed cross-culturally (Beltz et al., 2011), as well as across our species and its closest living relatives, chimpanzees (Lonsdorf et al., 2014) in line with the gendered interest distinction between things and people. Insofar as any evolutionary psychological constraints have been adequately addressed, sociocultural implications of sense of place and the development of subcultures can be addressed (Su and Rounds, 2015).

The sense of place as a multidimensional construct encompasses concepts representing cognitive and affective dimensions including place attachment, place dependence and place identity, among others (Urquhart and Acott, 2014). For recreational fisheries, sense of place manifests as a byproduct of fishing as more than a simple leisurely activity but instead an important characteristic of life (Toth Jr and Brown, 1997). Often the product of local culture and tradition, recreational fishing as a subculture is created and recreated by the shared interests of those involved. The inclusion of sense of place as an analytical dimension within natural resource management has been discussed but remains difficult to attain given the challenges posed by the study thereof (Urquhart and Acott, 2014). However, it is fairly clear that recreational fishers view fishing as more than just an activity but rather an extension of their values and identities, often shared with other recreational fishers. Anthropological research suggests that individuals construct and maintain a bond, or 'sense of place' within a setting of one for or the other that can come to represent who they are (Urquhart and Acott, 2014). In the industrial context, recreational fishers

face increasing challenges to this extension of themselves stemming from management failures as well as contamination of their fisheries (Burger et al., 1999).

A growing concern in industrial societies is the contamination of fish through industrial and agricultural practices. Ecotoxicology studies in industrial societies suggest environmental pollution is driven primarily by heavy metals, well-known pollutants dangerous because of their bioaccumulative and persistent nature (Ali et al., 2019). Introduced primarily by urbanization and industrialization, heavy metals embed themselves into water bodies, sediments and soils (Ali et al., 2019). Resulting, heavy metal contamination is an ever-present threat to aquatic ecosystems. Polluted aquatic environments can in turn pollute fish populations, leading to cascading contamination down trophic systems as well as threatening fishing populations who consume these fish (Burger et al., 1999). Additional contaminants of aquatic ecosystems stem from agriculture. Speaking of the Somme River, Nets et al., (2014) found that agricultural and municipal wastewater contaminants had been responsible in degrading water quality and by extent endangering local commercial and recreational fisheries. The authors found a wide diffusion of pesticides, phthalates, polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCBs) among others present in the Somme waters (Nets et al., 2014). Legally, France was and remains bound by the European Union Water Framework Directive (EU WFD) of 2000 which stipulated good or very good surface water quality for 60 % of water resources by 2015 (Bayramoglu et al., 2019).

The nation unfortunately failed to fulfil its obligations under the directive within the deadline resulting in a ruling by the European Court of Justice in 2014. In terms of chemical pollution, only 48.2 % of water resources were deemed acceptable while in terms of ecological status only 43.5 % were deemed acceptable (Bayramoglu et al., 2019). This is due partly to the historic inefficiency of France's natural protected areas caused by a weak management plan, lack of population monitoring, and very little research (Souchon and Keith, 2001), as well as the challenges presented by the increasing role private property is playing in the implementation of conservation policies, to be discussed further (Kamal et al., 2015). Since the adoption of the EU WFD France's management plan has improved, according to some sources (European Commission, 2019; Bayramoglu et al., 2019). Two further deadlines remain, 2021 and 2027 for the nation to meet its obligations (Bayramoglu et al., 2019). France's fisheries management regime is based on public

and private ownership (along with common patrimony which is discussed later) and a multilevel management system (Boisneau and Boisneau, 2008).

Under the Fishing Act of 1984 two types of freshwater fishers are recognized and allowed in France; commercial inland fishers who may sell their catches and products; and recreational anglers who are not allowed to sell theirs (Boisneau and Boisneau, 2008). Fishing rights are leased through a license placing individual fishing quotas to both types of fishers, providing further they belong to a statutory association (Souchon and Keith, 2001; Boisneau and Boisneau, 2008). Recreationally, local associations are federated at county level into a statutory anglers' federation. However, fishers in France face two major challenges; poor representation in decision-making bodies; and governance by two separate ministries; the Ministry of Agriculture and Fisheries, and the Ministry of Environment (Boisneau and Boisneau, 2008). Commercial fishers answer to the former whereas recreational fishers to the Ministry of Environment which establishes regulations in consultation with the National Fishing Board which is financed through tax euros (Boisneau and Boisneau, 2008).

Since at least the turn of the millennium the quest to restore French freshwater fisheries has led to two implemented strategies; the rehabilitation of individual fish species such as salmon, sturgeon and shads; and the restoration of ecosystem functions hydrologically and morphologically (Souchon and Keith, 2001). National water laws in tandem with the EU WFD promulgated and adopted between the early 90's to the year 2000 defied limits to the use of hydrosystems favouring regionalization of waterbodies as means of reducing natural variability and improving fisheries (Souchon and Keith, 2001). Souchon and Keith, (2001) wrote that population surveillance of fish communities would be a good measure of the benefits of rehabilitation actions proposed by French policy, leaving future researchers the task of such studies. Bayramoglu et al., (2019) in a way respond with their paper which contains mixed reviews. However much remains understudied including the more phenomenological aspect of recreational fishing as a subculture, and the concurrent sense of place experiences by fishers. In addition, the integration of this aspect into management, while reflect to an extent by the French approach of cultural patrimony, like the rest of the world may still remain poorly integrated.

Research into recreational fisheries in Europe is scant (Font and Lloret, 2014), even more so for freshwater fisheries due to difficulties in data collection (Cooke et al., 2017) however the essentials

of ecological theory and our understanding of ecosystems function remains the same. The protection of ecosystems and their services is necessary, so too is socioeconomic and political stability. As such, theoretical clarity is required in the research process certainly if the knowledge produced is to be applicable and useful. These are the challenges that recreational fisheries in Europe face (Arlinghaus, 2006). Concerning implementation, it is useful for researchers to follow up and ensure the management systems they help design and policies they have influenced work as intended and control for unintended consequences (Taleb, 2012). Socio-ecosystems are complex systems that are difficult if not impossible to understand in totality. Caution is advised especially with large-scale interventions. Thus, what we currently understand is that conservation efforts in fisheries management have been subject to the same debates as in conservation broadly. Anthropologically, cross-cultural comparison of the sort necessary for conservation efforts compel questions once of human nature and the quest for universal theories.

Chapter 3: Historical Context

Fishing in Eurasia dates back at least 42 000 years (O'Connor et al., 2011). It is more challenging to place recreational fishing in Europe, dating back at least a few hundred years in its present form. The historical record is scarce; however, one of the earliest sources describing fish in the rivers of France, then Gaul/Gallia is provided by Roman author and naturalist Pliny the Elder, dated to the 1st century CE (Pliny the Elder, 1906). Pliny the Elder mentions salmon in central Gaul as the 'king of fishes' and describes lampreys in the region, observing how their spots changed from gold to black upon death. He also speaks of the marine waters of the region, observing that dolphins and humans would cooperate in fishing explaining how these events were as much social as subsistence driven. Describing the scene, crowds would gather knowing the exact time the sport took place and showing keen interest. They would then shout 'snubnose' from the shore at which point dolphins would gather, weaving through boats, nets and fishermen, chasing mullets and other aquatic life. Fishermen would place nets in open waters and lift fish out with two-pronged spears. It is clear from this account that dolphins and fishers actively interacted with each other in fishing. By the 10th century commercial fisheries by modern standards had begun, and eventually a dam was built in 1312 in the Brioude region, south of France for purposes of salmon harvesting.

Human settlement in the modern Somme region predates contemporary records by thousands of years. The earliest known settlement in the region dates back to Gaul (Gallia) as well, dating roughly 2 500 years ago (Schultz, 2010). The region was originally occupied by Gaulish tribes, a Celtic people present in Europe since at least the Iron Age up until the rise of the Roman Empire. During this period, Gaulish tribes were steadily Romanized becoming the Gallo-Roman people. The last West Roman stronghold, located between the Loire and Somme Rivers fell after the Frankish invasion of the 5th century CE (Bachrach, 1972). The Frank's were a Germanic people who resided on the boundaries of the Roman Empire in Western and Central Europe. The Frankish Empire, once established, would gradually transform into the modern French Republic through four main events: the treaties that crystallized French borders, the formation of the Capetian Dynasty which marked the beginning of the French Kingdom, the Revolution of 1789 birthing the first iteration of the five French Republics since, and the adoption of the Napoleonic Code of 1804 which created unified laws for the entire French territory (including overseas territories after colonization) and continues to influence French law today.

The Frankish Empire, established in the late 5th century, also known as Francia was the predecessor of the modern-day French and German states having emerged after the fall of Western Rome. The king of the Franks at the time, Clovis I became the first monarch who, though greedy, successfully catalyzed the beginnings of a unified Frankish identify between the Germanic and Gallo-Roman peoples living under his rule. He achieved this by converting to Catholicism in 496, even becoming the first king to be anointed (Schultz, 2010). He won favour as a Germanic king with his Gallo-Roman populous and his kingdom would follow suit adopting the faith, though not uniformly. As an admirer of the Romans, Clovis I used much of the same symbolism; he wore similar purple robes and even made Latin the official language of the courts, institutions of dispute resolution. This symbolism further added to his favour. Before long, the population began speaking a form of Vulgar Latin that would later evolve into the *langues d'oïl* including modern standardized French, as well as other romance languages still present in metropolitan France including Occitan and Picardy. The Frankish people under Clovis I slowly became united in language and religion (Schultz, 2010). Like Clovis I, succeeding kings adopted existing Roman structures into their kingdoms, for better or for worse too as means of consolidating power.

Frankish kings would have official Roman magistracy conferred on them by Roman emperors in Constantinople, sometimes going as far as to appropriate Roman official titles alongside their Germanic ones to strengthen their positions of power against Germanic competitors when all else had failed. Around this time the upper-classes in the new kingdom were taking shape, leading to the birth of pre-French aristocracy made up mostly of the decedents of Frankish warriors and Gallo-Roman landowners. When Western Rome collapsed and Frankish rule began, the indigenous Gallo-Roman elites' economic power often remained respected. As a means of themselves consolidating power these elites built large, rural estates called *villae* (Harmand, 1961). This marks a very important point for several reasons, most notably the dozens of families living on these estates often became legally dependent on the landowners and their land leading to the emergence of a domainial tenure system. This landowner-peasant bond would shape society for centuries to come, further dividing the aristocracy from lower classes.

Though a capable people in terms of warfare, what differentiated the Franks from other Germanic groups such as the Goths or the Vandals of the time was their farming ability. Therefore they preserved the domainial system introduced by the Gallo-Romans. Initially, the separation between

Germanic and indigenous Gallo-Roman elites reflected in the new political structure, however this distinction would later become one of class as opposed to heritage (Schultz, 2010). As society began to stratify into noble and peasant classes, along came the gradual adoption of what would later be recognized as medieval feudalism evolving out of the domainial system. France's long standing history with aristocracy became cemented. Feudalism as a socioeconomic system was based on reciprocal legal and military benefits between the upper-classes including nobles and the clergy, and the lower-classes of peasants. Feudal land tenure was based on fiefs, heritable rights and property. Importantly, the rights of exploitation including hunting and fishing, and monopolies on trade all fell under fiefs. Overlords could grant fishing fiefs to vassals, among others, creating an obligation on the part of the latter usually in the form of allegiance or service to the former. Though a system of entrenched extreme inequality, feudalism succeeded in providing much-needed stability in Francia.

Charles, later Charlemagne the Great would be the next king of historic consequence being the first ruler of a united western Europe since Rome. Charlemagne was instrumental in unifying all of the different ethnolinguistic groups from lands he had conquered into a united Frankish people, now including Gallo-Roman descendants, under the concept of *Personenverbandstaaten* (O'Sullivan et al., 2018). Frankish identity would no longer be tied to a geographical area but instead a shift in personal relations, in line with Germanic tradition where no notion of an autonomous body politic with a fixed territory existed. Therefore, the title held by a king reflected his rule over the people he governed not the physical area. The Christianization of western and central Europe swiftly followed through his series of conquests, which, though rejected at first eventually became the predominant religion. Charlemagne would develop a close relationship with the Catholic church, even being declared the new emperor by the Church. It was then that the Church's influence as an institution grew and Charlemagne's kingdom strengthened. However, Charlemagne's predecessors who had begun the tradition of dividing their land between sons sowed the seeds that would inadvertently lead to the splitting of Francia.

Infighting amongst royal heirs led, in 843 to the signing of an important treaty called the Treaty of Verdun (Benham, 2018). Francia was divided into three; East, Middle, and West Francia and allocated to three of Charlemagne's grandsons, each becoming king of their respective third. Charles the Bold succeeded in the Western portion of Francia. West Francia would extend its

borders to encompass most of what became modern-day France, its namesake, when Middle Francia was partitioned by the Treaty of Meerssen (Ottewill-Soulsby, 2018), in 870 and divided between East Francia (roughly modern Germany) and West Francia. After the formation of West Francia the next figure of consequence was Hugh Cape who, in 987 ascended the throne and became king. He established the Capetian dynasty; an event widely considered the beginning of the French Kingdom which ruled uninterrupted until 1789. During this period, feudalism also evolved into a new form of particularly economic arrangement called seigneurialism. Under this organization considered less 'archaic' than medieval feudalism by some historians (Greer, 1985; Hayhoe, 2008), occupants of land owned by a seigneur, usually peasants, had to pay feudal dues usually in either cash, produce, or service.

Seigneurialism differed from feudalism in that it took the form of a land contract between the landowner and the peasant farmer. On top of the feudal dues, peasants were required to pay taxes for their use of infrastructure and the seigneur could demand a period of unpaid labour from tenants called the *corvée* (Greer, 1985). Unlike feudalism however, seigneurialism failed to provide the stability and security which connected social classes. Unrest between the aristocracy and lower classes developed. These exacerbated tensions between the common citizenry and the aristocracy meant by the 18th century seigneurialism had become a growing source of dissatisfaction among the French populous, as documented in the *Cahiers de doléances* (République Française, 2021b), more so in the North where it had been more prevalent and carried heavier dues. The Cahiers was a list of grievances commissioned by King Louis XVI held by the populous in 1789, compiled with the intention of reform in a time of increasing political upheaval. Among the grievances presented were government waste, high taxes, corruption, and hunting and fishing rights which somewhere along the historical line had become exclusive to the aristocracy.

The political upheaval previously discussed finally culminated in the revolution leading to the abolition of the monarchy and feudalism, secularization, and the eventual birth of the first French republic, the first radical departure from a political regime since 987. Between these pivotal centuries (18th and 19th) also came the codification movement. Sparred by the French Revolution of 1789, this movement led to the collecting and restating of laws by jurisdiction and subject leading to an eventual legal code. Before the revolution and codification movements there had not been a unifying legal system, people instead deferring to local customs to resolve disputes. Many

of these customs had special provisions for feudal lords and royalty, showing again how deeply entrenched the divide between aristocracy and the lower classes ran. This was not at all in accord with the new Republic. The result was the Napoleonic Code of 1804 or *Code civil des Français*[1] which, while not the first of its kind, was the first to receive pan-European recognition spanning from Spain to Poland, Italy, Netherlands, and Belgium among others greatly influencing their legal systems. The legal code was commissioned by Napoleon to reform the French legal system in accordance with the ideals of the French Revolution and persists to the present albeit having been amended several times.

In the year of the revolution, on the 4th of August 1789 special hunting and fishing privileges were finally abolished rendering recreational fishing accessible to all citizens. No longer was there an aristocratic divide inherited initially from the separation of Frankish warriors and Gallo-Roman landowners into a ruling class, and the rest of the citizenry. The new legal rules around fishing were based off what was called *l'Ordonnance de Colbert*[2]. The ordinance which had been promulgated in 1669 clarified policies relating to the waters and forests of the then French kingdom and importantly established uniform rules around fishing. Later, the *Amusements de la Campagne* (Liger, 1734) was published, the first text dedicating itself to the practices of hunting and line fishing inspired by Izaak Walton's 'The Complete Angler' published in England in 1653. 40 years after the liberalizing of recreational fishing the first ever fishing legislation was promulgated[3]. This legislation would later be modified in 1941 to prevent pollution, as well as making provisions allowing for fish stocks to replenish and the surveillance of freshwater. This marked the birth of recreational fishing as is known today in France. The revolution played a crucial role in the development of France's tenure system.

Before the revolution of 1789 French land tenure was based on feudal landlords owning most available land with small tenants and labourers working on it (Swinnen, 2002). In the years following the revolution land owned by the Catholic Church and emigrated nobility, constituting about 30% of total agricultural land was nationalized and sold to larger farmers and the relatively wealthy who could afford the costs (Swinnen, 2002). After the adoption of a the Napoleonic Code across all of France, compulsory equal division of land, inheritance, property rights, and freedom

[1] Code de Français 1804, Titre Préliminaire de la Publication, Des Effets et de l'Application Des Lois en General.
[2] *Conférence de l'ordonnance de Louis XIV du mois d'août 1669, sur le fait des eaux et forêts*.
[3] *LOI du 15 Avril 1829 Relative à la Pêche.*

for landowners in contracting with tenants were introduced causing a decline in the concentration of landownership and sparring massive cultural shifts (Swinnen, 2002). Further, in 1848 small farmers and farm workers were given voting rights, later voting for Louis Napoleon Bonaparte who campaigned on a further reduction of feudal rights, giving land to tillers, as well as tax reductions for farmers (Swinnen, 2002). All these events led to the majority of land in France being owned by farmers by 1880 (Swinnen, 2002). These developments also had the effect of crystalizing the concept and institution of private property within the nation (Swinnen, 2002).

An awareness of the effects of recreational fishing appears to have generally been present relatively early on after liberalization. In the very first chapter of *L'ami du pecheur* (the fisher's friend), an investigation into fishing in France published in 1873 the following quote appears on the prevalence of anglers: '*leur nombre augmente même dans de telles proportions, que, si cela continue, il y aura bientôt moins de poissons à prendre que de lignes tendues'* (their number is even increasing in such proportions that, if this continues, there will soon be fewer fish to be caught than taut lines) (Poitevin, 1873). After the revolution had forever changed land, labour and capital relations French industrialization began, dated between roughly 1810 to 1870. Though not the last revolution, most notably those of 1830 and 1848, the revolution of 1789 marked a pivotal moment in the historical trajectory of the nation. From that point on France slowly became a market economy based on private property, contract and free trade and one of the wealthiest countries in the world. It would then join the EU in 1958 (European Union, 2021), where it remains a member.

In present-day France, the broader governmental office overseeing all such activity is the Office Français de la Biodiversité, or French Office of Biodiversity which began operating on January 1st, 2020. This office came into effect after the passing of legislation[4] which merged two previous offices: The National Office of Hunting and Wildlife, and the French Biodiversity Agency. Legally, present-day French management is based on national law, EU directives and the international agreements signed onto by the state. The approach to aquatic management is based on key legislation promulgated between 1964 and 2016; the Water Act of 1964 seeking to create basin-level governance bodies around mainland France and amended in 1992 for the creation of water development and management plans; the Water and Aquatic Environments Act of 2006 which created the National Office for Water and Aquatic Environments (ONEMA); the

[4] LOI n° 2019-773 du 24 Juillet 2019 Portant Création de l'Office Français de la Biodiversité.

Biodiversity, Nature and Landscapes Recovery Act of 2016 which established water and biodiversity around French territories as well as created the now defunct French Biodiversity Agency incorporating ONEMA; and the Management of Aquatic and Environments and Flood Prevention Act of 2017 which transferred the authority of managing water and aquatic environments from communes to collective communes, towns and urban and metropolitan groups.

France's obligations to the EU consist of; the Urban Wastewater and Treatment Directive of 1992 obliging treatment of wastewater; the EU WFD previously discussed; the Drinking Water Directive setting quality criteria for consumption water; the Flood Directive of 2007 for managing flood risks; and the Marine Strategy Framework Directive of 2008 similar to the EU WFD but for the marine environment. The international agreements France has signed include but are not limited to the Kyoto Protocol in 1997, the Paris Accord in 2015, and the Program for Suitable Development by 2030 Agenda also in 2015. The last of these in particular has set a teleological pathway to meet within the present decade of 17 UN SDG's including clean water sanitation, protection of aquatic life, climate action, and partnerships to achieve these goals. Protection of freshwater ecosystems is fairly decentralized between three broad stakeholders; the government responsible for decision-making at the EU and international levels; basin-level bodies largely tasked with water management planning and the allocation of financial aid to communes and group communes; and local decision-makers who can be anything from local authorities to civil citizens. The key stakeholders start at the level of government and parliament. There is a separation of powers in France between the executive, legislative and judicial branches of government however, the first two remain closely associated in management as the parliament passes national laws and the governments complies while also defining the management policies with EU directives (Hilty et al., 2020).

Following is the French Office of Biodiversity, which implements public policies in resource management along with devolved government services and regional health agencies who implement regulations and organize environmental and sanitary health controls. Basin-level bodies including committees and agencies draw up plans which are then supported by regions and departments, the level at which the Somme Federation operates who provide management and financial services to French regions. Following, chambers of commerce and industry then provide addition services representing involved private stakeholders from the economic sector. As to the

monitoring of freshwater ecosystems, individual and or groups of communes take this responsibility represented by intercommunal or joint unions. Finally, civil society form the base of human-environment interactions through their participation in political bodies as well as their individual and group decisions. The French approach towards resource management depends on cooperation between all these levels of stakeholders in the service of national, European, and international interests.

With regards to water specifically, France's management strategy approaches small and large water cycles as independent. Referencing the former specifically, communes and or groups of communes are given the power to decide between government or private management of their drinking water and sanitation. With regards to the latter the focus primarily rests on the restoration of waterways as well as flood prevention, the management strategy followed mirroring that of fisheries resources. At the base of management once again are civil society, who as stakeholders along with basin-level bodies, the government, and parliament all interact via unique obligations laid out by law and international agreements including those of the EU. Frances conservation strategy makes use of a mixed approach utilizing both voluntary and involuntary methods. A mix of both voluntary and involuntary management methods are used by the Federation in Amiens including conservation networks and non-binding conservation activity in the former, and imposed restrictions and regulations in the latter. Conservation easements (*obligation réelles environnementales*) which are a voluntary method were introduced into France by legislation in 2016, but have not been used much given it is required that benefit to a neighbouring property first be established (Račinska and Vahtrus, 2018).

Chapter 4: Methods and Materials

Research Question and Goals

Research question:

Do rates of altruism expressed by individual fishers mirror rates of altruism expressed in collective contexts concerning natural resource exploitation in Amiens' recreational fisheries?

To answer this question the study observes and records the following:

- Observe and measure individual rates of altruism present in an interpersonal context amongst recreational fishers.
- Observe and measure individual rates of altruism present in a collective context framed around common-pool fisheries resources and test for correlation.
- Observe and measure whether or not a local (informal) management system exists in the area.

Hypothesis tested:

- *There is no relationship between individual rates of altruism and decision-making in the exploitation of common-pool resources (H_0)*
- *Individuals who express greater altruism towards fishers utilizing the same fisheries will demonstrate a greater willingness to cooperate in the exploitation of common-pool resources (H_1)*

Study Site

Fieldwork took place in the commune of Amiens in the northern French region of Hauts-de-France through which the Somme River passes. The Somme River is one of the major rivers that drain northern France towards the English Channel (Bahain et al., 2007). The Somme department, under which Amiens' administration falls possesses a dense river network central to the region, its coastline stretching for around 60 kilometers (European Parliament, 2019). The study was funded by the EU's Erasmus+ mobility program under l'Université de Lille and focuses on recreational anglers active at the Somme River, in Amiens. Accepting that decision-making in recreational fisheries impacts ecosystems integrity, I was interested in cooperation amongst anglers, particularly as it concerned adherence to management rules and restrictions geared towards preserving ecosystem function. While no sex preference was present in my research design, all participants ended up being male rendering the study one of male recreational fishers in Amiens.

The town of Amiens is located roughly 120 kilometers north of Paris under the jurisdiction of the Somme department. As of 2020 it has a population of over 130 000 residents and possesses a diversified economy composed primarily of public services, the service sector, construction, industry, and agriculture (République Française, 2021a). Over the last decade and a half, Amiens has consistently ranked among the best managed cities in France, as well as among the most attractive cities for business with a population lower than 200 000 in the nation. The town, in 1783 was recorded as having 6000 households and a population of roughly 60 000 people (Caron, 1860). From the same records, Amiens' primary industrial activity at the time appears to have revolved around cotton imported from England. Clothing, from tulles and muslin to hosieries were among the largest products produced and sold by Amiens' industrial sector. Agriculture and industry at this time dominated the economies of Amiens, and the Somme region more broadly which were relatively prosperous (Departement de la Somme, 1855). Social and economic activity was heavily disrupted in the early 20th century when Amiens and the Somme region suffered massive devastation as Europe plunged into the first World War between 1914 and 1918.

In recent history the Somme region, starting from July 1st to November 18th, 1916, was the location where the Battle of the Somme occurred. In an article published by the Parisian newspaper L'Action Française on July 2nd, 1916, the following quotation is found: '*Au nord de la Somme, les troupes française se sont etablies aux abords du village de Maricourt et aux lisieres du village de Curiu, ou le combat continu* (in the North of the Somme, the French troops established themselves on the outskirts of the village of Maricourt and on the outskirts of the village of Curiu, where the fighting continues) (Vaugeois and Daudet, 1916a). Fought between the allies: the Third French Republic and the British Empire against the German Empire, the battle had been an attempt by the allies to hasten the defeat of the Germans and bring an end to the war. In addition to being one of the deadliest battles with about one million casualties, the battle all but destroyed the Somme region. Two years later in 1918 the Battle of Amiens, fought between August 8th and 11th commenced, including the allies this time composed of the Third French Republic, the British Empire, Canada, Australia, and the United States, marking the first in a succession of offensive victories later call the 100 Days Offensive.

The 100 Days Offensive was so named because it started in Amiens on August 8th, marking one hundred days before the end of the first world War and the defeat of the German Empire on

November 11th, 1918. From an article in L'Action Française published on November 19th, 1916, an edition plastered with war-related articles the following quote is found: '*Au sud de la Somme, un fort détachement ennemi, qui tentait d'aborder une de nos tranchées du secteur de Biaohes, a été aisément repoussé à la grenade*eur l'ensemble du front. *Partout ailleurs, nuit calme. Le mauvais temps a gêné les operations'* (in the South of the Somme, a strong enemy detachment, which was trying to approach one of our trenches in the Biaohes sector, was easily repelled with grenades. Everywhere else, a calm night. Bad weather hampered operations on the whole front) (Vaugeois and Daudet, 1916b). Needless to say, it would take Amiens and the Somme years to restabilize to its present after the events of both the battles as well as the war more broadly. Europe would of course see a second World War two decades later, no doubt affecting Amiens as well.

Research interest in France was twofold: a desire to work in an industrial context, and wanting to see if informal fisheries management of the sort described in Maine (an industrial context) was present in France. Arrival in France was complicated, and research was delayed by a slow process of ethical clearance. My first visit to the field site in late February 2020 was followed a week and a half later by covid 19 lockdowns. Eventually, once possible (July 2020) fieldwork resumed. A passive approach to field work was preferable given time constraints caused by lockdown. A more active approach under different circumstances would have been ideal despite the drawbacks of disturbing natural behaviour amongst participant groups. A greater rapport and deeper knowledge would also have been generated. Recreational fishers in France are a fairly open 'community', and my relationship with the Federation made access easier. By open, I mean access does not require months of pre-planning. I chose to reveal my identity as well as my non-affiliation with the Federation so participants felt comfortable divulging information that may have been contrary to management restrictions and rules. For the same reason, the anonymity of research participants was closely guarded whether or not what they had to say bore questionable implications. There were other challenges during the research process. Shortly after completion of the descriptive component of the study in September 2020, France went into a second 'hard' lockdown (no leaving your home unless for exercise, shopping, or work; requirement of a 'legitimate' reason if traveling more than 10 kilometers from your home; closing of all places of public activity; a fine of €135 (R2295) when caught infringing restrictions).

Methods

The research design involved two components: the first experimental, and the second descriptive. The experimental components, using two economic games sought to address the research question posed (Bernard, 2006). The study first employed a DG to observe altruism (or a lack of) within two-player, interpersonal settings. A fictional endowment was offered to participants, all playing the role of dictator, to split however they wished with another fictional player who was not dictator. The fictional player was purposely revealed as an angler in Amiens as the goal was to understand cooperation (or its lack) among the regions anglers. The endowment chosen was €500 (R8500, June 2021), roughly half of France's monthly minimum wage. With the same participants, the study then employed a PGG to observe if rates of altruism captured would mirror those of the DG and test for correlation. A hypothetical endowment of €500 was again provided to participants with the option to contribute either to a public investment, or a public investment. Participants were made aware that both investments would be doubled upon completion and equally distributed to all contributing participants regardless of individual contribution. The rules were explained, and the game framed around the ecological health of Somme's fisheries and management. No further context was given as omissions were designed to encourage situational behaviour (Croson, 2005; Aswani et al., 2013).

For the descriptive component seven participants were located over the course of a month and separated into two focus groups, one with three members and another four (Bernard, 2006). Fishers were asked to free-list species they knew of present in the river, then asked to pile-sort from least targeted to most (Bernard, 2006). Through word of mouth, 20 or so willing participants had been located however due to the pandemic and novelty of the coronavirus, many, who tended to be over 60 were hesitant to participate face-to-face. Tools including Google hangout or Zoom could not alternatively be used as this component required face-to-face discussion and description. Further, as the descriptive element required detailed mapping and listing with myself present to guide the interaction using context specific questions, online mediums were not viable. First, a map of the fishing grounds was obtained from Google maps. The map was printed, and each focus group given a copy and two markers in green and yellow respectively. The participants were asked to indicate the areas were fishing was permitted by the Federation by marking out spatial boundaries on the map.

Using a different coloured pen, participants were asked to plot areas where fishing was managed by a local, informal system (if it existed). For free-listing exercises, participants were individually given sheets of paper and asked to list all the fish species they could which were present at the Somme. Participants were then asked to pile-sort the list, ranked ordering the listed fish from those they personally targeted most to least. Participants where then interviewed using a mix of structured and informal interviews targeting knowledge on the existence (or not) of an informal management system (Bernard, 2006). Eventually, the pile-sorting exercises had to be abandoned as participants stated their preference were based on size more so than particular species. All interviews were conducted in French, which I had learned enough of to function as a researcher. Participants names are not included as I did not obtain permission to do so. I designed all the research instruments used for this study.

In addition to the primary data collected, Mister David Dufrêne, deputy director of the Federation and key informant allowed access to private Federation records that would not have otherwise been accessible. These records are not available publicly and included the number of licenses issued for the 2019 and 2020 seasons in the Somme and all other French departments, the different licenses available and the percentages of each issued within the same season broken by age and gender categories, the financial commitments the Federation had to French regional authorities (DRFIP), and of the Federations' operations. The latter is public knowledge. This supplemented understanding of management in the region, particularly the operations of formal governance. Ethnographic data was collected in two different ways: *in situ* observations, and historical research from written sources. *In situ* observations had to be minimized substantially due to the 2020 lockdowns. When possible, participant observation was carried out among fishers in Amiens, and with the Federation.

Sampling Design

Ideally, a randomly selected sample would have been used for the game component (Bernard, 2006). However this was not possible due to covid restrictions. Instead, an online survey with scenario-based questions was sent to the Federation and a link put on Facebook pages unique to Amiens targeting fishers. The survey was written in French and designed with help from the key informant who better understood what kind of language would work best with fishers. Much like other research studies during 2020, the present study had to render a research design friendly to an

online medium. Thankfully, telecommunication devices and internet connectivity are commonplace in Amiens, softening the blow dealt. The original plan had been to invite, along with the deputy director of the Federation, a randomly selected number of participants at different time intervals to the Federation offices and perform the games. The sample frame was going to be used to randomly select 20 percent of the total number of fishers present in Amiens over the course of a month or two. The individual fisher served as the unit of analysis and variables under observation grouped into two categories, 'individual trait' and 'community-trait' to test correlation of the latter and rates of altruistic propensity (Bhattacherjee, 2012; community trait variables are independent of individual variability (Aswani et al., 2013).

For the descriptive component, I used a snowball sampling strategy to locate participants with a minimum of 15 years fishing experience (Bhattacherjee, 2012). I chose this method to locate fishers who possessed deeper Local Ecological Knowledge (LEK) to address the third research goal investigating the existence of a local (informal) management system. Fieldwork was completed in the brief period of deconfinement between July and August of 2020, making limited in-person gatherings possible. Participant observation of any kind was near impossible given the legal constraints resulting from the global pandemic of 2020. Under confinement, the hour or two permitted by the French government for outside activities including jogging, walks, or walking a dog severely handicapped observation. Virtually no recreational fishing took place between March 2020 and June 2020, where it did those fishers were infringing on lockdown restrictions. When rules were finally relaxed, participants often exhibited hesitancy to interact socially given the novelty of the virus and the uncertainties surrounding mortality rate and spread. France was one of the hardest hit regions by the coronavirus during its earlier days, making these fears understandable particularly among older participants who were more at risk.

Statistical Analysis

I opted for parametric statistics in the data analysis as it could be assumed that the variables under observation were normally distributed (Chibnik, 1985). The data was first described by summarizing the sample, inferences are then made to test the validity of the hypotheses presented. A repeated measures ANOVA was used for hypothesis testing as the same sample played both games (Chibnik, 1985). A significance level of alpha set at $\alpha = 0.05$ was followed, in line with most social science studies (Chibnik, 1985; Bhattacherjee, 2012). The significance was kept at

0.05 despite the increased probability of type II errors as a methodological trade off. The probability of type I and type II errors remains average by having a n of 25, although a larger sample size would have decreased the probability of a type I error (Chibnik, 1985). A one-sample t-Test was used to analyze the potential effects education level and age have on contribution to the public investment. Gender could not be used as an independent variable as there were no female participants, neither could average earnings as participants preferred to keep this information private. The null hypothesis remained the same when analyzing these individual-trait variables; no relationship exists with investment choice.

Chapter 5: Research Results and Discussion

Game Results

DG results:

Offer	Minimum	Maximum	Mean	Median	Mode	S.D.
Kept	250 (50 %)	500 (100%)	370 (74%)	250 (50%)	250 (50%)	127,48
Shared	0 (0%)	250 (50%)	130 (26%)	250 (50%)	250 (50%)	127,48

Starting with the DG, the mean percentage kept of the 500-euro hypothetical endowment was 74 %, whereas the mean percentage shared was 26 %. As suggested in the literature, dictators chose to split their endowment as opposed to keeping it all for themselves. Commensurate with theory, the Nash equilibrium is not observed. Barring individual personality and temperamental variability, tacitly framing the scenario around fishing by having only fishers participate and describing the research in those terms may explain this behaviour. The individual variables of the players are presented below.

Sex		Mean	
Male	Female	Education	Age
25	0	6,28	53,52

Different educational levels have been assigned a number; 1 – none, 2 – primary, 3 – collège or middle school, 5 – lycée or high school, 6 -vocational school, 7 – university or specialized school. Each respondent was assigned a number based off their level of education, and the cumulative value divided by n resulting in a value of 6,44. The mean age of the participants came out to 53,52. In the sample collected none of the participants were female, which was expected given a limited

n as well as males making up 93 % of recreational fishers in Amiens, see appendix B. The following table shows basic investment data for the PGG;

Offer	**Minimum**	**Maximum**	**Mean**	**Median**	**Mode**	**S.D.**
Public	350 (70%)	500 (100%)	486 (97.2%)	500 (100%)	500 (100%)	39,58
Private	0 (0%)	150 (30%)	14 (2.8%)	0 (0%)	0 (0%)	39,58

In the PGG'S, a far greater percentage of participants chose to contribute to the public fund as opposed to keeping the share for themselves. Again the Nash equilibrium is not observed, and fishers express altruistic propensities. Given that the game was framed around management of the Somme River, individual fishers appear to have a strong preference for collective investment suggesting the institution of recreational fishing as well as the environment that permits it are regarded as valuable. Below are the results from a Repeated Measures ANOVA.

Repeated Measures
ANOVA

SHARED	25	3250	130	16250
PUBLIC INVESTMENT	25	12150	486	1566,667

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	209300	24	8720,833	0,958772	0,540644	1,98376
Columns	1584200	1	1584200	174,1677	1,7E-12	4,259677
Error	218300	24	9095,833			
Total	2011800	49				

As the p-value > 0.05, the null hypothesis remains and the alternate hypothesis is rejected. Results show that there is no statistically significant relationship between individual altruism and altruism in collective contexts concerning common-pool resource exploitation. Fairness in resource use and social norms appear to factor into individual interactions as influence by among others culture,

individual temperament and presumably mood but do not appear to translate in a meaningful way for collective decision-making for Amiens' recreational fishers. The results of two T-tests are presented below.

Participants have been categorized by two individual-trait variables: age, and education. Participants' ages were categorized into two; below 50 and 50 or over. For their level of education, high school and specialist schools were group together due to a limited n, and university or its equivalents grouped together as well.

t-Test: One-Sample Comparing Age Groups

	Under 50	*Over 50*
Mean	485	493,3333
Variance	2250	666,6667
Observations	10	15
Hypothesized Mean	486	486
Df	9	14
t Stat	-0,06667	1,1
P(T<=t) one-tail	0,474152	0,144944
t Critical one-tail	1,833113	1,76131
P(T<=t) two-tail	0,948305	0,289888
t Critical two-tail	2,262157	2,144787

t-Test: One-Sample Comparing Education

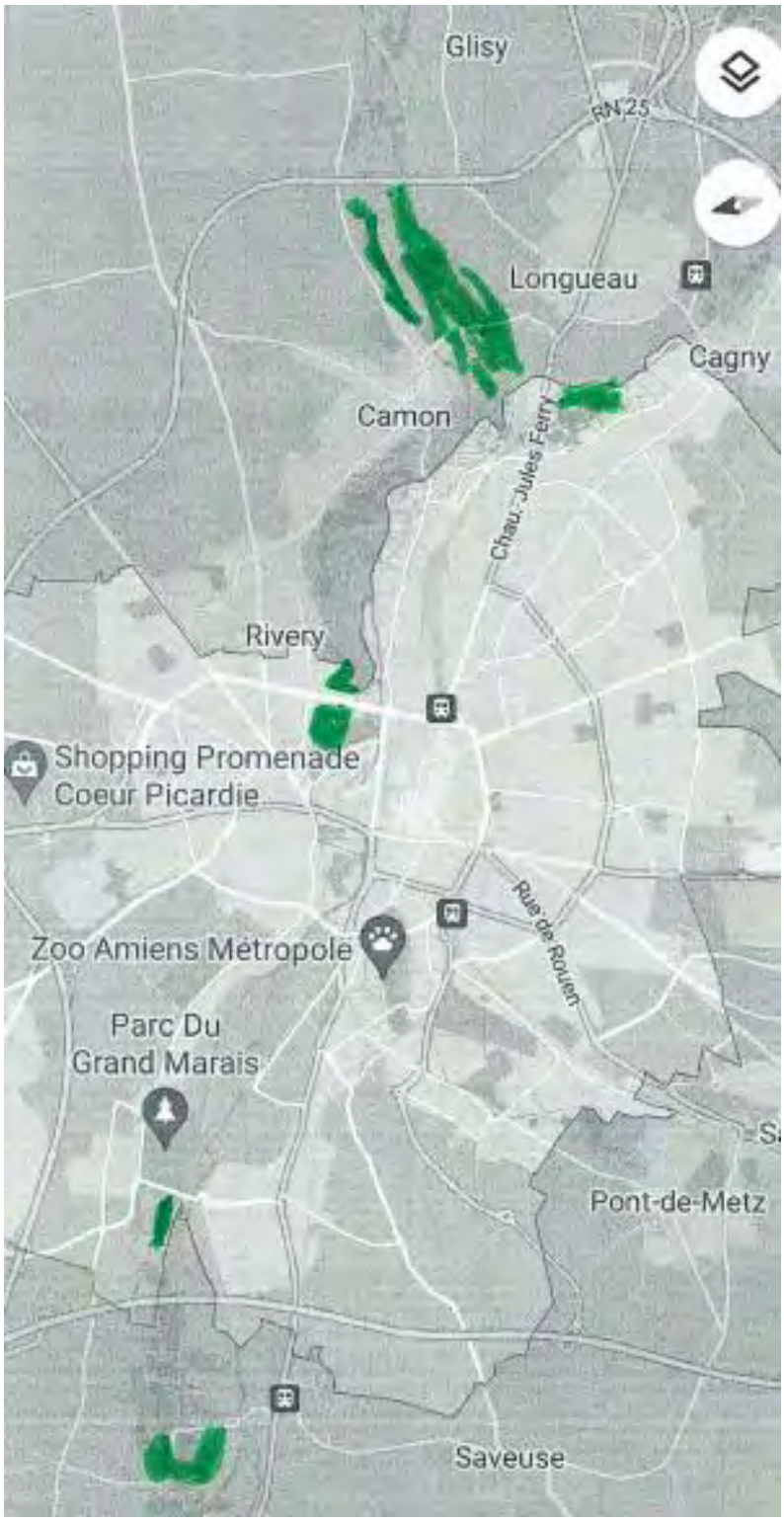
	HS or specialized	*Univ*
Mean	493,75	483,3333
Variance	625	2500
Observations	16	9
Hypothesized Mean	486	486
df	15	8
t Stat	1,24	-0,16
P(T<=t) one-tail	0,117011862	0,438424
t Critical one-tail	1,753050356	1,859548
P(T<=t) two-tail	0,234023724	0,876847
t Critical two-tail	2,131449546	2,306004

Though not uniform, all show a p-value > 0.05 suggesting no correlation between either of these individual-traits and altruistic propensities in decision-making concerning investment choice. Anecdotally, it is possible that fishers under 50 years of age appear to show a weakened proclivity to share compared to those over 50 however this has not been tested for. The same is true for fishers with a university background versus those with a high school or specialized background.

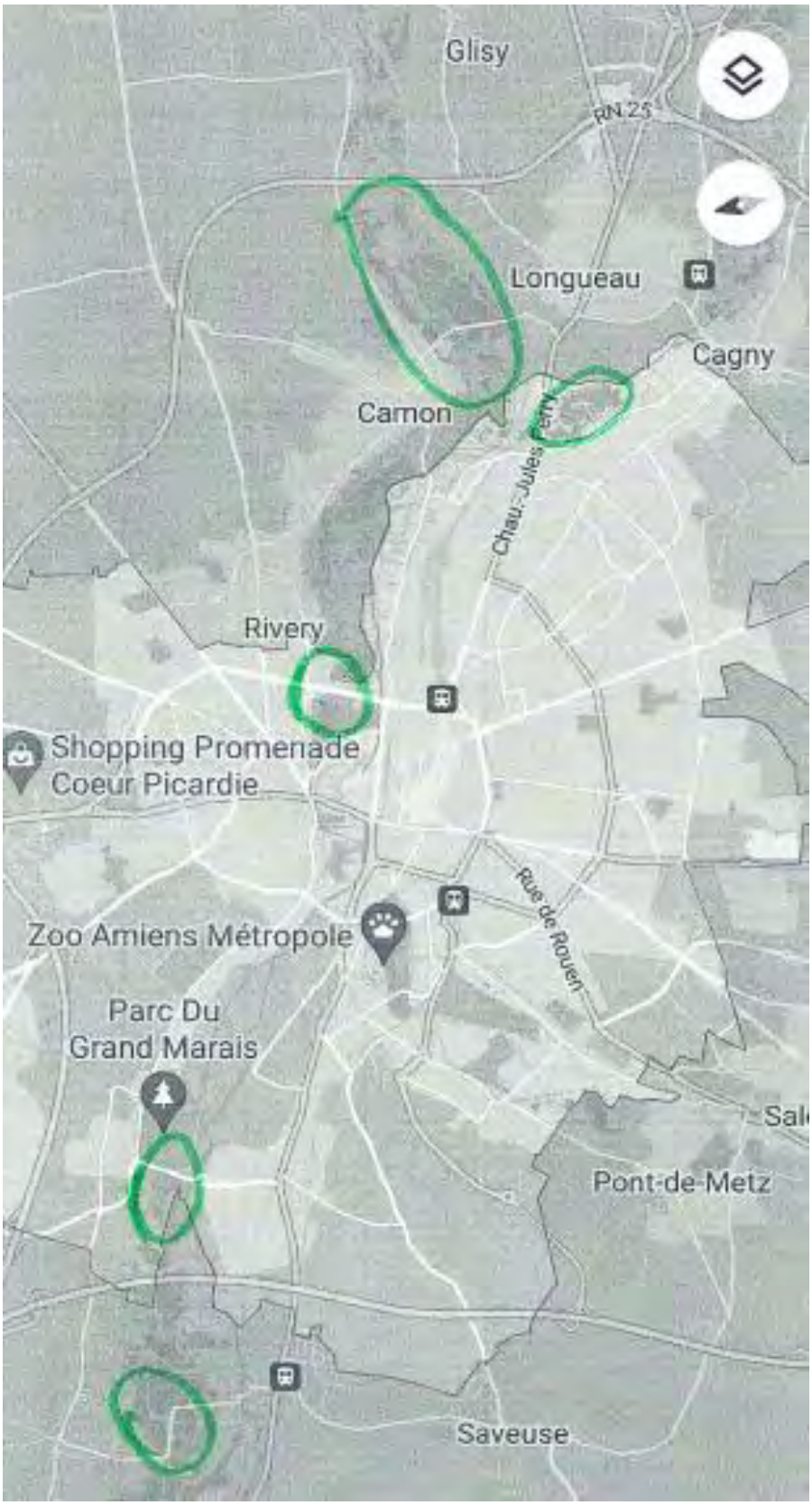
Fisheries Governance

From the cognitive-mapping exercises, no parallel fishing boundaries nor alternative fishing grounds are observed. What one would expect so see if an informal system were present was informal fishing boundaries and concurrent rules differing to those established by the Somme Federation. Instead, the areas marked by both focus groups correspond with official fishing grounds provided by the Federation, see page 86 of appendix A. As such, no evidence was collected for the existence of an informal management system. Neither were the structured and semi-structured questions aimed at governance successful at finding evidence for an informal recreational system (see appendixes C and D). *'La, il n'ya personne sauf le Federation qui gere les pecheurs*' (here there isn't anyone apart from the Federation that manages fishers) one participant told me. As was expected none of the participants, neither in the game sample nor the descriptive focus groups indicated a reliance on fishing for nutrition needs nor livelihood. The literature, in tandem with national laws on fishing had explicitly stated recreational fishers were restricted in their activities. Catch limits are in place, and importantly sale of fish is prohibited. As per Mr. Dufrêne (key informant), the fish remain public property (see appendix A) even if the watercourse where they are found passes through private property (see appendix H). Mr. Dufrêne attributes this to a distinction between northern and southern France, where a more communal ethos has historically existed. I could not verify this claim, the historical record did not turn anything over. *'Avant 1804, la France a ete diviser par plein different regions avec leur proper traditions et lois*' (before 1804, France was divided into many different regions with their own traditions and laws' he said.

Cognitive-mapping exercise results, see appendix C for interview schedule (next page)



Focus group one.



Focus group two.

On a morning drive with Mr. Dufrêne the impact of agriculture in the Somme department ecologically and economically was made clear. The landscape is dotted with patches of privately owned land where agricultural activities are common place. From Mr. Dufrêne as well as historical records (provided in the next section) agricultural activity have played and continue to play a crucial role in the Somme's economy. While on this drive, it so happened that dead fish had been spotted somewhere along the river by a Federation worker. The authorities under the Federation responsible for investigating these kinds of events, '*les flics ecologique'* (the ecology police, though this name is informal) were deployed. Initially, the suspicion was either contamination from agricultural activity or from industrial wastewater. By midday a report was called in, the issue had instead been an invasive species of plant. Water flow had been impeded by some blockage, and the plant in question had stripped the river area in question of oxygen leading the fish to die from oxygen deprivation. The Federation works closely with its agricultural counterpart as a means of curbing any potentially harmful activity that may impact the health of the local fishery. Mr. Dufrêne did however state that agricultural runoff does present challenges from time to time, and more coordinated effort is required to mitigate the damage.

Free-listening exercise revealed a depth of knowledge concerning local fisheries ecology on the part of Amiens' recreational anglers. On the following page is a list of fish species present as per the focus groups. The fish are presented by their scientific names A grouping between native and non-native (introduced by human beings) was chosen as a follow-up to the work by Souchon and Keith (2001), and Bayramoglu et al., (2019), to conserve a baseline for future researchers interested in the Somme region. The list appears fairly accurate given the repeat species listed by participants and validates the assumption older fishers would have more ecological experience. The origins of the species were not always known by participants: '*je [ne] sais pas, je entendu le gens dit que les môle n'est sont pas natif la mais je [ne] suis pas sur'* (I don't know, I've heard people say the Sunfish are not native but I'm not sure). In general, participants appeared to have a good grasp of fish habitats and patterns. When asked about specific fish they had mentioned, the most often response would be *'ils ont la bas*' (they are over there) followed by pointing, or a description of sorts. However, similar to results from the mapping exercises no evidence was found that any other management system other than the formal one was in operation. Questions specifically aimed at observing and documenting this knowledge did not turn anything over, see appendixes C and D.

Table 1. showing results from the free-listing exercises with both focus groups. Fish have further been categorized as either native or non-native, see appendix C for interview schedule.

Name of Fish	**French name**	**Native**	**Non-native**
Crucian carp	Carpe Crucien	x	
River herring	Hareng de rivière	x	
Lampreys	Les Lamproies	x	
Gudgeon	Goujon	x	
Carp de nuit	Carp de nuit	x	
Barb	Les Barbus	x	
Perch	La perche commune	x	
Black bass	Perche d'Amérique	x	
Sunfish	La Môle/ Perche soleil		x
Ruffe	La grémille	x	
Sculpin	Le Chabot commun	x	
Tench (Tinca tinca)	La tanche	x	
Three-spiked stickleback (Gasterosteus aculeatus)	L'épinoche	x	
Nine-spiked stickleback (Pungitius pungitius)	L'Épinochette	x	
Northern pike (Esox lucius)	Le brochet	x	
Spirlin (Alburnoides bipunctatus)	Le Spirlin	x	
Common bleak (Alburnus alburnus)	L'ablette	x	
White bream (Blicca bjoerkna)	La Brème bordelière	x	

Common bream (Abramis brama)	La brème commune	x	
Name of Fish		**Native**	**Non-native**
Rudd (Scardinius erythrophthalmus)	Le rotengle	x	
Amur bitterling (Rhodeus sericeus)	La Bouvière	x	
Common dace (Leuciscus leuciscus)	La vandoise	x	
Common roach (Rutilus rutilus)	Le gardon	x	
Common chub (Squalius cephalus)	Le chevesne	x	
Ide (Leuciscus idus)	L'ide mélanote	x	
Common nase (Chondrostoma nasus)	Le hotu	x	
Brook trout (Salvelinus fontinalis)	L'omble de fontaine		x
Stone moroko ((Pseudorasbora parva)	Goujon asiatique	x	
Sunbleak (Leucaspius delineates)	L'Able de Heckel	x	
Wels catfish (Silurus glanis)	Le silure glane	x	
Spined loach (Cobitis taenia)	La Loche de rivière	x	
Stone loach (Barbatula barbatula)	La Loche franche	x	
Sea trout (Salmo trutta)	La Truite d'Amérique	x	

Rainbow trout (Oncorhynchus mykiss)	La truite arc-en-ciel		x
Grayling (Thymallus thymallus)	L'ombre		x
Zander (Sander lucioperca)	Le sandre doré européen	x	
Name of Fish		**Native**	**Non-native**
Arctic trout (Salvelinus alpinus)	L'Omble chevalier	x	
Brown trout (Salmo trutta)	La truite fario	x	
Lake trout (Salvelinus namaycush)	Le touladi		x

An assortment of equipment is used by Amiens' anglers. Rules of etiquette, watercourse, and fishing targets augment the gear fishers use and where they on the water they fish. '*Pour nous, le truc le plus important c'est d'avoir le respet pour un endroit et d'autre pecheurs'* (for us the most important thing is to have respect for an area and other fishers) as reported by one participants. '*Il faut savior comment lire l'eau* (it's important to know how to read the water). Some fishers stated it is often easier to fish where there are weeds or lots of vegetation close to the shore. Allegedly fish spend lots of time around those spots '*ouai c'est vrai, on ai des bateau pour quoi que c'est sois qui est situe plus loin dans l'eau*' (yeah its true, we have boats for whatever else that is found deeper [more inward] in the water. In Amiens, there are two watercourses fishers may use to fish. However, access to either is dependent on season given the Federation manages use dependent on the time of the year. This is done to maintain fish stocks, see appendix A. Infringement is punishable by fines.

Beginner guides which are offered by the Federation advice first-time or inexperienced anglers use a rod and reel to start off with. Rods and reels are fairly easy to master, have a small ecological foot print relative to cages for example, and often come together meaning no complicated setup is required. More experienced fishers use a more elaborate assortment of products. Bait is also sold by the Federation including worms and a putty-like substance that fishers can attach to their hooks.

Young fishers (below 12 years old) can also acquire some training offered as a response to declining rates in fishing. In addition, plaques and safety clothing (made with reflective material for example) and gear (life jackets) are available. Price's range from €19 for a single cage to €130 for five depending on the size, €5 for plaques, and €37 for books on the history of fishing in the area among others. Some items are shown in the images on the following page for reference.

Images of some products offered by the Federation including fishing and hunting gear, and their prices.

Discussion

The DG results, as with similar studies indicated that individual altruistic propensities were present among Amiens' recreational fishers even when they could benefit from complete selfishness. The Nash equilibrium was not observed in the games, consistent with relevant experimental economic literature. Once again the assumption of selfish rational choice did not hold, although the observed rates of altruism were relatively low in comparison to those of the PGG. Mean rates of endowments captured with Amiens' anglers stood at 74% (kept) and 26% (shared) respectively. Anglers expressed generally altruistic behaviour despite being prone to decisions that accrue greater personal benefit (maximum endowment kept being 100%, minimum 50%) at the cost of another (maximum endowment shared being 50%, minimum 0%). We can assume then that, like other studies into altruism, concepts of fairness, and broader personal and social norms influence individual economic decision-making.

The results also showed that rates of altruism in collective scenarios exceeded those observed in individual scenarios. The PGG data indicates that mean rates of contribution to a collective investment concerning local fisheries stood at 97.2% and its individual counterpart only at 2.8% (a difference of 23.2% in both compared to the interpersonal scenario of the DG). The increased willingness to incur personal cost for collective benefit is further shown by the maximum and minimum total contributions made to the public investment (100% and 70% respectively) verses those made to the private investment (30% and 0% respectively). These finding too undermine selfish rational choice as once again the Nash equilibrium was not observed. Like DG findings, Amiens' recreational fishers seem to factor in other, perhaps more holistic considerations when making economic decisions. Both of these games were played only once, under exceptional conditions (given the global pandemic), without a randomly sampled group of participants. As such, future research with a stronger, iterated design (de Figueiredo, 2018) could arrive at different conclusions.

Assuming games stand as decent proxies first for cooperative behaviour, and second for collective decision-making concerning natural resources, theory would suggest that Amiens' recreational fishers are more likely to cooperate for preservation of their commons. The game results showed a greater preoccupation with self in interpersonal contexts concerning strangers, but greater collective altruism concerning fisheries management even with strangers who were also fishers.

The repeated-measures ANOVA ran suggests the same, showing a P-value of 0.54, thereby retaining the study's null hypothesis; there [was] no statistically significant relationship between individual altruism and decision-making in the exploitation of common-pool resources. On the question of value, following von Mises I prefer not to speculate as to why Amiens' anglers exhibited the preferences they did. I am willing only to say that the available evidence suggests a value placed on recreational fishing, and by extent the freshwater ecological health that permits fishing as an institution and as an activity. Research into the exact motivations of recreational fishers in Amiens remains open to future scholars. Below I now address recreational fisheries governance in Amiens.

What function does a system of tenure play universally? The first is described by Hardin and Ostrom: four property configurations are present globally, that is to say no fifth has ever been documented among any peoples. These are private, state, common, and open access. Depending on region, the specifics change but those are better thought of as differences in degree not kind. Recreational fisheries at the Somme River, Amiens from the data gathered are subject only to a state management system based on private and public systems of tenure. The development of the tenure system present can be traced historically from the fall of the last Western Roman stronghold incidentally located between the Loire and Somme Rivers, the evolution of the dominial system, its transformation into feudal and seigneurial systems, and later the instantiation of public and private tenure after the French revolution of 1789.

Cross-culturally, a tenure system appears to delineate members of the in-group from members of the out-group. A question: Agrarian subsistence fishers from Brazil, industrial recreational and commercial fishers from New York and Maine respectively, !kung hunter-gatherers from Southern Africa, what remains common between all these groups? Exclusion of outsiders, offering the right to subtract to insiders, and a form of punishment for free-riders and interlopers whether through social exclusion or fines are present in all as resource management strategies. What constitutes either group differs by context, spanning from dialect differences to differences in belief and appearance among many others. In Amiens, from the perspective of formal management it is the holder of a valid license which grants access only to rivers in the Somme department. Human ecological scholars have noted in hunter-gatherer, agrarian, and industrial societies alike that group exclusion from the right to subtract natural resources through physical or social boundaries

accompany all tenure configurations. For recreational and commercial fishers in France the same holds true, who themselves are divided by law.

The same holds true in Amiens as well where recreational fishers differ managerial responsibility to the Federation which then excludes by way of fishing permits. Permits separate recreational and commercial fishers, then specify the geographic location an angler may fish. Subtraction rights are provided to licensed fishers with guidelines placed to curb overexploitation be it through seasonal or geographic constraints, catch limits, or restrictions on equipment. Free-riders and interlopers incur fines if caught. Presumably if continuing, the threat of imprisonment is on the table. A third universal found in the literature concerns formal or informal management systems. A formal system, repeating is one recognized by a population which, in principle is the central governing system. An informal system may or may not be recognized and is usually managed by local peoples. Formal systems have been observed in Agrarian and industrial societies alike, differing only in degree but not kind as well. These systems can standalone or run parallel to formal counterparts. Informal systems tend to mirror common tenure systems in their approach to boundaries, in-group rights, and out-group exclusion. In Amiens, the data did not suggest the existence of an informal system for recreational fishers. Instead, the Somme Federation enforces a formal, state mandated management system financed through tax euros. Perhaps one exists for their commercial counterparts, an area for future research.

From the ecological anthropological literature, an informal system if present can be observed using LEK tools. My study settled on cognitive-mapping exercises, and free-listing exercises which attempted to document knowledge from experienced fishers on their local ecology and governance. The data produced, or rather lack of data suggested no parallel governance in addition to that of the Federation. For example, mapping exercises turned over the same boundaries as official state documents. What would be expected if an informal system existed is a different system of rules and fishing ground boundaries, however none of that was observed. Experienced, local fishermen were snowball selected as research participants, eliminating the likelihood of ignorance. The fishermen further did show an understanding of local fish in their behaviour and classification, a testament to their experience which increased my confidence in their knowledge. Initially, a pile-sorting exercise was incorporated into the research design, however this element was dropped. Pile-sorting entails taking a list of items and sorting them by preference given whatever research

context is presented. Amiens' recreational fishers by self-admission showed little preference for species and more for size rendering pile-sorting null.

The final cross-cultural pattern, albeit with lots of variation observed in the research literature is on the level of centralization within a management system. Centralization refers to the level of top down management present in a given system. Centralization does not mean organization, as the latter can present anywhere between the spectrum of centralized and decentralized authority. From the literature, strong centralization does not appear necessary for resource management where locals engage in cooperative behaviour and mutual exchange. This observation holds for the earliest civilizations of humankind dating back thousands of years to present societies, suggesting a deep human constant. In Amiens, the historical data, empirical data, and informant testimony all point to a strongly hierarchical but largely decentralized system. Within the present management system legal obligations scale from local concerns to the EU and its international obligations. These obligations are managed by the national government, the relevant stakeholder at this level. Below the government are basin-level bodies whose obligations including water and fisheries management planning and the allocation of funds to communes, group communes and decision-makers. Below basin-level bodies are the final stakeholders, civil society whose consumption choices and political activity form the basis of governance. A mix of both voluntary and involuntary management methods are used by the Federation in Amiens including conservation networks and non-binding conservation activity in the former, and imposed restrictions and regulations in the latter (see appendix A). Conservation easements have also been introduced but not much utilized given benefit to a neighbouring property first has to be established.

France's peculiarity in natural resource management stems from the nation's apparent commitment to common patrimony. 'Recreational fishers' as a class according to France's system retain rights to use and exploit fisheries resources in the nation. Whether or not a French citizen or resident holds a fishing license or indeed interests him or herself in fishing, the right remains as an inherence of patrimony. The right is actualized when a fisher takes the steps to be recognized as such, namely, attaining a recreational fishing license which automatically registers him or her to local governmental bodies that provide political representation for anglers. Like previous anthropological research into individual and group-based rights of exploitation, this study finds in Amiens that individual fishing rights are not transferable. This is consistent with the theoretical

assumptions of pragmatic economic approaches to environmental study (new environmental pragmatism). Simultaneously, the study also finds harmony with common patrimony and the theoretical assumptions of Social ecological economics where the rights to fishing as an institution (patrimonialisation) are transferable. The institutional right transfers from generation to generation, but the individual rights do not. This may be because the right is assumed but requires action to take effect (obtaining a fishing license in this regard).

From the historical record it is evident that recreational fishing rights are a relatively recent phenomenon. With the development of feudalism, fishing rights were subject to fiefs granted by feudal lords to their vessels. At some point along the historical line as the French aristocratic class crystallized and recreational fishing right became exclusive, enjoyed only by the upper classes. With the Revolution of 1789 and the subsequent birth of the French Republic bound by a universal legal code (the Napoleonic Code of 1804) recreational fishing is liberalized for the first time in centuries. Feudalism is abolished, property and contractual rights are established, the French common class are granted voting rights eventually extending to women, and a culture of recreational fishing again develops. With the privatization of land however, the French Republic recognizes the common nature of many public goods and attempt to meter the potential excesses of privatization and may be one response to the issues raised by Kamal et al., (2015). Regardless, large areas of land are administered by the government as a matter of heritage.

As Mr. Dufrêne (himself an experienced fisher) as well as experienced fishers revealed, fishing is permitted only at designated public areas, unless one gets permission from a private owner were the river runs through private land. Two watercourses are present, each with its specific governing rules and regulations, see appendix A. While fishing is open to all with a license, fish as a natural resource remain monitored by the government through the hierarchical but decentralized formal management system present in Amiens. On private property where a body of water crossed, according to the key informant one still requires a permit as the fish and water are not private property. Further, any activity that interferes with the natural flow of water and fish contravenes law. If a permitted fishing ground shades into private territory and a fisher knowingly continues to fish, that person contravenes the law. Say this fisher continues to fish in the public waters but from private property without permission, that person may have legal charges brought against them

(most likely trespassing). For photographs, see appendix H. Where the situation shifts in Amiens differs from that present in the selected literature pertaining to management is plentiful.

First, as the study focuses exclusively on recreational fishing, dependence (on fisheries resources for livelihood or nutrition) as a factor of governance is likely negligible given sale is legally prohibited and from the data collected it is suggested fishers were concerned more with fish size and enjoyment then nutrition. Second, France as an industrial society along with its fisheries are strongly integrated into the market. Third, immigration to France, being a wealthy nation is relatively high. And fourth, inclusion and exclusion is not based on kinship-relations in the same way as it is in the examined Latin American, Southeast Asian, and Oceanic societies. France much more closely resembles the situation in Maine, US described by anthropologist James Acheson barring that in Maine an informal, parallel management system is present focusing on commercial fisheries. Intergenerational interest in fishing, while not studied was a topic consistently brought up by research participants as well as my key informant.

Anecdotally, changes have allegedly been observed by locals who claim interest in fishing overall in the nation is on the decline. The available data does suggest there is merit to the observation. For example, when comparing the proportion of licenses issued by region one finds that bustling metropoles have fewer licenses issued per annum as a percentage of their populations than other territories, see appendix G. The observation is attributed by locals to cultural shifts brought by globalization in tandem with technological change, which are impacting the youth in particular. There are simply more recreational activities available in the present-day, perhaps the young in particular just have more options. Immigration may also explain this observation. It is possible that immigrant populations, who tend to cluster in metropoles, partake in recreational fishing at lower rates due to cultural and economic factors. In addition, as expressed in the fishing literature concerning sense making and the emergence of subcultures, rates of participation among demographic groups vary. These are open areas where future research could illuminate.

There has also been an active attempt on the part of the Federation to get more women and youths, specifically those under 12 years of age involved as a matter of heritage and feasibly, business. Promotional licenses such as the carte découverte 12-ans and carte découverte femme which carry lower tariffs where introduced with the goal of offering easier entry to recreational fishing to these groups (see appendix A). While fairly successful with the youth, recreational fishing remains an

overwhelmingly male activity. Controlling for potential cultural reasons, this trend follows the 'things versus people' gendered interest divide found by biological anthropologists, evolutionary psychologists and primatologists alike where on average, given freedom of choice males and females prefer spending their time differently as a feature of primate evolutionary history, see appendix F. An even more interesting question presents itself, especially given the current political climate: should men and women be equally represented at every level of social organization if the goal is genuine equality of opportunity and freedom of choice?

At the heart of modern anthropological discussion is the nature-culture dialogue. What is anthropology? To what extent can we justifiably claim our theoretical observations are universal, assuming universals exist? As an adjunct, how much variability exists within universal constraints? Does such a thing as 'human nature' exist? Responding, I believes so. Historically, anthropological skepticism of grand theories of humanity can be traced back to Franz Boas. Boas made significant anthropological strides away from taxonomic classifications based on notions of progress to historical particularism paired with cultural relativity. He was responding to the sociopolitical milieu of early 20th century Europe and America which had been informed by social Darwinism, an evolutionary theory predicated on this notion of 'progress' and projected into intellectual currents including but not limited to eugenics and theories of racial supremacy. Up until the mid 20th century in Europe and America alike, social Darwinism remained a popular heuristic informing explanations of cultural phenomena, particularly among non-Western peoples. This remained the case up until Claude Levi-Strauss' introduction of structuralism as an alternative. Following, social Darwinism was banned in Europe following the atrocities of the fascists led by Nazi Germany, and Levi-Strauss was exiled, under threat as a Jew, to the United States where he was introduced to Boasian thinking allowing structuralism to flourish on both continents.

Structuralism's importance vests not in the approach itself, but rather the assumptions it made about what anthropology ought to be, a vision which has been heavily criticized since the 1970's onwards. Structuralism's central thesis, like cultural ecology and most neo-evolutionary approaches hinges on cognitive, sense-making apparatuses being universal among peoples, paired with a corresponding quest for cross-cultural social and behavioural patterns stemming from this psychic unity (Levi-Strauss, 1963). For Levi-Strauss, anthropology was to be a comparative discipline searching for human universals. Since the mid-20th century I would argue that the

evidence for generalities across human cultures has piled, coming from the behavioural (and later cognitive) sciences, social science, and ethology. Consequently, are there any observable patterns in natural resource management across cultures? I have attempted to answer this question in the affirmative. Cross-cultural comparisons of the sort presented in this study are likely to be criticized on the same grounds as contemporary criticisms of structuralist and neo-evolutionary approaches alike which I must therefore address.

I focus here on structuralism because post-structuralist criticism animates most contemporary criticisms of cross-cultural research, as well as quests for universal patterns in human organization within the humanities and social sciences broadly (Hicks, 2004; Patoine and Hope, 2015; Pluckrose and Lindsay, 2020 among others). Therefore, a defense of structuralism's central thesis is simultaneously a defense of cultural ecology and most neo-evolutionary approaches to Anthropology, where they converge. As such, I agree with the overall structuralist vision of anthropology as a cross-cultural comparative disciple, along with many of the approaches assumptions regarding symbolic expression and culture as dependent upon uniform cognitive structures which are not simply conventional. By conventional I am referring to linguistic conventionality, denoting an arbitrary relationship between concepts and actual objects, which is the basis for the post-structuralist social constructionism (Hoffmeyer, 1993). This thesis however is not itself a structuralist work. Beginning, is it justifiable to reduce human complexity to a few generalizations? If any exceptions to the rule are presented, can the claim of 'universality' or 'patterns' still be defended? With specific attention to the reflexive turn of the 1970's, to what extent does the researcher's biases, and structural 'privilege' negate his ability for lucid analysis free from an underlying quest for power of which he is not in control?

Addressing, it is near impossible to find completely baseless criticisms. The points presented by post-structuralists appear salient… to a degree. However, the flaws in many of these arguments lie not in the specific claims alone but rather their level of analysis. Post-structuralist criticism of cross-cultural anthropological study and the quest for human patterns and universals stems fundamentally from Saussurean 'semiology', a branch of semiotic theory developed by Swiss social linguist Ferdinand de Saussure (Levi-Strauss, 1963; Patoine and Hope, 2015). These criticisms make deep philosophical claims about the foundations of human cognition and behaviour, not simply warnings about humanity's more negative tendencies as many may assume.

Post-structuralists and their compatriots posit a central anthropological thesis where no ground exists for universality of any kind, outside of that dictated by a society through a language convention, given an independent ontology is inaccessible to humanity. Post-structuralism and its offshoots are radically subjectivist and almost entirely social constructionist in their ontology, a viewpoint best encapsulated by Jacque Derrida's infamous proclamation that '*Il n'ya a pas de hors-texte*' (there isn't an 'outside-text'). As such, every society is a world of its own disconnected from others.

Accordingly, external reference from an ontological perspective is possible only as the product of an internal social reference system that has no 'real' ontological basis neither philosophically nor biologically. Under those conditions, post-structural epistemology argues that central to any truth or universal claims vests the impulse by privileged groups to maintain power acting through social structures. Power is conceived uniquely as an oppressive zero-sum game targeting victimized groups (Hicks, 2004). There is no individual agency from a post-structuralist point of view either given human behaviour, including individual decisions are products of the local superstructure. I adamantly reject every one of these claims. I base this thesis, and therefore my rejection not on Saussurean semiology but rather on the semiosis of American logician and pragmatist Charles Sanders Peirce, Saussure's contemporary. Peircean semiosis differs from semiology in that access to an independent ontology is not only possible, but a pragmatic constant for all life including humanity. As such, I take it as a given that: language is not the primary way humanity communicates or contacts reality, there exists an accessible ontology independent of human society and culture, that cross-cultural research is possible and necessary, that the claim of all human behaviour as socioculturally constructed is an unacceptable tautology, that species-specific continuity exists between all members of our species, that language (and by extent culture) is not merely an arbitrary social convention and is dependent upon cognitive and biological constraints common to all projected outwards, and that explanations of human behaviour and organization that are not biologically commensurate (depending on the strength of evidence) must be regarded with great suspicion (Levi-Strauss, 1963; Hoffmeyer, 1993; Kockelman, 1998; Aswani, 1998; Deacon, 2003 among others).

Peircean semiosis stands as a branch of logic (discipline), not social linguistics, which accounts for their differences. Peirce recognized that while an independent ontology may never truly be

accessed, approximations were possible. He called this abduction, a pragmatic tool supplementing hypothetico-deductive methodology (Hoffmeyer, 1993). His semiotic theory recognized semiosis as a universal process of sign-relations at the basis of biological and cultural meaning-making and communication (Deacon, 2003; Kockelman, 1998). Worse still for post-structuralists and the insistence on 'no outside text' so to speak, semiosis as described by Peirce being unconstrained by social linguistic reference alone can and has been successfully applied to research into molecular biology (Barbieri, 2003), ecology (Nielsen, 2007; Maran and Kull, 2014), and non-human behaviour and social organization (Delahaye, 2017), suggesting a broad applicability that Levi-Strauss himself as a Saussurean was likely unaware of. Signs as a grounded ontological reality present in three interrelated forms: icons, indexes, and symbols (Kockelman, 1998). All three barring symbols (the basis for symbolism), which appear to be human specific (another universal) as far as we can tell are present amongst all plant and animal life. Peirce thus solves the tautology of social constructionism by showing that the fact of culture (another human universal) is the product of underlying cognitive processes, not itself. Culture is emergent. In this way he anticipated modern human behavioural science. Below, I expand on my criticisms of post-structural thought further.

First, are the claims of internal reference (Saussure's dyadic model, accepted by post-structuralism and rejected by me) and power themselves not universal? If so, then not only can universality not be negated but the post-structuralist argument must be assessed against every other claim of universality as an equal, and evidence presented. Perhaps post-structural criticism is aimed uniquely at Western societies and those that have been subjected to Western influence. The claim would accordingly no longer be universal, rendering post-structuralist critique more logically consistent. If that is the case, by what standard can any claims about non-Western peoples or cultures be made be they positive or negative by any researcher? Can any truth claims be advanced about a society of which you are not a part? Where does this end? Can I as a Zulu man make any claims about any other Southern Bantu groups given the historical and institutionalized oppression, genocide, and suffering caused by 'my people' against 'them'? Does my Sotho half perhaps negate my Zulu half? What does post-structuralism offer as an alternative? As far as I have been able to discern, it by definition cannot because that would require generating a metanarrative, a concept post-structuralism explicitly rejects.

Perhaps the solution instead lies in the complete rejection of the concept of truth as posited by some post-structural theorists including Michel Foucault, Stanley Fish, and Judith Butler among many others (Hicks, 2004; Pluckrose and Lindsay, 2020). If that is the case, there is no point engaging theories or arguments that are not and cannot be true by self-admission. What would the point be? Truth, a far as I can tell refers to the actual state of affairs, and a goal of human life be it artistic, scientific, or philosophical is to elucidate this state. If that is indeed the case, no more cynical, nihilistic, and counterproductive a claim could be made than one that no such thing as truth exists. This goes to the level of analysis problem I first mentioned. It is perfectly acceptable to state that ultimate truth is unknown, and that often falsehoods masquerade as truth for personal or group benefit. To say however that there is no truth, an ontological claim which has downstream metaphysical and epistemological consequences, is to take the argument beyond what is logical. Is that statement itself true or untrue? The end point is logical regression which would require a metastatement to resolve if possible, something once again explicitly rejected by post-structuralism.

On the second claim of power, again as a claim about the human tendency towards corruption I accept. However, if espoused as a central feature of human society and simultaneously conceived as an oppressive, zero-sum game the claim is rejected. The problem with post-structuralism is its rooting in explicitly radical, not in the positive sense, political philosophy, particularly radical left-wing philosophy (von Mises, 1998; Hicks, 2004; Pluckrose and Lindsay, 2020 among others). Resulting, it is often difficult to parse the approach's academic claims from its political ambitions. The Sokal hoax (1996), and the more recent grievance studies affair or 'Sokal 2.0' (2017-2018) where intentionally nonsensical, politically charged papers were successfully accepted, published, and defended by 'serious' journals purporting to be academic even once the 'jig was up' is a troubling indictment. Societies predicated on power as their central feature, the ability to subject swarms of people to arbitrary whim without regard for their affective experiences incur huge enforcement costs in comparison to their more cooperative counterparts eventually, rendering their 'game' unplayable from a game theoretical perspective (Boyd et al., 2004; Henrich, 2020). The problem with essentially Marxian claims of this sort (critical theory, post-structuralism, and decolonial theory all actively or tacitly accept Marxist conflict theory as central to the human story) is human nature is theorized as fundamentally combative (von Mises, 1998; Hicks, 2004; Pluckrose and Lindsay, 2020).

Evidence from the behavioural sciences does not support such claims as we are both combative and cooperative. We could not be social animals otherwise. I would further argue that the historical record looks upon conflict theory unfavorably given every time its premises were instantiated and permeated a society, those societies transformed into what can only be described as hell on Earth (Rummel, 1997). Marxian conflict theory was dubious in the economic realm evidenced by the collapses of the Soviet Union, Zimbabwe, Cambodia, Vietnam, Cuba, Latvia, and Bulgaria among many others in 20th century, not to mention the continued infringements on the human spirit in North Korea, and increasingly in China. Marxian conflict theory most likely remains dubious in the sociological realm; I am of the opinion that the cracks are already visible within the political dialogue of much of the Anglosphere, including South Africa, and on university campuses which have increasingly become intolerant of 'oppressors'. Worse still, you need not do anything to be an oppressor but be born in the incorrect body or hold an incorrect political opinion whether conservative or liberal. Yeonmi Park, a well-known North Korean defector has spoken unfavourably of her time as a Columbia University student where she had to 'learn to self-censor again' so as not to slaughter any sacred political cows. Her interviews are well worth a read and or listen.

Marxian conflict 'theory', which by the standards of even the social sciences is nowhere near a theory has been put to rest among behavioural researchers of human and non-human primates. Predicated fundamentally on class (or identity in the contemporary formulation), conflict social organizations are again not game theoretically stable. A good example can be seen in the present intersectional movement which keeps on fractionating (or better yet, deconstructing), influenced by much of the same thought. An amusing story is provided by feminist Christina Hoff Sommers in her book 'Who Stole Feminism?'. Hoff Sommers attended a feminist conference in the early 90's composed of a variety of feminist perspectives. She notes that among the intersectionalists, as the conference progressed so too did the divisions among their members. First, on the basis of conflict theory the intersectionalists fractured into white and non-white camps as the former possessed 'oppressive structural privilege' over the latter. Among the non-white members, the group fractured again between those who were heterosexual and those who were queer as the former again possessed oppressive structural privilege over the latter. Naturally, the two fractionated further into those with white sexual partners, and those with non-white sexual partners as the former benefited from the oppressive structural privilege of their significant other. All this

to say, as these ideas play out sociologically the ‘progress’ and ‘justice’ claimed by their proponents cannot be seen, suggesting to me the informing heuristic is flawed both practically and for research purposes.

Anchoring Levi-Straussean structuralism on Peircean semiosis validates many of Levi-Strauss’ claims which have since been attacked rather vehemently by his detractors: a true anthropological science predicated on linguistic (and semiotic) and evolutionary analysis is possible, an external reality independent of class struggle exists, uniformity exists in fundamental human mental (such as those that permit symbolism or enculturation) processes at the level of cognition, cross-cultural comparison is not only possible but desirable to elucidate human universals and patterns (which necessarily exist), and empirical synchronic observation must be couched within a diachronic historical context. To this suite I would add, a simple oppressor-victim assumption of human relations as is nowadays all the range is too unidirectional and shallow to contribute seriously to the discussion of human nature. As observed by Patione and Hope (2015), structuralism’s reliance on Saussurean semiology rendered it an approach working against itself from the very beginning. The door was left wide open for the post-structural turn of the 70’s which I view unfavourably. Terrence Deacon, Professor of Anthropology at UC Berkeley in the US posits that there are aspects of human nature that are neither biological nor social basing his argument on semiotic theory. Paul Kockelman and Michael Silverstein (deceased, 2020), Professors of Anthropology at Yale and the University of Chicago respectively make similar arguments. Perhaps that is the direction this debate will head in the coming decades, personally I am inclined to agree with the premises.

Chapter 5: Conclusion

In conclusion, in Amiens it was found that no relationship existed between individual altruistic propensities and decision-making concerning common-pool resources amongst recreational fishers. In line with the experimental economic literature, the Nash equilibrium was not seen in either the DG nor PGG. Narrow selfish rational choice did not apply to recreational fishers in Amiens, instead altruism predicated presumably on notions of fairness and perhaps cultural norms influenced individuals' decision-making. The study's findings suggest that recreational fishers in Amiens place value both on fishing and the ecology that permits the fishing institution's continued existence. Referring to governance and management no local, informal system was observed. While more experienced fishers possessed LEK related to fish and their behaviour, no evidence was shown of neither independent nor parallel informal systems. No parallel fishing boundaries were found through cognitive-mapping exercises, no reports of a local system where made by participants, and pile-sorting failed as a research method. Instead it appears that local anglers differ management responsibility to the formal system in place.

Formal management in Amiens is hierarchical and decentralized, scaling from local obligations through to those of the EU. The study found that many of the strategies in place broadly mirror those observed in hunter-gatherer, agrarian, and industrial societies differing in degree but not kind. First, a tenure system predicated on outgroup exclusion is present and based on private and public ownership. Licenses are issued by the AAPMAA separating recreational fishers from their commercial counterparts. Outgroup exclusion is aimed at curbing free-riders and interlopers who are fined if caught contravening rules and subject to prison time at the extreme. In-group inclusion provides rights of subtraction and exploitation of natural resources, in this case fisheries resources. Catch limits, as well as seasonal and geographical limits are further placed by licenses, aimed at resource management. Common patrimony solidifies recreational fishing as an institution conferring heritage rights to French residents. Use rights emerge once licenses a procured. Lastly, recreational fishers are automatically admitted to a recreational fisheries association that offers political representation.

Theoretically, this study falls in the tradition of human ecology. While heeding economic anthropological warnings against assumptions of Homo economicus, it is not a work of economic anthropology. The study accepts the central thesis of structural and neo-evolutionary research: a

comparative anthropological science. Like Levi-Strauss, my view regards anthropology as a comparative empirical discipline relying on historical methodology to provide context. Consequently, the existence of a human nature, the use of linguistics and semiotics to access cognitive meaning-making apparatuses, and species-specific continuity are accepted. Diverging from Levi-Strauss and the overall structuralist project, the paper basis itself not on Saussurean semiology but Peircean semiosis. Resulting, the post-structuralist claim that comparative studies between different societal groups may be or definitely are impossible (depending on the theorist) is rejected. The paper has attempted to demonstrate, to Levi-Strauss' point that not only is cross-cultural work possible due to the presumption of some degree of human universality but that such a view is crucial to anthropology. To understand humanity, we must understand how it presents comparatively in all forms. This is particularly true given the governance decisions we may need to make in the near future that invariably concern the biosphere.

Appendixes

Appendix. A. Field report.

Figure. 1. The departments of metropolitan France, from www.federationpeche.fr

It should first be noted that all the information presented in this section comes from Federation records and interviews with staff. France is a unitary semi-presidential republic divided into 94 departments. It is also a member state of the EU. The commune of Amiens falls under the jurisdiction of the 80th department called Somme in the North. The organization which oversees

governance of fishing at the Somme River in Amiens and adjoining lakes and canals is the Fédération de la Somme pour la Pêche et la Protection du Milieu Aquatique, translating to the Federation of the Somme for Fishing and the Protection of the Aquatic Environment. It is united with other federations under the Fédération Nationale de la Pêche. This body coordinates the Associations Agréée pour la Pêche et la Protection du Milieu Aquatique, (AAPPMA). The AAPPMA is responsible for issuing fishing licenses and automatically registers holders into the association. The Federation describes its mission as promotion of fishing and protection of the aquatic environment. It does so through education, representing fishers in meetings and bodies, and policing fishing activity contributing to restorative environmental actions. The Federation pays effectively rent to the state through the Direction Régionale des Finances Publiques (DRFIP) annually permitting their operation in the Somme area. The DRFIP describes itself as the decentralized level in the region and the department of the North and manages the collection and expenditure of public funds.

Tenure in Amiens falls into two categories: state property and private property. State property is owned by the French republic and private property is owned either by the individual cities and or communes, or natural and or juristic persons. The Somme River is classified as public, meaning owned by the state whereas the surrounding land, ponds and canals are private. The aquatic life in the river, ponds and canals is also considered public property. The aquatic life, mostly fish may be fished and consumed however selling is prohibited and subject to a fine of 3 750 euros (R63 750). Purchasers face the same penalty. In order to fish at the river, one must obtain a fishing license which allows fishing in designated areas regulated by the Federation, as well as any private areas with permission. Licenses are issued by departments and are only valid within that department, a Somme license holder cannot fish at any other fishing ground for example. However, there exists a license which permits holders to fish in areas where departments have signed reciprocal association. As of September 2020, 91 departments are signatories. This was instituted to encourage tourism.

There are three classes of license available at different price points divided into two categories: those for adults and those for youths. Adult licenses can be subdivided into those which run annually and those which are temporary. Youth licenses are all annual. Within the annual adult category there are three different license types; the carte personne majeure interfédéral allowing

the holder permission to fish on grounds in associated jurisdictions; the carte personne majeure allowing fishers to fish within their home jurisdiction alone; and the carte découverte femme which is exclusive for females and carries a unique tariff and fishing limited to one line. Within the temporary category are two license types; the carte hebdomadaire, valid for seven consecutive days; and the carte journaliere, valid for one day. In the youth category are two license types; the carte personne mineure for those between 12 and 18 years of age; and the carte découverte – 12 ans for those under 12 years of age and is limited to one fishing line. The license for under-twelves and women in particular are promotional to encourage fishing within these groups.

Product	Number
Carte Personne Majeure Interfédéral	4701
Carte Personne Majeure URNE 2020	4898
Carte Découverte Femme	761
Total adult licenses	**10 360**
Carte Personne Mineure (13 to 18 years of age)	1386
Carte Découverte – 12 ans	1740
Total youth licences	**3126**
Carte Hebdomadaire	479
Carte Journaliere	4162
Total temporary licenses	**4641**
Total	**18 127**

Figure. 2. Number of licenses issued for the 2019 season, from private Federation records.

While the river may be public, the areas in which fishing may take place cover a fraction of the total area. The Federation manages fishing based on book IV, title III of France's Environmental Code. This article states that the conservation of water environments and protection of fishing and farming heritage are in the French public interest. Therefore, the protection of this heritage requires a balanced management of the fishing resources. The article further states that the main constituent of such balanced management is fishing as a social and economic activity. These national measures stem from Frances commitments under the Convention on Biological Diversity, a multilateral treaty signed between 1992 and 1993 between 196 states including those of the EU. This

commitment coincides with the EU's aims to restore at least 15 % of degraded ecosystems of which France is bound.

Yearly fishing courses are divided in two categories which correspond with the reproduction and migratory patterns of specific categories of fish as well as broader ecology. The first watercourse runs from roughly the 14th of March to the 20th of September and the second throughout the year. The water courses differ in their rules as well. The first watercourse limits the number of permitted fishing lines to one. Captures other than salmon and trout are limited to six per fisher in this category. Fishing lines in the second category are limited to four. The number of predator fish are limited to three for both categories, except Northern pikes which are limited to two. There are also restrictions placed on the size of fish allowed for capture depending on the species. The minimum size permitted four trout, barring the brook trout and the sea trout is 25 cm, 35 cm for the sea trout, 50 cm for salmon, and 35cm for the grayling for both watercourses. The minimum size specifically for different fish in the second watercourse are 30 cm for black bass, 50 cm for the zander, 60 cm for the northern pike, and no restrictions for the rainbow trout. The northern pike in the first watercourse is restricted to 50 cm.

Further general fishing restrictions are; fishing half an hour before and after sunrise is prohibited except for sea trout and night carp; all fishing is prohibited from dams and lakes as well as over a distance of 50 meters downstream from the end thereof, with the exception of fishing using a line; fishing is prohibited in devices that ensure the circulation of fish, in structures constructed in the watercourse beds, in sluices, winnowing and in water passages inside buildings. It is forbidden to fish live, dead, or artificial fish and lures likely to catch pike in a non-accidental manner in waters classified in the second category (canals, rivers and bodies of water in communication with the waters free) during the specific ban on pike and zander fishing. As defined in this notice; in all canals, rivers and bodies on water it is forbidden to use as bait or bait bellow the fixed size or protected as per the environmental code; and in waters of the first category it is forbidden to use as bait or bait maggots and other diptera larvae.

Specific Fishing Periods		
Species designation	**1st category watercourse**	**2nd category watercourse**

Trout, brown trout, (others except sea trout and rainbow trout) brook trout, arctic char, lake trout	From 14th March to 20th September	
Rainbow trout	14th March to 20th September	1st January to 31st December
Sea trout	From 25th April	to 20th September
Becard salmon or downhill salmon	**Forbidden**	
Atlantic salmon	From 25th April	to 20th October
Grayling	16th May to 20th September	16th May to 31st December
Northern pike, zander and black bass	25th April to 20th September	1st January to 26th January and 25th April to 31st December
European eel	14th March to 15th July	15th February to 31st December
Silver swallow eel	**Forbidden**	
Regional eels, river herring, lampreys	**Forbidden**	
Freshwater crayfish (white-clawed, red-clawed, narrow-clawed)	**Forbidden**	
Other species of crayfish	14th March to 20th September	1st January to 31st December
Edible and common frogs	From 09th May	to 20th September
Other species of frog	**Forbidden**	

Figure. 3. First and secondary category by yearly openings and fishing regulations, from public Federation records.

Additional to these general restrictions, the Federation also imposes particular restrictions on fishing resources and specific migratory aquatic life; salmon, trout and eels. The first set is specific

to night carp; their fishing is authorized throughout the year. All catches must be returned to the water immediately. Fishing nets are prohibited, and amateur fishers may not transport living carps larger than 30 cm. The second set concerns migratory fish, specifically salmon, sea trout. These fish switch from freshwater to seawater to complete their lifecycles and their management requires knowledge of catches made throughout the year. All amateur fishers who catch salmon and sea trout catches must pay the CPMA Migrateur, an 'aquatic environment fishing contribution' due to fragility of their stocks and all catches must be declared at www.declarationpeche.fr. The last set concern, specifically eels. Eel fishing at night is prohibited outside of legal fishing hours. These rules, along with those concerning eels apply to the Somme and two smaller adjoining rivers; Bresle and Authie. Finally, there is a penalty of 9000 euros for the introduction of non-native fish to the watercourses. Below is a visual representation of the fishing grounds in Amiens.

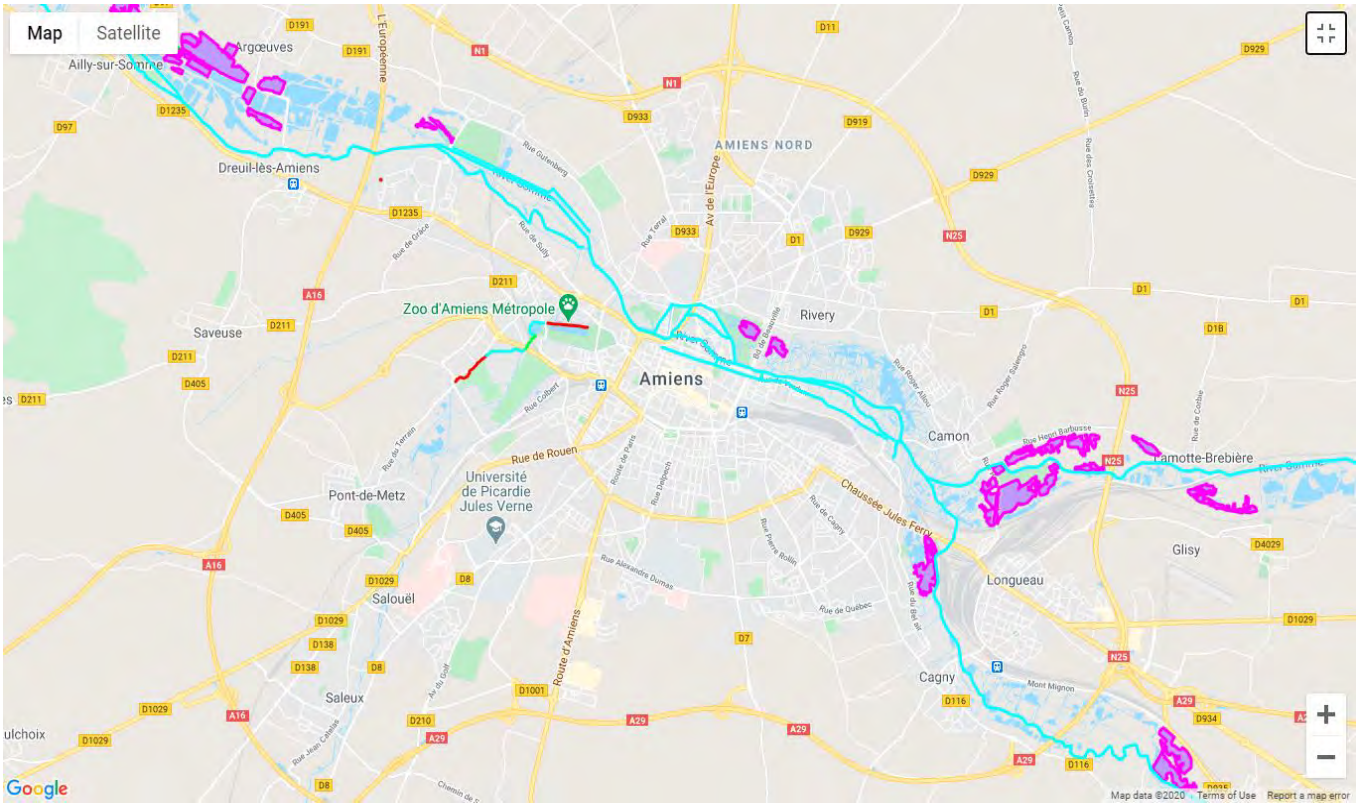


Figure. 4. Official fishing grounds in purple, taken from public records at www.peche80.com

Appendix. B. Online surveys. Original version sent to participants was uniquely in French.

Jeux économiques (economic games)

Merci de répondre le plus honnêtement possible. Toutes les informations sont anonymes et privées. L'étudiant chercheur (Brian Khumalo) chargé de l'enquête n'est pas affilié à la fédération. Merci d'avoir participé.

Please answer as honestly as possible. All information is anonymous and private. The student researcher (Brian Khumalo) administering the survey is not affiliated with the federation. Thanks for participating.

Age :

_____

Sexe (Sex) :

_____

Occupation :

_____

Question 1

Imaginez être dans une pièce avec un autre pêcheur d'Amiens. Je vous ai également donné 500 euros et deux options; vous pouvez soit conserver tout l'argent, soit donner un montant de votre choix à un fonds de protection des pêches. Quoi que vous choisissiez, je doublerai le montant final (exemple; si vous gardez 250 euros et donnez 250 euros, je doublerai chaque option à 500). Veuillez indiquer le choix que vous faites:

Imagine being in a room with another fisherman from Amiens. I also gave you 500 euros and two options; you can either keep all the money or donate an amount of your choice to a fisheries protection fund. Whatever you choose, I'll double the final amount (example; if you keep $ 250 and donate $ 250, I'll double each option to $ 500). Please indicate the choice you make bellow:

_____
_____
_____

Question 2

Imaginez que vous êtes dans une pièce avec un autre pêcheur d'Amiens. Je vous donne 500 euros et la possibilité de garder l'argent ou de partager un montant ce que vous voulez avec l'autre pêcheur (exemple, garder 250 et partager 250). Combien gardez-vous / partagez-vous:

Imagine that you are in a room with another fisherman from Amiens. I give you 500 euros and the possibility to keep the money or to share an amount you want with the other fisherman (example, keep 250 and share 250). How much do you keep / share:

Appendix. C. Interview Schedule, cognitive-mapping and free-listing exercises (originally in French).

Topic	**Sample questions**
Cognitive-mapping	Question: 1A: Could you please, using the red pen indicate where on the map the Federation allows fishing?
	Question 1B: Could you please, using the blue pen indicate where on the map local fishers fish (outside of the Federation boundaries)?
Free-listing	Question 2A: Could you please list all the fish species present in the Somme.
	Question 2B: Could you please indicate using a cross next to the name, each species which is native to river?
Governance	Question 3A: Who is responsible for managing recreational fishing in the area?
	Question 3B: Is there another management system, along with the Federation's in place in Amiens?
	Question 3C: If such a system exists, who creates and enforces the rules.
	Question 3D: What happens if a fisher from outside the Somme region fishes here without permission?
	Question 3E: What happens if a fisher who does not have a license fishes here (in Amiens)?

Appendix. D. Interviews conducted (originally uniquely in French).

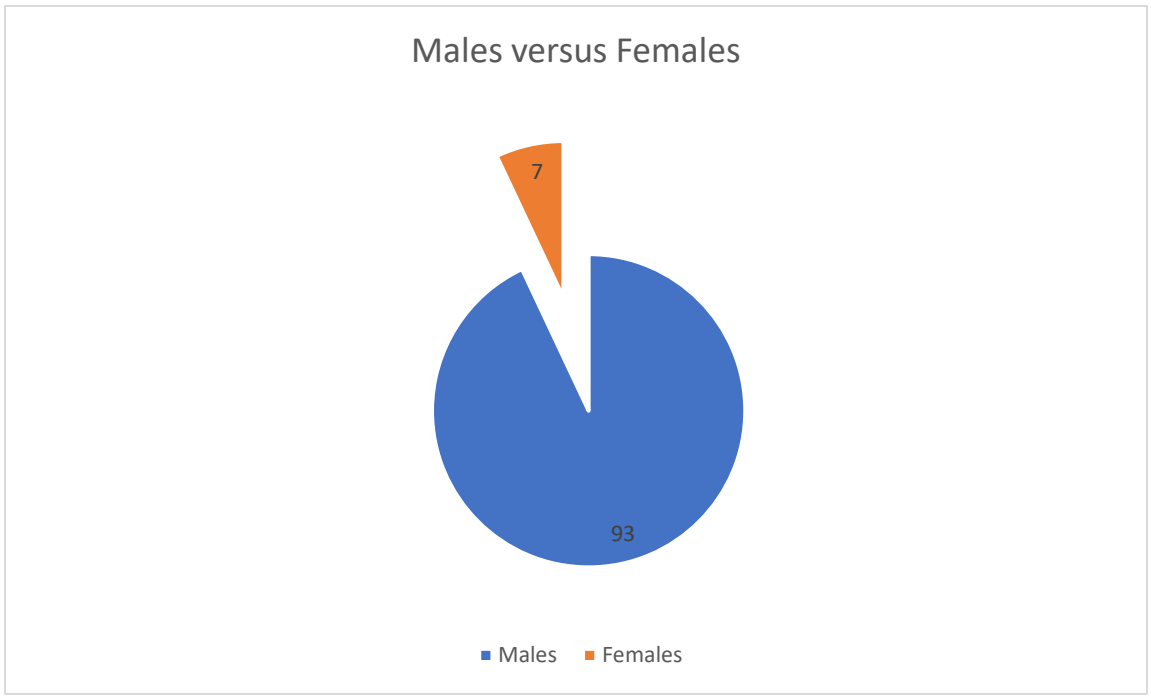
Focus group one:

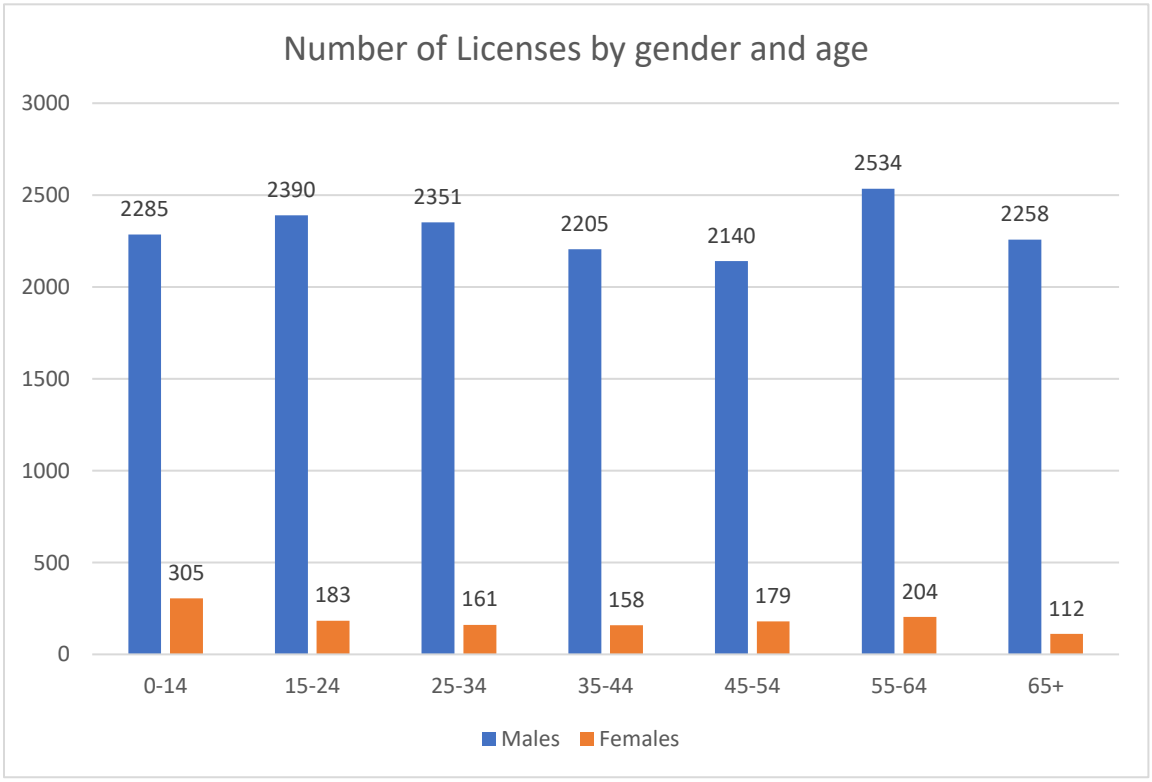
Question 2B	- Pour moi c'est la taille qui est important, pas l'espèce donc je [ne] sais pas. [Et] vous, les gars ? (For me it's the size that is important, not the species so I don't know. you guys?) - Ouais, pareille (Yeah, same) [unanimous]
Question 3A	- *Ici, il n'ya personne sauf le Federation qui gere les pecheurs* (here, there isn't anyone except the Federation who manages fishers) [agreement]
Question 3B	- Non, on est toujours tres occupe pour ca [laughs] (no, we are always too busy for that) - *Pour nous, le truc le plus important c'est d'avoir le respet pour un endroit et d'autre pecheurs* (four us, the most important thing is having respect for the area and other fishers) [group agreement] - ouai c'est vrai, on ai des bateau pour quoi que c'est sois qui est situe plus loin dans l'eau (yeah, it's true, we have boats for whatever is found further in the water)
Question 3C	[redacted]
Question 3D	- *Ils sont mis a l'amende* (they are fined) - *Sauf s'ils ont une licence specifique* (unless they have a specific license) - [researcher] the carte interfédéral? - *Celui-là, exactement* (that very one exactly)
Question 3E	- *Tout d'abord, les pecheurs seront pas tres heureuse* (Well firstly, the fishers wouldn't be too happy) - *Certain, pas tous* (Some, not all) - *Ouais* (Yeah) - *Mais plus que ca, il ou puni par la Federation* (but beyond that, they would either be warned or fined by the Federation) - *Ouais, ca depend sur les* circumstances (Yeah, it depends on the circumstances.

Focus group two:

Question 2B	- *Je [ne] sais pas, je entendu le gens dit que les perche soleil n'est sont pas natif la mais je [ne] suis pas sur* (i dont know, i heard people say sunfish aren't native here but i'm not sure) - *et le [brook trout]* (and the brook trout) - Ah, ouai? Cool (oh yeah? cool)
Question 3A	- *C'est le Fédération de la Somme, vous le connaisse* ? (it's the Somme Federation, do you know it?) - *Pour loisir c'est eux ouais, mais je pense que pour le gens qui vendre leur pèche c'est une autre organisation du gouvernement* (for recreation its them yeah, but i think that four people who sell their fis hits another governmental organisation)
Question 3B	- *Rien* (nothing) - *Rien du tout* (nothing at all) - *Peut-etre dans le sud* (maybe in the South)
Question 3C	[redacted]
Question 3D	- *ca arrive jamais* (it never happens) - *On ai tous des licence pour no zones locales, les pecheurs exterieurs n'utilisent jamais ces zones sans la licence appropriee* (we all have licenses for our local zones, outside fishers never use these zones without the proper license) - Ouais, s'ils le faissaient, ils seraient condamnes a une amende (yeah, if they did they would be fined)
Question 3E	- *Ce n'est pas permis* (that is not allowed) - *C'est effectivement illegal, ce serait a la Federation de faire quelque chose* (its actually illegal, it would be up to the federation to do something) - *Si la personne est prise…* (if the person is caught…) - *Ouais, si la personne est prise* (yeah, if the person is caught)

Appendix. E. Showing the proportion of male to female fishers, and a breakdown of licenses given by gender and age for the period 12th January 2020 to 24th August 2020 at the Somme, from private Federation records.





Appendix. F. Showing total licenses given between 12th January 2020 to 24th August 2020 at the Somme, from private Federation records.

Product	**Type**	**0-14 years**	**15-24 years**	**25-34 years**	**35-44 years**	**45-54 years**	**55-64 years**	**65 and over**	**Total:**
Carte Interfédéral URNE 2020	Carte Personne Majeure Interfédéral	0 00.00%	462 09.71%	827 17.39%	809 17.01%	806 16.95%	1026 21.57%	826 17.37%	**4756**
Carte Personne Majeure 2020	Carte Personne Majeure ou Interfédéral	0 00.00%	313 07.25%	440 10.19%	560 12.97%	736 17.04%	1045 24.20%	1224 28.35%	**4318**
Carte Promotionelle Découverte Femme 2020	Carte Découverte Femme	0 00.00%	103 13.29%	122 15.74%	129 16.65%	153 19.74%	176 22.71%	92 11.87%	**775**
Carte Personne Mineure 2020	Carte Personne Mineure	670 46.66%	769 53.44%	0 00.00%	0 00,00%	0 00.00%	0 00.00%	0 00.00%	**1439**
Carte Promotionelle Découverte - 12 ans 2020	Carte Découverte – 12 years	1819 100%	0 00.00%	0 00.00%	0 00.00%	0 00.00%	0 00.00%	0 00.00%	**1819**
Carte Promotionelle Hebdomadaire 2020	Carte Hebdomadaire	2 00.58%	51 14.87%	55 16.03%	92 26.82%	62 18.08%	47 13.70%	34 09.91%	**343**
Carte Journaliere 2020	Carte Journaliere	99 02.47%	875 21.79%	1068 26.60%	773 19.25%	562 14.00%	444 11.06%	194 04.83%	**4015**
	Total:	**2590 14.83%**	**2573 14.73%**	**2512 14.38%**	**2363 13.53%**	**2319 13.28%**	**2738 15.68%**	**2370 13.57%**	**17465**

Appendix. G. Total number of licenses in France and her territories from 12th of Jan to 24th of Aug 2020, from private Federation records.

Department	**Carte Interfédéral URNE**	**Carte Personne Majeure**	**Carte Découverte Femme**	**Carte Personne Mineure**	**Carte Découverte - 12 ans**	**Carte Hebdomadaire**	**Carte Journaliere**	**Total:**
01 – Ain	0	8 157	881	2 111	3 366	742	8 176	**23 443**
02 – Aisne	2 186	5 945	467	1 350	1 223	201	2 784	**13 556**
03 – Allier	0	3 120	732	1 288	1 925	388	3 308	**10 761**
04 – Alpes-de-Haute-Provence	0	2 260	329	770	1 357	930	1 152	**6 798**
05 – Haute-Alpes	0	5 352	448	1 207	2 320	2 096	2 493	**13 916**
06 – Alpes-Maritimes	0	1 288	311	588	874	272	2 166	**5 499**
07 – Ardèche	0	7 121	579	1 843	3027	2 820	4 254	**19 376**
08 – Ardennes	1 222	6 296	506	1 236	1 442	513	1 009	**12 764**
09 – Ariegè	0	650	369	842	1 658	811	3 800	**8 130**
10 – Aube	1 268	4 821	415	949	1 225	462	1 037	**10 177**
11 – Aude	0	1 399	363	871	1 093	316	509	**4 551**
12 – Aveyron	0	4 517	699	1 733	3 686	1 151	3 487	**15 273**
13 – Bouches-du-Rhone	0	849	286	779	1 346	126	416	**3 802**
14 - Calvados	0	1 270	245	958	927	167	785	**4 352**
15 – Cantal	0	3 043	612	1 146	1 934	709	2 334	**9 778**

16 – Charente	0	4 041	623	1 357	1 855	320	1 004	**9 200**
17 – Charente-Maritime	0	5 715	935	1 824	2 807	401	3 206	**14 888**
18 – Cher	0	3 300	547	1 179	1 613	222	2 520	**9 381**
19 - Corrèze	0	2 648	511	1 036	1 683	753	2 670	**9 301**
20 – Corse (2A et 2B)	0	2 688	143	282	200	102	355	**3 770**
21 – Cote-d'Or	0	7 318	1 118	2 073	2 960	784	3 080	**3 770**
22 – Cote-d'Amour	0	3 356	340	1 191	1 813	370	2 261	**9 331**
23 – Creuse	0	1 170	298	491	688	308	1 220	**4 175**
24 – Dordogne	0	4 929	722	1 796	2 362	949	1 975	**12 733**
25 – Doubs	2 556	6 928	688	1 704	2 620	1 145	6 339	**21 980**
26 – Drome	0	3 526	592	1 348	2 366	212	2 132	**10 176**
27 – Eure	0	1 212	250	986	886	240	1 184	**3 667**
28 – Eure-et-Loir	0	2 916	377	1 191	1 876	116	3 607	**10 083**
29 – Finistère	0	2 378	201	698	1 206	286	1 463	**6 232**
30 - Gard	0	2 794	551	1 526	2 027	571	2 283	**8 932**
31 – Haute-Garonne	0	1 780	972	2 324	4 029	656	2 248	**12 009**
32 – Gers	0	940	336	788	1 165	172	792	**4 193**
33 – Gironde	0	6 799	1 194	2 608	3 668	695	1 654	**16 618**
34 – Hérault	0	3 147	606	1 619	2 454	709	2 630	**11 165**

35 – Ile-et-Vilaine	0	5 743	408	1 921	2 203	265	3 863	**14 403**
36 – Indre	0	2 456	468	994	1 182	226	1 770	**7 096**
37 – Indre-et-Loire	0	6 200	706	1 764	2 355	416	4 457	**15 898**
38 – Isère	0	7 560	926	2 365	3 822	695	5 675	**21 043**
39 – Jura	0	8 056	619	1 618	2 401	1 274	5 199	**19 167**
40 – Landes	0	5 448	872	2 238	3 636	887	4 435	**17 516**
41 – Loir-et-Cher	0	3 457	515	1 355	1 722	268	3 491	**10 808**
42 – Loire	0	3 459	687	1 553	2 904	224	4 625	**13 046**
43 – Haute-Loire	0	3 279	574	1 250	2 404	530	2 956	**10 993**
44 – Loire-Atianitque	0	7 065	734	2 998	4 094	310	7 090	**22 291**
45 – Loiret	0	3 863	558	1 329	1 884	281	3 624	**11 544**
46 – Lot	0	1 957	392	1 054	2 342	856	2 018	**8 619**
47 – Lot-et-Garonne	0	2 768	559	1 480	1 853	535	1 120	**8 297**
48 – Lozère	0	5 378	435	1 100	1 592	2 521	1 980	**13 006**
49 – Maine-et-Loire	0	9 373	1 052	3 004	4 329	447	8 683	**26 888**
50 – Manche	0	3 778	276	1 302	1 185	113	989	**7 643**
51 – Marne	3 207	3 894	437	997	1 065	177	1 444	**11 221**
52 – Haute-Marne	4 045	1 034	389	992	1 246	348	516	**8 570**
53 - Mayenne	0	3 215	275	1 114	1 152	203	2 216	**8 175**

54 - Meurthe-et-Moselle	3 328	7 612	839	2 012	2 452	620	1 406	**18 269**
55 – Meuse	3 688	3 049	592	1 365	1 581	565	1 718	**12 558**
56 – Morbihan	0	3 333	440	1 350	2 077	502	2 514	**10 216**
57 – Moselle	5 108	5 313	539	1 484	1 770	1 896	2 515	**18 625**
58 – Nièvre	0	3 760	752	1 097	1 604	746	4 008	**11 967**
59 – Nord	4 913	12 678	893	3 048	2 877	163	1 664	**26 236**
60 – Oise	2 179	3 269	302	715	817	103	2 143	**9 528**
61 – Orne	0	1 536	272	771	787	160	1 475	**5 001**
62 – Pas-de-Calais	4 048	8 624	613	2 456	2 447	164	4 645	**17 057**
63 – Puy-de-Dome	0	3 937	761	1 391	2 549	554	3 866	**13 058**
64 – Pyrénées-Atlantiques	0	5 152	684	2 020	3 385	705	2 724	**14 670**
65 – Hautes-Pyrénées	0	858	526	1 439	2 715	1 181	2 023	**8 742**
66 - Pyrénées-Orientales	0	2 769	373	873	1 465	827	2 310	**8 617**
67 – Bas-Rhin	6 637	11 142	912	2 313	2 591	977	4 451	**29 023**
68 – Haut-Rhin	4048	4 961	472	1 208	1 455	640	1 773	**10 509**
69 -Rhone	0	3 038	660	1 586	2 950	217	5 485	**13 935**

70 – Haute-Saone	0	4 699	767	1 577	2 126	584	1 692	**11 445**
71 – Saone-et-Loire	0	10 426	1 727	2 722	3 439	1 227	6 576	**26 117**
72 – Sarthe	0	6 659	578	1 655	1 826	269	3 672	**14 659**
73 – Savoie	0	7 951	709	1 693	3 187	2 333	7 019	**22 892**
74 – Haute-Savoie	0	10 535	1 013	2 128	4 127	2 608	6 827	**27 238**
75 – Paris et petite couronne (75, 92, 93 et 94)	0	1 021	224	584	934	80	1 256	**4 099**
76 – Seine-Maritime	3 460	985	227	824	847	163	871	**7 377**
77 – Seine-et-Marne	0	4 154	522	1 112	1 539	185	2 503	**10 015**
78 – Yvelines	0	881	119	381	621	78	931	**3 011**
79 – Deux-Sèvres	0	3 946	685	1 656	2 067	292	3 183	**11 829**
80 – Somme	4 756	4 318	775	1 439	1 819	343	4 015	**17 465**
81 – Tarn	0	2 818	691	1 445	2 330	364	1 490	**9 138**
82 – Tarn-et-Garonne	0	2 101	465	1 215	2 015	190	831	**6 817**
83 – Var	0	2 463	499	993	1 638	628	1 598	**6 349**
84 – Vauciuse	0	1 694	408	1 149	1 782	231	1 470	**6 674**
85 – Vendée	0	7 547	665	2 431	3 313	401	8 982	**23 339**
86 – Vienne	0	4 787	595	1 469	1 888	281	2 807	**11 827**

87 – Haute-Vienne	0	1 567	587	1 179	1 860	469	2 769	**8 425**
88 – Vosges	2 985	4 517	575	1 499	1 956	1 061	2 089	**14 682**
89 – Yonne	0	4 713	661	1 318	1 909	512	2 689	**11 802**
90 – Territoire de Belfort	0	917	121	297	516	30	651	**2 532**
91 – Essonne	0	1 318	231	581	907	98	1 390	**4 525**
95 – Val-d'Oise	0	748	110	258	470	37	700	**2 323**
974 – La Réunion	0	691	79	55	92	7	44	**968**
975 – Saint Pierre-et-Miquelon	0	0	0	0	0	0	0	**0**

Appendix. H. The Somme River (first three public areas, last private area).

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