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Market Demand, Routine Activity, and Illegal Fishing: An Empirical Test of Routine Activity Theory in Iran

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ABSTRACT

Despite the presence of the punishment mechanisms in Iran's criminal law to deal with illegal fishing, this crime remains a major problem in the country, threatening the sustainability of the targeted species and affecting the livelihoods of the communities that depend on it as a significant source of protein. Applying the lens of environmental criminology, specifically the routine activities approach, this research seeks to examine the major driving factors of illegal fishing in the Mazandaran Province in Iran. Data for this study were collected through a survey questionnaire administered to villagers in the city of Fereydunkenar. Using proportionated stratified random sampling, we collected data from 400 respondents on various variables designed to measure the routine activities constructs. Nearly 53% of respondents engaged in fishing without a license. Structural equation models indicate that the presence of a capable guardian, the presence of the economically motivated offender, and market demand had the greatest influence on illegal fishing. The market demand had significant direct effect on the economically motivated offender, who then engaged in illegal fishing. Policy implications are discussed in light of these findings.

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Introduction

Illegal fishing is one of the major environmental crimes in the world. It refers to fishing activities that do not comply with national, regional, or international fisheries conservation or management legislation or measures (Agnew and Barnes 2004). Illegal fishing, with an annual revenue of about 30 USD million, remains one of the most profitable environmental crimes (UNODC 2013).

Illegal fishing causes devastating effects on marine ecosystems, marine species, and human food security (Sollund, Stefes, and Rita Germani 2016). Activities, such as blast bombing, which are frequently used by illegal fishers in developing countries, can have a dangerous impacts on marine ecosystems, such as permanently damaging coral reefs and sea grass beds. Illegal fishing may also lead to by-catch, whereas non-target species, such as turtles and seabirds, get entangled in illegal lines and nets, and die as a result. Illegal fishing also exerts extra pressure on fish stocks, contributing to the reduction of those stocks. In addition, through the illegal exploitation of fish stocks, the resources available to legal fishing enterprises are significantly reduced, in effect yielding decreased profits and unemployment. These illegal activities often affect small-scale fishing communities, leading to significant repercussions for development and food security.

Despite significant punishment mechanisms available to deal with illegal fishing through Iran's criminal law, these activities are nevertheless prevalent in the country. According to Aghilinejad (2016), the presence of illegal fishermen in the Caspian Sea poses a major threat to the endangered fish, especially to sturgeon. Fereydunkenar County in Mazandaran Province is one of the counties in

northern Iran where illegal fishing takes place, and this activity is one of the major reasons for the destruction of the environment in the County. Environmental groups warned of the consequences of illegal fishing in Fereydunkenar (Hoseini 2015), such as overfishing or fishing during spawning season, thus leading to the disruption of reproduction and significantly affecting their populations (Mir Mohamad Tabar et al. 2020).

Most criminological research on illegal fishing conducted to date focuses on illegal fishing in Europe, America, Africa, and East Asia, leaving a significant gap in the literature. This study aims at studying the extent of illegal fishing in the Middle East, more specifically Iran, thus expanding the scope of the research in this field. Additionally, the studies that empirically tested the application of environmental criminology have not used structural equation modeling to examine decision making related to illegal fishing, neither did these studies use survey research of likely offenders. In these regards, this paper is also filling a methodological gap. Lastly, to date, no study has empirically examined the market reduction approach in the context of illegal fishing, which is what is accomplished in this paper.

Environmental criminology

Environmental criminology refers to the family of theories that posit that crime events should be understood in terms of the opportunity structures within the built environment, and that crime patterns should be analyzed through the “socio-demographic, temporal, and spatial qualities” (Wortley and Mazerolle 2008) that make crime more likely and easy to commit. Thus, the theories within environmental criminology focus on the crime event and the immediate circumstances in which they occur, as well as on the environmental influences and how these shape crime patterns. The emphasis on the ‘crime event’, i.e. the setting of crime, rather than the individual dispositional causes of crime is what distinguishes environmental criminological theories from the traditional criminological perspectives (Felson and Clarke 1998).

While green criminology, conservation criminology, and environmental criminology may be used interchangeably, there are significant and distinct differences between them. Both green criminology and conservation criminology broadly study crimes against nature. Green criminology encompasses the study of harms to the environment, as well as the various policies and legal instruments that are designed to reduce such harms (White and Heckenberg 2014). Conservation criminology’s focal concern is environmental risk reduction through three interdisciplinary approaches that encompass natural resource policy and management, risk and decision science, and criminology (Gibbs et al. 2010). Environmental criminology’s focus is not the study of nature per se, despite the fact that its name may imply so. Environmental criminology focuses on the study of the built (and natural) environment and its effect on the crime event, making the crime event the focus of inquiry (Wortley and Mazerolle 2008). Nevertheless, the environmental criminological theories have been used to study wildlife crimes in the past decade, expanding its use to the study of the nature and the environment.

The three major premises of the environmental perspective are that (a) criminal behavior is significantly influenced by the nature of the immediate environment in which it occurs; (b) the distribution of crime is concentrated in time and space; and (c) it is vital to understand the role of criminogenic environments and how crime patterns emerge within such environments. Three theories, namely the routine activities approach (Cohen and Felson 1979), the crime pattern theory (Brantingham and Brantingham 1993), and the rational choice perspective (Cornish and Clarke 1987), are among the well-known theories within this family. These theories either focus on wider social trends, or examine the choice of specific offenders or the characteristics of the settings and space. The routine activities approach, the theoretical framework adopted in this study, argues that for a crime to occur, three elements must be present: (a) a motivated offender, (b) a suitable target, and (c) absence of the capable guardian, because it is then that the opportunities to commit a crime are most ripe (Figure 1).

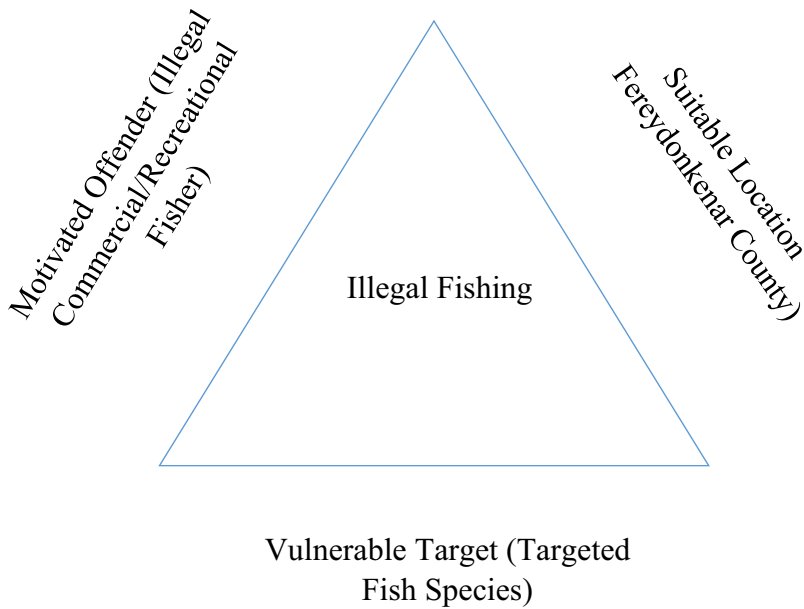


Figure 1. The crime triangle and illegal fishing in iran.

According to Cohen and Felson (1979), suitable targets are the objects or individuals that criminals selectively target for their offenses. The absence of capable guardians means a loss of law enforcement or others who are responsible for protecting these targets that are sought after by criminals. Motivated offenders are individuals who have a tendency to commit a crime (Eliason 2012: 73). Accordingly, crime results from the interaction of a motivated offender, in the current context illegal commercial or recreational fisher, and situation, herein the suitable location where most vulnerable fish species concentrate in the Fereydunenar County, in the absence of the capable guardians that increase the risk of apprehension. The suitable targets in the context of the current research are the fish that are caught illegally.

The section that follows examines the literature that has applied and empirically tested these approaches in the study of illegal fishing.

Past literature on opportunity and illegal fishing

Criminological literature that specifically uses the environmental criminology lens to empirically examine illegal fishing patterns remains scarce. The studies that have been published to date speak to the importance and relevance of understanding opportunity structures that affect the offenders' decision to engage in illegal fishing.

In an attempt to understand the factors associated with illegal fishing in the exclusive economic zones (EEZs) of 53 countries, Petrossian (2015) applied the rational choice and situational crime prevention frameworks. The study findings suggested that the likelihood of illegal fishing occurring in these countries' EEZs increases with the number of commercially significant species found within their territorial waters and these countries' proximity to known ports of convenience where illegally caught fish are laundered through. Additionally, countries with strong fisheries management and formal surveillance capacity were those that had significantly less illegal fishing within their territorial waters. Similar to Petrossian (2015), a micro-spatial analysis of illegal fishing activities within the EEZs of 23 Western African countries revealed that this activity is highly concentrated in places where most sought-after (CRAVED) fish can be found, as well as areas that were closest to the nearest exit point (Petrossian 2018). Australian scholars revealed similar spatial, as well as

temporal concentrations of illegal recreational fishing in the Great Barrier Reef Marine Park in Australia, whereas they used the risky facilities framework, rational choice and routine activities perspectives to examine these patterns (Weekers, Mazerolle, and Zahnow 2020; Weekers and Zahnow 2018).

The risky facilities framework has also been applied to understand the vulnerabilities of ports of convenience that receive illegally caught fish. Two such studies, namely Marteache, Viollaz, and Petrossian (2015) and Petrossian, Marteache, and Viollaz (2015a) examined the characteristics of these ports, finding that the ports that facilitated the concealment of illegally caught fish, had generally lax law enforcement operations, and were in countries high in corruption and lack of rule of law were more likely to receive illegally caught fish landings.

In an effort to understand the characteristics of “suitable targets”, Petrossian and Clarke (2014) and Petrossian, Weis, and Pires (2015b) applied the CRAVED (Clarke 1999) theft model originally devised to understand the attributes of *hot products*, which are those that are easily concealable, removable, available, valuable, enjoyable, and disposable. Petrossian and Clarke (2014) Identified 58 such fish species and Petrossian, Weis, and Pires (2015b) identified 10 high-risk crustacean species that possessed the CRAVED characteristics, thus making them vulnerable for illegal harvesting.

Overall, the studies that specifically used the theoretical lens of environmental criminology to examine illegal fishing provided empirical evidence that this criminological approach proved useful as a framework to study illegal fishing. The findings of these studies then led to policy recommendations that derived from the techniques of situational crime prevention, one of the many targeted intervention approaches.

It is noteworthy to mention that many of these prior empirical studies were based on the examination of secondary data collected by governments, agencies, and non-governmental organizations. Importantly, none of these studies examined the role of the market demand and the subsequent relevance of the market reduction approach as another targeted response strategy alongside situational crime prevention in the context of illegal fishing. The market reduction approach (MRA) is an effective strategy that has been used to disrupt the stolen goods markets (e.g. Schneider 2005; Sutton, Schneider, and Hetherington 2001). Reuter (2004) suggests that the demand in illegal markets for purchasing stolen goods is a major driver for committing crimes, specifically theft. This approach, unlike other theoretical approaches, therefore, underplays the role the thieves or sellers of stolen goods play, and instead, places more emphasis on the role the consumers and buyers of these goods. The strategy, thus, calls for using a multi-dimensional partnership strategy that incorporates not only the use of official police data, but also interviews with offenders and buyers, to identify the patterns of how stolen ‘hot products’ are handled in these illegal markets and what reduction and disruption strategies can be developed to effectively deal with it.

The literature on the effectiveness of the MRA as it applies to the illegal wildlife trade is rare (e.g. Herrera and Hennessey 2007; Martin 2010; Pires and Petrossian 2016), and no research to date has applied this approach to study illegal fishing. The current proposed study, therefore, has two primary goals: (a) to expand the empirical literature on illegal fishing by shedding light on the problem at a significant, but an understudied geographic area, the Middle East (specifically Iran); and (b) to use primary data to examine the relevance and applicability of both the routine activities and the market reduction approaches to examine illegal fishing.

Hypothesis

This research proposes to explore the following research hypotheses:

- 1-Market demand has a positive effect on illegal fishing of fishermen.
- 2-Market demand has a positive effect on routine activities related to illegal fishing.
- 3-Fishers’ routine activities have a positive effect on illegal fishing.

The research model shown in [Figure 2](#) details these hypothetical expectations.

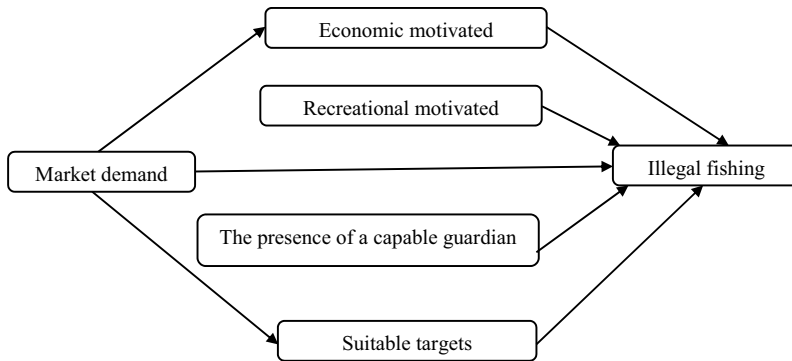


Figure 2. Research model

Methods

The present study uses a survey method and a questionnaire for data collection. The population of this study consists of male villagers in Fereydunkenar County. The reason for choosing male villagers was that fishing in this area is a male dominated occupation, and women do not engage in these activities. The survey was undertaken using a self-reported questionnaire. According to the Statistical-Center-Iran (2017), there are 24 villages and 8895 male inhabitants above 15 years of age living in Fereydonkenar County.

Using Cochran's (1977) formula which is a statistical method that allows for the determination of an ideal sample size, a desired level of confidence and error for a sample, a sample size of 400 was deemed sufficient. The data were gathered during spring and summer of 2017. Using proportionate stratified random sampling, primary and secondary sampling units were selected. Final sampling units (individuals) were selected purposefully. Of all the villages in Fereydonkenar, eight villages were chosen randomly (primary sampling unit), and, then, from the selected villages, households (secondary sampling unit) were chosen randomly. In visiting the selected households, individuals' eligibility was determined based on their engagement in fishing over the previous year. If such a determination could not be made, considering the systematic design of sampling, the next household was chosen for determination of eligibility (the final individual for filling out the questionnaire in this study was selected purposefully). The response rate was 95.4%.

Independent variables

Routine activities variables: In this study, the routine activities variables were measured by the presence of a capable guardian, suitable targets, and the motivated offenders. *The presence of a capable guardian* was measured using the following six items: *How much does the presence of any of the following people in the area prevent you from fishing?* 1) Environmental Protection Officers, 2) Pro-environment groups, 3) The police, 4) Local people, 5) Tourists, 6) Fisheries Officers. This dimension was measured using four Likert-scale questions (very low = 1 to very high = 5). *The suitable targets* dimension also used Likert-scale items ranging from 1 (very low) to 5 (very high). The respondents were asked the following: *Which of the following criteria is most important to you in fishing?* 1) Weight and size, 2) Rare species, 3) Higher price, 4) There are so many, 5) Ease of access and hunting. *The motivated offender* construct was measured using the following four items: *How motivating can each of the following be for fishing?* 1) Make money, 2) Personal consumption, 3) Fun and enjoyment, 4) Pleasure and excitement. This dimension was also measured using a Likert-scale measure (from very low = 1 to very high = 5). Items 1 and 2 were summed to create an economically motivated offender scale, and Items 3 and 4 were summed to create a recreationally motivated offender scale. While the routine activities theoretical application has been primarily in

victimization research, with a particular focus on explaining the victims' characteristics that made them suitable targets, its application in this paper primarily focuses on the offender motivations, shedding light on the various mechanisms that are both driven by need (e.g. personal consumption) and want (make money, pleasure and excitement). Therefore, various aspects of the offender motivation have been taken into account in this regard.

Market demand variable: The market demand variable was measured using the following three items: 1) Fish caught are sold at a good price in the fish market, 2) Fish caught by fishermen without license are purchased at good prices by locals for personal consumption, 3) People prefer to buy their fish directly from fishermen. This variable used Likert type items ranging from 1 (strongly disagree) to 5 (strongly agree).

Dependent variable

Illegal fishing: Before the measurement of the illegal-fishing variable, the respondents were asked about their fishing methods. Answers to this question were as follows: Pareh¹ cooperative, personal bait, fishhook, fishing net, and fishing rods.² After this question, four questions asked the respondents about the number of whiting, mullets, farmed fish, or other species they had captured over the last year. These four questions were measured on an interval scale. It should be mentioned that only fishing by Pareh cooperative is legal in this county and other fishing methods are banned; hence, the extent of illegal fishing among the respondents of the study could be revealed. To gain the trust of the respondents, the researchers used several local people to collect data. After collecting the data, it was found that from 234 people who engaged in fishing, only 22 were fishing through legal methods and were authorized fishermen, while the rest, that is 212 people, engaged in fishing using illegal and unauthorized methods and were instances of illegal fishermen. Because they do not consider these methods illegal, these people answered the questions easily and without sensitivity. The following analysis is based on the data gathered from these respondents.

Control variables

Age, marital status, number of family members, income and education were used as control variables. Age was measured using biological age. Education was measured by the number of years of formal education. Monthly total family income and number of family members were actual counts. All the control variables were measured at the interval level of measurement.

Validity and reliability

All the variables were created as additive scales. All scales were found to have high internal consistency ($\alpha > .70$; $CR > .70$) as recommended by Esposito Vinzi et al. (2010; see Table 1). We also tested their discriminant validity by exploring the average variance extracted (AVE) shared between a construct

Table 1. Validity and reliability of research's variables.

Variables	Factor loadings (minimum-maximum)	AVE	CR	α
The presence of a capable guard	0.721–0.848	0.612	0.853	0.923
Suitable targets	0.660–0.814	0.535	0.832	0.861
Motivated offender	0.571–0.990	0.718	0.794	0.714
Market demand	0.711–0.834	0.517	0.814	0.747
Illegal fishing	0.522–0.911	0.573	0.787	0.750

AVE = average variance extracted; CR = composite reliability

¹The name of the only authorized fishing cooperative in Fereydonkenar County.

²A specific type of fishing trap in Fereydonkenar County which is mainly used by illegal fishermen.

and its measures. AVE indices were found to be higher than .50 as recommend by Rodgers and Pavlou (2003). Finally, we conducted a first order confirmatory factor analysis (CFA) for these scales; factor loadings for all the items were significant (factor loadings > .50). Moreover, the CFA revealed good fit indices for all scales (Byrne 2016).

Plan of analysis

Statements from open-ended questions were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 22. The occurrence of illegal fishing in the villages, routine activities and market demand were described and presented by mean and standard error. Linear regression analysis was used to determine the degree of impact of the control variables (age, marital status, family members, income, and education) and independent variables (routine activities and market demand) on illegal fishing. The results from the linear regression analyses were reported as standardized coefficients (beta coefficients). To achieve the main goals of the study, the researchers used structural equation models in the Amos software (version 22) shown in Figure 1. The reason for using the structural model of simultaneous testing was that this allowed us to measure both the direct and indirect effects of independent variables on the outcome variable illegal fishing.

Results

Descriptive analyses

Sample Characteristics. Following the completion of the questionnaires, the analyses revealed that about 212 (53%) respondents had engaged in fishing without a license. Subsequent analyses are performed on these 212 people who were engaged in illegal fishing. The demographic composition of the respondents was as follows: the mean age was 40.9 years; the mean level of education was 11.2 years; the mean number of family members was 4.1; and the mean monthly income was 1587. USD According to the results of various reports (Central-bank-Iran 2018; Mir Mohamad Tabar and Noghani 2019), the average income of the respondents was lower than the average income of Iranian households (\$2330) in 2017.

Illegal Fishing. Every fisherman, on average, had captured 51.9 fish illegally over the previous year. Mullet was the most captured fish, and, on average, nearly 69.1 of this species had been captured over the previous year. After Mullet, the category ‘other species of fish’, with an average of 58, had the highest capture rate. Whiting, with an average of nearly 39.8, was the least illegally captured fish in Fereydonkenar (Table 2).

The mean for the presence of a capable guardian was 15.78, indicating moderate presence of these guardians in villages of Fereydonkenar County (Table 3). The mean for the variable of the suitable targets is 18, which, considering the maximum and minim scores, is at a moderate level. The mean for the variable “motivated offenders” was 13.32, which was at a moderate level. The variables measuring market demand (about 10.41) have moderate values.

Table 2. Descriptions of the dependent variable: Illegal fishing.

Type of fish	Mean	Standard deviation	Minimum	Maximum
<i>Mullets fish</i>	69.1	7.1	1	185
<i>Whiting fish</i>	39.8	2.9	1	81
<i>Farmed fish</i>	46.4	3.6	1	127
<i>Other species</i>	58	6.8	1	151
<i>Total</i>	51.9	5.7	4	142

Table 3. Descriptions of the independent variables.

Variables	Mean	Standard deviation	Minimum	Maximum
<i>The presence of a capable guard</i>	15.78	8.7	6	30
<i>Suitable targets</i>	18	6.2	5	25
<i>The motivated offenders</i>	13.32	4.5	4	20
<i>Market demand</i>	10.41	2.7	3	15

Hypothesis testing

The variables *economically motivated offender* and *market demand* had a positive influence on illegal fishing. The presence of a capable guardian has a negative, significant effect on illegal fishing (Table 4, Model 1). This model explained approximately 7% of the variance in illegal fishing. Adding control variables to the model (Model 2), the coefficient of presence of a capable guardian and the market demand increased, but the coefficients of economically motivated offender decreased. Among control variables, age had a positive effect on illegal fishing. The addition of control variables did improve the model fit significantly, and as the adjusted R-squared value increased from 7% to 11%.

Table 4. Standardized coefficient of multiple regression on illegal fishing.

	Model 1	Model 2
Independent variables		
The presence of a capable guardian	-.274**	-.351**
Suitable targets	.020	.071
Economically- motivated offender	.190**	.178**
Recreationally-motivated offender	.030	.020
Market demand	.156**	.193**
Control variables		
Age		.148**
Education		.027
Family members		.001
Income		.020
R ²	.091**	.144**
Adjusted R ²	.074**	.112**
N	212	212

* $p < .05$, ** $p < .01$.

Structural equation models of illegal fishing. Figure 3 depicts the results of the structural equation model of illegal fishing. The model was run with the sample of 212 individuals who had reported having engaged in illegal fishing. According to this figure, the presence of a capable guardian (beta = -0.314, sig = 0.000), the economically motivated offender (beta = 0.180, sig = 0.001), and the market demand (beta = 0.156, sig = 0.005) have the largest influence on illegal fishing, respectively. Market demand indirectly affects illegal fishing through its positive effect on the economically motivated offender (beta = 0.183, sig = 0.005) and the availability of the suitable targets (beta = 0.303, sig = 0.000). The value of this indirect effect is nearly 0.05.

Discussion

The main objective of the present study was to explain illegal fishing using the routine activity theory and the market reduction approach. Illegal fishing in the Middle East region is rampant, however, little empirical research has been done in the past to study it when compared to the rest of the world. Considering the critical status of illegal fishing in Mazandaran province and Fereydunkenar city, we, thus, set out to investigate illegal fishing among Fereydunkenar's villagers.

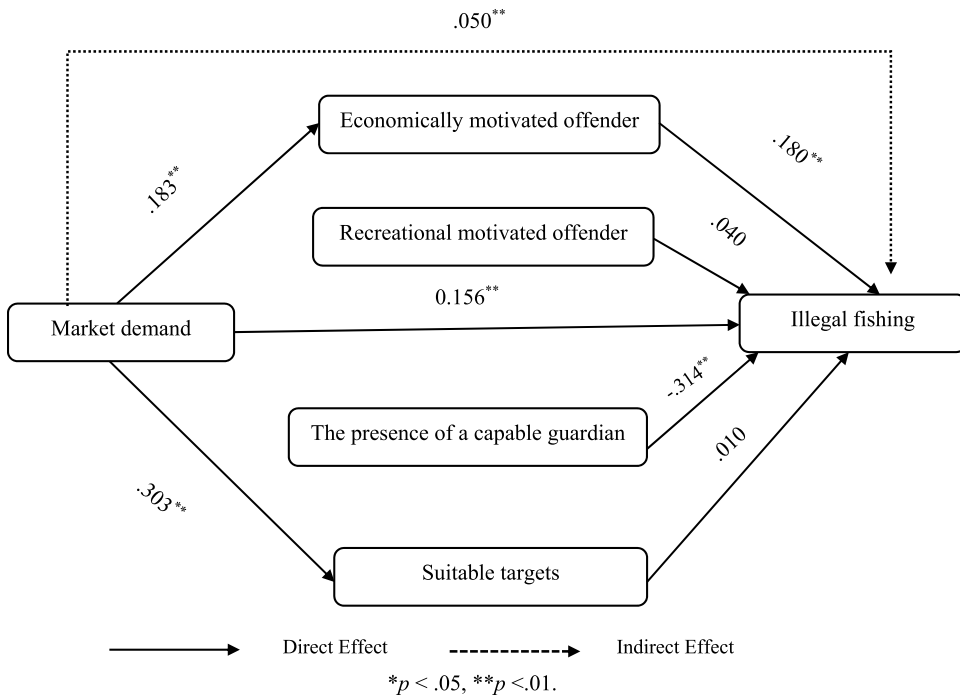


Figure 3. Model of direct and indirect effects on illegal fishing.

The findings of the study show that increase in illegal fishing is associated with an increase in the market demand. Schneider (2008) claims that the market demand approach identifies daily patterns of actors involved in illegal wildlife trade, such as hunters, smugglers and consumers. In this regard, Warchol, Zupan, and Clack (2003) stated that suppliers (or hunters) mainly commit these crimes with the aim of earning a livelihood and making a profit. Traders and smugglers are the second link in the supply chain who facilitate the movement of products provided by initial suppliers (hunters) to final consumers. The fish market in Fereydunkenar city is thriving, and illegally caught fish are easily sold in this market. The high demand for these fish from fishermen is a good incentive for them to do more illegal fishing. The findings of various empirical studies mentioned earlier, as well as arguments proposed by Pires and Petrossian (2016), Wyatt (2016), and Herrera and Hennessey (2007), are consistent with our findings that market demand leads to an increase in environmental crimes, in our particular case as they relate to illegal fishing.

The findings of the structural equation model indicated that market demand affects an illegal fishing activity through its positive effect on the fishers' routine activities. The market has a greater impact on the motivated criminal. Reuter (2004) and Schneider (2005) state that the market and demand for illicit goods plays an important role in motivating individuals to engage in criminal activity. When thieves turn their stolen goods into cash, they have a greater incentive to commit the crime again. In addition, market demand can affect the assessment of the appropriate target for the crime. In this way, the more demand there is for the stolen products in the market, the more criminals will try to choose targets that are of greater financial and economic benefit to them. Cohen and Felson (1979) state that increasing sales of consumer goods due to the oversupply of the intended purpose affects the committing of the crime. Increasing the sales of consumer goods can be considered a good example of market demand. The fish market in this area has an impact on the motivation of criminals, especially economic motivation. Increasing income, reducing poverty, and earning a living are among the economic motivations of illegal fishermen. The findings of previous

studies, such as Pires and Clarke (2011) and De Souza and Alves (2014), support the hypothesis that an increase in the market demand leads to higher economically motivated offenders and suitable targets, and that in such conditions, individuals are more likely to engage in criminal behavior.

Moreover, our findings show that the routine activity elements (specifically the economically - motivated offender and the presence of a capable guardian) have significant effect on illegal fishing. The results of this study show that the presence of a capable guardian has a significant and negative effect on illegal fishing. The increased presence of different people on the sandy beach of Fereydunkenar, coupled with police presence, will reduce illegal fishing. The findings of previous studies (e.g. Eliason 2012; Forsyth 1994, 1993; Forsyth and Forsyth 2009; Margavio et al. 1994; Petrossian 2018, 2015), support this hypothesis that the presence of a capable guardian affects environmental crimes, including illegal fishing.

Additionally, results indicated a positive and significant effect of economic incentives on illegal fishing, and recreational incentives do not have a significant effect on illegal fishing. These results suggest that the economic need of the people in the area drives them to engage in illegal fishing. However, it should be noted that fishing takes place in the seasons (autumn and winter) when most of the villagers in the area do not have agricultural work to do and are in seasonal unemployment. Fishing remains one of the few sources of income during that period. Therefore, it can be said that resolving the issue of seasonal unemployment and making a profit are the main motivations of the villagers for fishing, which can also lead to illegal fishing. Hübschle (2016), Zabyelina (2014), Wyatt (2009) and Forsyth, Gramling, and Wooddell (1998)'s findings are consistent with the findings in this research.

The results of this study indicate that both the routine activity theory and the market reduction approach provide a useful theoretical model to study illegal fishing. A major contribution of this study to the literature is that it tested these theories in a different social context and on a different type of deviant behavior. Choosing Iranian villages as the study site is a considerable contribution to the international application of these theories. Societies differ in the magnitude of particular crime opportunities, so certain opportunities may have more severe consequences in some societies than others. Also, people in different societies may differ in their subjective interpretation of crime opportunities because of cultural differences. Thus, in this study, the applicability of the theory is tested in an Islamic country that has a completely different social structure from other countries. The results imply that even when Western measures of routine activity variables are used, the routine activity theory plays an equal role in the explanation of environmental crimes in a non-Western society. Also, the study indicates that theories developed in one society may apply to other societies, regardless of its geographic location.

Similarly, the relevance and applicability of the market reduction approach in understanding environmental crimes, in our particular case, illegal fishing, points to the need of expanding the empirical literature using this lens, as the policy instruments available through this theoretical approach can be expanded to devise response strategies to deal with environmental crimes as well, and, illegal fishing in particular.

Policy implications

According to the MRA, successful interventions of illegal fishing should focus on important market actors, such as suppliers, dealers, and consumers. Dealers play a key role in sustaining crime levels by facilitating the process of purchasing wildlife products from sellers (fishermen), thus enforcement should focus on cutting ties with sellers and early suppliers (Sutton, Schneider, and Hetherington 2001). Schneider (2005, 2008) states that consumers should be given a lot of attention, so that more severe actions are taken to combat with them, and their role should not be underestimated. The authorities should reduce the market demand by strictly enforcing the law and punishing consumers for the purchase of fish caught by illegal methods such as personal bait, fishhook, fishing net, and

fishing rods. In Fereydunkenar fish market, fish caught by Pareh cooperative can be distinguished from fish caught by illegal methods. This demand reduction would have a significant impact on reducing illegal fishing. Due to positive and significant effects of market demand on illegal fishing in this study, it is necessary to focus on dealers and consumers of illegal fish to reduce the market demand. To reduce demand, officials in the region should focus their efforts on identifying the primary markets and engaging in focused intervention that targets both the dealers and the consumers.

In the field of environmental criminology, the situational crime prevention (SCP) approach can be used to combat wildlife and illegal fishing. The SCP framework suggests focusing on situational determinants, which include temptations, inducements and provocations, to devise strategies that reduce the opportunity to commit crime, and make it more difficult and less rewarding to commit it (Clarke 1980). This framework suggested five main actions that include increasing the risk, increasing the effort, reducing the reward, reducing provocations, and removing excuses. The following are some of the measures that can be taken to combat illegal fishing. These recommendations are summarized in Table 5.

First, *increasing the effort* in the current context can be achieved through various techniques. Controlling tools and weapons can be achieved by regulating the sale of hunting equipment, such as fishing nets. There should also be a strong and coherent licensing system for fishermen. Controlling access to facilities can be achieved by carefully monitoring people entering the seas, as well as through establishing protocols for entry and exit to the sea to prevent illegal fishing.

Second, illegal fishing can be addressed through *increasing the risk* of apprehension. Strengthening formal surveillance by increasing the number of trained officers to combat illegal fishing can be one way to increase the risk. Surveillance can also be strengthened through informal means, which can be done by providing financial incentives to local people and legal fishers who report illegal fishing, who can do so through an established 24-hour hotline. Additionally, local management of the species can be strengthened by not only assigning managers who will identify and regularly monitor protected fish, but also by providing up-to-date training for fisheries officers and agents.

Third, *reducing reward* can be achieved by disrupting and eliminating the illegal markets. Here, the activities of local fish markets should be regularly monitored to identify the possible endangered

Table 5. Situational crime prevention techniques that can be used to prevent illegal fishing in fereydunkenar county, Iran.

Increase the Effort	Increase the Risk	Reduce the Rewards	Reduce Provocations	Remove the Excuses
Control access to facilities Control access to the seas through established protocols for entry and exit Create a robust licensing system	Extend guardianship Provide financial incentives to locals and legal fishers for reporting through an established 24-hour hotline	Disrupt markets Identify and disrupt/eliminate known primary illegal markets Discourage imitation by identifying and removing endangered species from illegal markets	Reduce frustration and stress Increase ecotourism to offer alternative jobs to fishermen	Set rules Establish and carry out specific penalties Enforce local and regional laws
Screen exits Establish exit protocols	Utilize place managers Assist managers to regularly monitor protected fish	Deny benefits Increase penalties for consumers who purchase illegally caught fish	Neutralize peer pressure Create and run "No to Unlicensed Fishing" campaigns Discourage imitation	Post instructions Post signs near protected areas
Control tools/weapons Regulate the sale of hunting equipment, such as fishing nets	Strengthen formal surveillance Increase the number of trained officers		Implement public education campaigns	

species (sturgeon in the Caspian Sea) traded there, and these illegally-sold species should be immediately removed from these markets to discourage imitation.

Fourth *reducing provocations* can be achieved by engaging in concerted efforts of increasing ecotourism in the region and giving alternative jobs to illegal fishermen. Most illegal fishermen own boats and can take tourists on these boats and get paid for them. They can also inform tourists about the traditional fishing methods in Fereydunkenar in the form of a tour. Neutralizing peer pressure can involve carrying out “No to unlicensed fishing” campaigns and public education campaigns focused on the dangers of illegal fishing.

Fifth, *removing excuses* can be achieved by setting rules through informing illegal fishermen and dealers about the penalties and threats for this illegal act. Local and regional laws should also be strictly enforced. Additionally, signs can be posted near protected areas and campaigns can focus on stopping local illegal fishing.

Study limitations

This study has several limitations. The sample of this study is limited only to one county, which may not necessarily be representative of the Iranian society as a whole. Therefore, generalizations based on the findings should be interpreted carefully. Additionally, the sample was particularly male. The issue of environmental crimes could be furthered with the inclusions of cross-gender perspectives for comparative purposes. However, it is our understanding that at the actual fishing stage, mainly males are involved, therefore, our sample can be treated as representative of the illegal fishers' population.

Additionally, the market demand measure was conceptualized through the inquiries with fishermen. As such, it may be seen as more of a measure of market demand perception. Future research, therefore, can devise more objective indicators to measure market demand. The explained variance of illegal fishing is about 11%. This indicates that the theories of this study (RAT) explain a relatively small percentage of changes in the illegal fishing variance. Therefore, future research could consider using other theories in combination with the RAT to increase the explanatory power of the models built to explain illegal fishing.

Another limitation is the under-representation of actual illegal fishing. Licensed fishermen who do not follow fishing rules could also commit illegal fishing, which this study does not assess. Finally, because the research design was cross-sectional, the study contained such problems as causal ordering and absence of control for prior illegal fishing. Future studies would benefit from longitudinal data that could document changes in illegal fishing over time.

Conclusion

Research shows that illegal fishermen are more likely to engage in illegal fishing for economic reasons, such as earning a living and supplementing seasonal unemployment. Some of them do this with nonstandard and unsafe tools and equipment, which shows that they are driven by economic hardship to engage in illegal fishing. For more detailed investigations, there is a need for qualitative research in this area to discover the conditions and consequences of illegal fishing. Qualitative research can reveal more in-depth reasons and how illegal fishing is committed and what tactic illegal fishermen use to continue this illegal activity.

One of the problems of the fishing industry in the Caspian Sea is the excessive increase of both legal and illegal activity in the region, leading to the significant reductions in the volume of fish in the sea, especially endangered ones. While the government of Iran claims that the main cause of the problem is illegal fishing, no official study to date has confirmed this empirically. Future research can focus on comparing the amount and volume of legal and illegal fishing in the Caspian Sea in order to determine the main drivers of the decrease in the volume of fish in this sea.

Disclosure statement

The authors declare that they have no conflict of interest.

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Informed consent

Informed consent was obtained from all individual participants included in the study.

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