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Subsistence Hunting During the COVID-19 Pandemic: The Case of the White-Tailed Deer (*Odocoileus virginianus*) in Rural Communities of Calakmul, Campeche, Mexico

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Abstract

Subsistence hunting for obtaining wild meat is a common practice in rural neotropical communities. Like other peasant practices disrupted by the COVID-19 pandemic, subsistence hunting could exacerbate pressure on wild mammals whose greater size contributes to feeding the hunter and his family. Thus, in the context of the pandemic, we assessed the subsistence hunting of the white-tailed deer (*Odocoileus virginianus*), one of the main traditional game species in the Calakmul region, Campeche, Mexico, and compared this activity with its pre-pandemic levels of such vertebrate species. Based on ethnographic information and hunting records from three rural communities, we found that in one trimester (July–September 2020) of the rainy season, a total of 26 white-tailed deer (923 kg of game biomass) were obtained by local peasant-hunters carrying out hunting mostly alone. Most peasant-hunters interviewed (36 of 51) stated that they hunted daily, and only a few hunted once a week or once a month (8 and 3%, respectively). This hunting activity and modalities were carried out at night (68%) versus day, stalking (21%) and opportunist (11%) near their community. The game biomass and hunting frequency in the studied communities were twice as high during the pandemic, compared to similar pre-pandemic periods in the region. Our survey highlights the need to expand monitoring and evaluation (during and after the pandemic) of subsistence hunting on key species, such as white-tailed deer, in order to ensure conservation and sustainable use of wildlife in this important Mesoamerican region.

Keywords

SARS-CoV-2 coronavirus, peasant-hunters, hunting modalities, wild meat, ungulates

Introduction

Subsistence hunting is a socially rooted practice in rural Mesoamerican communities (Montiel & Arias, 2008; Oliva et al., 2014). In this region, wild meat represents a major component for food in sites adjacent to ecological reserves (Briceño-Méndez et al., 2016; León & Montiel, 2008; Quijano-Hernández & Calmé, 2002), providing most of the animal protein in the diet of the rural population (Schulte-Herbrüggen et al., 2013; Shoobridge, 2019).

In December 2019, the World Health Organization announced the pandemic outbreak associated with the acute respiratory disease caused by the SARS-CoV-2 coronavirus (globally referred to as COVID-19) (Hasöksüz et al., 2020; Kideghesho et al., 2021; Simon et al., 2020). Since the

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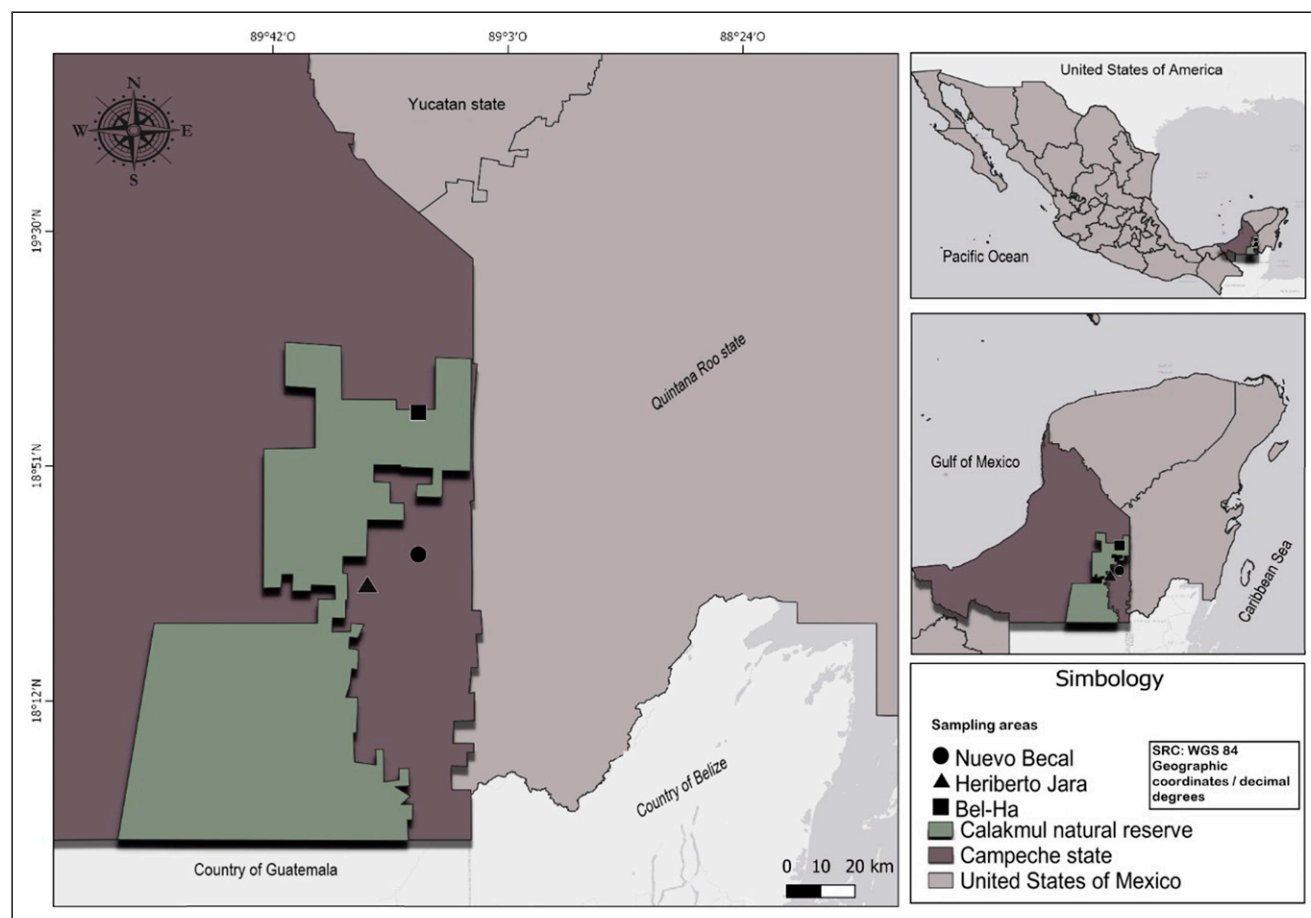


Figure 1. Location of rural communities evaluated during the COVID-19 (SARS-CoV-2) pandemic, from July to September 2020, in the Calakmul Campeche region, Mexico. Bel-Ha community (BHC). Nuevo Becal community (NBC). Heriberto Jaras community (HJC).

beginning of this pandemic, human societies have been affected globally, from urban to rural, in ways never seen before (Tarakini et al., 2021). In rural environments, COVID-19 inevitably also impacted peasant lifestyles (agroforestry practices and wage labor) (Akinsorotan et al., 2021; Corlett et al., 2020; Kideghesho et al., 2021). Since the beginning of the pandemic, social isolation was required to mitigate the spread of the virus and break the chains of contagion, leading to the loss of wage labor, alteration in the supply and demand of goods and services, as well as new challenges for family subsistence and health (Abd Rabou, 2020; Akinsorotan et al., 2021; Amanda et al., 2021; Gaynor et al., 2020; Montes de Oca, 2016). As an expected consequence, the use of local natural resources (e.g., wildlife) in different socio-ecological contexts was accentuated, including subsistence hunting.

The white-tailed deer (WTD; *Odocoileus virginianus*) is one of the main species traditionally hunted by rural communities of the Yucatan Peninsula (Herrera-Flores et al., 2019; León & Montiel, 2008; Retana & Lorenzo, 2016). In addition to its high sociocultural value (Ríos-Vázquez, 2020),

the hunting of this ungulate is highly appreciated in rural environments due to the type and quantity of meat (individual average weight = 41.7 kg) it provides for society (Gallina & Mandujano, 2009; García-Flores et al., 2021; Kideghesho et al., 2021; León & Montiel, 2008; Quijano-Hernández & Calmé, 2002; Villarreal, 2002). This is particularly evident in the context of group hunting modalities such as “batida” commonly practiced in the Yucatan Peninsula (BriceñoMéndez et al., 2011; Montiel et al., 1999; Rodríguez et al., 2012).

Although WTD is one of the most studied species in Mexico (Gallina & Mandujano, 2009), the use of this ungulate by peasant-hunters amid the current socio-economic crisis associated with the COVID-19 pandemic in the Calakmul region is unknown. Thus, here, we analyze the subsistence hunting activity on WTD, during the pandemic in Calakmul, Campeche. Taking as reference historical records of pre-pandemic hunting activity associated with WTD, we hypothesize a greater frequency of hunting and an emphasis on non-group hunting modalities in order to avoid possible infections by COVID-19 between peasant-hunters.



Figure 2. White-tailed deer (*Odocoileus virginianus*) hunted in the communities of Bel-ha (A); Heriberto Jaras (B and C); and Nuevo Becal (D). During the COVID-19 (SARS-CoV-2) pandemic, from July to September 2020. Photo credit: Leonides Córdoba and Marcos Briceño-Méndez.

Methods

Study Region and Rural Communities

The Calakmul region is located south of the Yucatan Peninsula, in the southeastern part of the state of Campeche, Mexico (Figure 1). The regional climate is warm-subhumid with rains in summer and with less than 60 mm of precipitation in the driest month (García-Gil, 2003). In comparison to the peninsular plain, the elevations of terrain in Calakmul vary between 100 and 380 m above sea level (García-Gil, 2003). In the past decades, three protected areas have been established in this region (Calakmul Biosphere Reserve, CBR; and Balam-Kim and Balam-Ku state reserves), constituting part of the most extensive tropical forest currently in Mesoamerica (Martínez & Galindo-Leal, 2002).

During the last decade, the landscape of Calakmul area has undergone abrupt changes, going from vast expanses of the continuous tropical forest to an agroforestry mosaic (with various human settlements), where the population carries out extractive activities such as subsistence hunting (Briceño-Méndez et al., 2016; Escamilla et al., 2000; Reyna-Hurtado & Tanner, 2007). The vegetation that exists in the region includes (1) semi-evergreen forest, (2) semi-evergreen flooded lowland forests, (3) lowland dry forest, and (4) secondary vegetation which developed once the original vegetation had been eliminated by human activities or by natural processes (Pennington & Sarukhán, 1998).

Our survey was carried out in three communities located in the Calakmul region, two adjacent to (Heriberto Jara and Nuevo Becal) and one immersed in (Bel-Ha community) the CBR (Figure 1). The Heriberto Jara community is located

near the CBR ($18^{\circ}30'43''N$, $89^{\circ}26'40.93''W$) with a total of 356 inhabitants (34% Ch'ol-speaking indigenous people). The Nuevo Becal community has a total of 450 inhabitants and is located on the northeast side ($18^{\circ}40'07.7''N$, $89^{\circ}12'34.3''W$) of the CBR, with a population constituted by immigrants from the states of Veracruz, Tabasco, and Campeche (after land's Mexican regulation of 1928). The Bel-Ha community is located north ($19^{\circ}00'25''N$, $89^{\circ}17'27''W$) of the CBR with a total of 183 inhabitants, most of them immigrants from Tabasco. In the three communities, the main subsistence activities are agriculture, livestock, and subsistence hunting (Briceño-Méndez et al., 2014; Escamilla et al., 2000; Santos-Fita et al., 2012).

Data Collection, Community Work, and Data Analysis

At the beginning of the survey (AprilMay 2020), field trips were conducted to document activities of local population during the first months of the COVID-19 pandemic. Subsequently, in 3 months (JulySeptember) corresponding to the regional rainy season (García-Gil, 2003), semi-structured and in-depth interviews were done with hunters of each community about their hunting activity (modality, purpose, frequency, and game biomass). Based on their willingness to participate in our survey, we were able to include most hunters (71%) identified in the three studied communities ($N = 51$).

Having received the consent of peasant-hunters, participant observation was additionally carried out in 23 hunting trips. The peasant-hunters who participated in the hunting trips also collaborated (under supervision by the first author) in data recording of prey (Figure 2).

Table 1. Comparative data from subsistence hunting of the white-tailed deer (*Odocoileus virginianus*) before and during the COVID-19 pandemic.

Study Site and Authors (Before the COVID-19 Pandemic)	Hunting Frequency	Hunting Modality	Number of White-Tailed Deer	Hunting Biomass (kg)
Maya community of los Petenes, Campeche, México (Burgos-Solis, 2020). (2010-2011 data) ^a	Weekly	Batida Group Hunting	15	498
Communities in southern Yucatán (Montes-Pérez et al., 2018). (2009-2010 data) ^b	Twice a month	Batida Group Hunting	10	454
Petcacab, Mayan community in Quinta Roo. (Ramírez-Barajas & Naranjo Piñera, 2007). (2003 data) ^a	Twice a month	Regularly two people	21	566
Mayan community 20 de noviembre. The Calakmul región Calakmul (Santos-Fita et al., 2012). (2010-2011 data) ^a	Weekly	Regularly three people	16	522.2
Lacondona jungle in Chiapas (Tejada et al., 2014). (2010-2011 data) ^b	Twice a month	Regularly two people	14	486 ^c
Yohactún de Hidalgo. The north of Yucatán (Herrera-Flores and Belén, 2016). (2016 data) ^a	Weekly	Batida group hunting	13	475 ^c
Tres Reyes. Community in Quinta Roo. (Quijano-Hernández & Calmé, 2002). (2001 data) ^a	Monthly	Regularly two people	9	440 ^c
Study site (during the COVID-19 pandemic)	Hunting frequency	Hunting modality	Number of white-tailed deer	Hunting biomass (kg)
Region of Calakmul, Campeche, Mexico. Date from Jul to Sep 2020	Daily	Mostly alone	26	923

^aOne community (annual data).^bThis study includes tree community (three to 4 months of data).^cBiomass estimates by individual average weight reported.

For each hunting trip, the number and individual characteristics of prey (weight, sex, and age) were recorded. For all activities, the official health protocols of the COVID-19 pandemic (Nina-Estrella et al., 2020) were followed, in order to safeguard all participants involved in this research.

Results

During the study period (July-September 2020), a total of 26 WTD (20 males and six females) were registered. Across the their selected communities, we found that estimated game biomass (923 kg) and quantity of prey of WTD doubled during the pandemic in comparison with similar pre-pandemic periods (Table 1).

Peasant-hunters interviewed ($n = 36$) stated that they mostly practiced hunting in a daily basis (89%), and few practiced it once a week or once a month (8% and 3%, respectively). The daily frequency in the practice of subsistence hunting recorded in our survey indicates a greater pressure and search for WTD compared to pre-pandemic records with frequency (weekly, twice a month, and monthly) reported in diverse communities (Table 1). This hunting activity was carried out mainly at night (68%) versus stalking or opportunistic (21% and 11%, respectively; both diurnal), in community surroundings.

Discussion

As a consequence of the pandemic, hunting of WTD in Calakmul region seems to be increasing with an orientation to

non-group hunting modalities. In this region, group hunting (i.e., *batida*), a traditional hunting mainly executed in the lowlands of the Yucatan Peninsula (Plata et al., 2019; Burgos-Solis, 2020) is now prevented by the hunter's fear of exposure to COVID-19.

Compared with pre-pandemic records reported for communities in southern Yucatan (Montes-Pérez et al., 2018), in the east for a Mayan community in Quinta Roo (Ramírez-Barajas & Naranjo Piñera, 2007), and western Campeche (Burgos-Solis, 2020), the game biomass and quantity of prey (WTD) shown here in Calakmul doubled during the pandemic. This is notable for a period (3 months) of the rainy season when subsistence hunting is expected to decrease in the peninsular region (León & Montiel, 2008). In this sense, the need to satisfy the demand for food during the pandemic at the study sites can be related to the registered differences concerning the amount of hunted WTD and biomass harvested that has been historically recorded before the pandemic.

The daily frequency in the practice of subsistence hunting recorded in this study indicates a greater pressure and search for WTD compared to pre-pandemic records with frequency (weekly and monthly) reported in diverse communities of Mexico: the Lacondona jungle in Chiapas (Tejada et al., 2014), the north of Yucatan (Herrera-Flores & Belén, 2016), the northern sierra in the state of Puebla (Hernández-Reyes et al., 2017), the south of the state of Yucatan (Briceño-Méndez et al., 2011; Montes-Pérez et al., 2018), and the Calakmul region (Briceño-Méndez et al., 2014;

Santos-Fita et al., 2012). Increased hunting is an alternative way to satisfy the basic food needs of the peasant-hunters and his family.

The impact on biodiversity derived from the COVID-19 pandemic around the world has recently been documented (Amanda et al., 2021; Akinsorotan, et al., 2021; Kideghesho et al., 2021), with an increase in the demand for wild species (Corlett et al., 2020). Our survey in the Calakmul region contributes to exploring the impact of the rural population on wildlife during the COVID-19 pandemic, inside and outside of protected areas in this important Mesoamerican eco-region.

Implications for Conservation

WTD populations in southeastern Mexico are subject to intense subsistence hunting (Burgos-Solís, 2020; Santos-Fita et al., 2012; Weber, 2014), which has caused population declines for this species in many areas of its range of distribution (Weber, 2014; Ortiz-Lozada et al., 2017). Information on the sustainability of its harvest is key to conservation strategies for this ungulate (Pinkus-Rendón & Rodríguez-Balam, 2020; Ruiz-Mondragón et al., 2020), taking into account its current importance for the subsistence of rural people.

It is urgent to conduct research to evaluate and demonstrate the situation of this highly demanded species, especially due to the pressure that it may be suffering as a result of the pandemic (Corlett et al., 2020). These aspects are fundamental since recent studies in the Yucatan Peninsula show that WTD densities tend to decrease, and consequently, the sustainability of the harvest of wild species becomes vulnerable (Pinkus-Rendón & Rodríguez-Balam, 2020). The resilience of the WTD to hunting is attributed to its high reproductive rates and adaptability. However, if hunting levels are high and habitat loss increases, the population can be considerably reduced (Gallina & Lopez Arevalo, 2016; Gallina & Mandujano, 2009; Robinson & Bodmer, 1999).

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