HUMAN KLEPTOPARASITISM ON EURASIAN LYNX (*LYNX LYNX* L.) IN SLOVENIA AND NORWAY

KLEPTOPARAZITIZEM S STRANI ČLOVEKA PRI EVRAZIJSKEM RISU (*Lynx lynx* L.) V SLOVENIJI IN NA NORVEŠKEM

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ABSTRACT

Throughout their evolution, humans have scavenged the remains of prey killed by large carnivores. Such human kleptoparasitism is still occurring nowadays, however, the reasons for it today are more diverse than the simple acquisition of food. The phenomenon is very poorly documented and most of the data available come for Africa and Asia. In this paper we present data of human kleptoparasitism on kills made by Eurasian lynx (*Lynx lynx*) in two contrasting regions of Europe, Slovenia and Norway, gathered from different sources. Due to their relatively small size and prolonged consumption process, Eurasian lynx is particularly vulnerable to human kleptoparasitism. The collected data suggest that people relatively often find prey remains of lynx in both countries. While in Norway they normally leave it at the kill site, in Slovenia they usually remove it and thereby prevent the lynx from finishing their consumption of the prey. Reasons for removal include their use for human or dog food, use as a bait for attracting other carnivores, to get authorities to do autopsy, to 'clean the environment', or to get 'revenge' on the lynx. We assume that although the extent of human kleptoparasitism is not such that it could lead to starvation of individual lynx, it probably increases the predation rate of lynx, which in turn leads to greater energy expenditure sustained during hunting and may also increase the conflicts with hunters due to higher pressure on game species.

IZVLEČEK

Z ostanki plena velikih zveri se ljudje in njihovi predniki hranijo že od pliocena dalje. Takšen kleptoparazitizem s strani človeka se pojavlja še danes, čeprav ni več nujno povezan s prilastitvijo mesa kot hrane. V literaturi je ta pojav zelo slabo dokumentiran, večina podatkov pa je na voljo za območje Afrike in Azije. V prispevku smo iz različnih virov zbrali podatke o kleptoparazitizmu s strani človeka pri evrazijskem risu (*Lynx lynx*) v Sloveniji in na Norveškem. Zaradi relativno majhne velikosti in podaljšanega časa konzumacije plena je evrazijski ris še posebej dovzeten za kleptoparazitizem s strani človeka. Zbrani podatki nakazujejo, da v obeh državah ljudje relativno pogosto najdejo ostanke risovega plena. Medtem ko najden plen na Norveškem večinoma pustijo na mestu uplenitve, ga v Sloveniji pogosto odstranijo in s tem risu preprečijo nadaljnjo konzumacijo. Razlogi za odstranitev plena so različni - od uporabe za prehrano psov ali ljudi, do uporabe za vabo za druge zveri, ali preprosto zato, da »očistijo« okolje ali v želji po maščevanju risu. Čeprav kleptoparazitizem s strani človeka verjetno ni tako pogost, da bi lahko vodil do stradanja posameznih

risov, menimo, da vpliva na povečanje stopnje plenjenja. Zaradi tega se na eni strani poveča poraba energije potrebna za lov in verjetnost poškodbe, po drugi strani pa se lahko zaradi večjega pritiska na divjad poveča tudi konfliktnost z lovci.

1. INTRODUCTION

Carrion resources are extensively used by both specialized and opportunistic vertebrate scavengers (DeVault et al. 2003). Besides scavenging on animals that die from other causes, scavengers often feed on the remains of prey killed by predators when these are available. This kind of exploitive competitive interaction is known as kleptoparasitism, in which scavengers negatively affect the predator by reducing the degree of utilization of prey that were killed by the predator (Hunter et al. 2006). For many mammal communities the extent of kleptoparasitism is still a poorly understood phenomenon. Most data are available from African savannas, where several studies on exploitive competition between large carnivores were conducted (e.g. Carbone et al. 1997, Honer et al. 2002, Hunter et al. 2006). The existing data indicate that the energetic costs of prey loss can be significant for some species (Gorman et al. 1998).

Although there is still much debate over the importance of scavenging behaviour in human evolution during the Pliocene and Pleistocene, archaeological data suggest that early humans more or less regularly scavenged on prey remains of large carnivores and that they may have even confronted large felids in order to obtain meat (Domínguez-Rodrigo 2002). Contemporary reports of scavenging on the prey remains of large felids, such as lions (*Panthera leo*), leopards (*Panthera pardus*) and tigers (*Panthera tigris*), in developing countries suggest that kleptoparasitism by humans is still present in Africa and Asia (Sunquist et Sunquist 1989, Treves et Naughton-Treves 1999, Shoe et al. submitted). It has even been suggested that human kleptoparasitism was a major factor in the decline of endangered Asiatic lion (*Panthera leo persica*) in Gir forest in India (Sunquist et Sunquist 1989).

The Eurasian lynx (*Lynx lynx*) is a solitary, medium-sized felid (16–27 kg for adults) that mainly hunts smaller ungulate species and normally returns to the carcass for several days until the meat of prey is totally consumed (Kos et al. 2005). Owing to this prolonged consumption process, Eurasian lynx are particularly vulnerable to kleptoparasitism by vertebrate scavengers, including people. Due to the small size of Eurasian lynx, when compared to species in the genus *Panthera* or *Puma*, there is practically no risk of attack on humans, which would make scavenging on lynx kills easier. However, since much of the distribution range of Eurasian lynx includes developed countries, there is probably less need to acquire food for human nutrition in this way.

In the published literature very little information is available about kleptoparasitism by humans on Eurasian lynx. So far, no data have been published from either Slovenia or Norway. In the present article we tried to gather as much data as possible on the cases of removal of lynx kills by humans in Slovenia and Norway in order to estimate the possible effects of human kleptoparasitism on this rare species, to determine the possible motives for

removing the carcasses, and to make a comparison between the situations in the two countries that differ considerably in ecological and socio-economic situations.

2. METHODS

Data on cases of the removal of lynx prey remains by humans were collected in the field through the inspection of the lynx kill sites, video monitoring using remote infra-red video system, surveying tracks in the snow, and visits to the persons who removed the carcasses. Lynx kill sites were located either using VHF or GPS-GSM telemetry of lynx, snow-tracking of lynx, from information on prey remains found by other people, and as coincidental finds during fieldwork. In Slovenia, data were also gathered through interviews with hunters and foresters, as part of our inquiries about lynx predation. However, since many people were not willing to admit that they have removed the carcass, usually the information about the finding and removal of the carcass was received by a third person not directly involved in the removing. In Norway, data was also available from a study on scavenger activity at simulated lynx kills. A remote video system with infra-red light was used to monitor roe deer carcasses that were randomly placed during all seasons in the boreal forest-farmland matrix in SE Norway in 2002 and 2003.

In addition, we tried to estimate the amount of ungulates killed by carnivores and potentially removed by people with the use of data on prey remains found by hunters in individual regional hunting grounds (»lovsko upravljalska območja«) in Slovenia gathered by the Slovenian Forestry Service (Zavod za gozdove Slovenije 2006a, 2006b, 2007a, 2007b). In order to get a better idea of possible effects on individual animal, we calculated the number of prey remains found per lynx living in the area. Since not much reliable information is available on lynx densities in Slovenia, we used figures from studies in Switzerland, where densities were estimated at one lynx per 106 km^2 (Breitenmoser et al. 1993). This number is probably higher than current densities of lynx in Slovenia, so it is possible that effects of human kleptoparasitism of prey remains on individual lynx are stronger.

3. RESULTS

3.1 SLOVENIA

3.1.1 Video monitoring of prey remains

We monitored scavenger activity on prey remains of Eurasian lynx at 6 kill sites during all seasons in 2007 and 2008. None of these six kill sites were found by people at the time when lynx were visiting their prey.

3.1.2 Anecdotal observations

We present 7 cases of people removing the remains of lynx prey, for which we were able to get information. Some of these are based on personal communication by hunters, and were not confirmed in the field.

- On May 25, 2002, hunters found female roe deer (*Capreolus capreolus*) killed by an uncollared lynx near Ribnica (S Slovenia, UTM VL76) and removed it to a brown bear (*Ursus arctos*) feeding site to be used as bait (source: personal communication with the hunter).
- On March 10, 2004, hunters found female roe deer killed by an uncollared lynx near Ribnica (S Slovenia, UTM VL76) and removed it to a brown bear feeding site to be used as bait (source: personal communication with the hunter).
- On January 13, 2006, prey remains were found by local hunters above Srednja Kanomlja near the town of Idrija (W Slovenia, UTM VL29). A male roe deer was killed in the morning by an uncollared Eurasian lynx, which was also observed next to the prey by hunters around 3 p.m. After two days, our research team was informed about the carcass and one of the authors (M.K.) went to the field to collect samples and recorded characteristics of the kill site. At the location it was observed that the whole carcass had been removed. With the help of a local hunter it was determined that another hunter took the prey remains to his home. This person was visited and he told us that he had taken the carcass to feed his dogs with it. He also gave us samples from the carcass for analysis.
- On March 30, 2006, hunters found a male roe deer killed by an uncollared lynx near Tolmin (W Slovenia, UTM VM01) and removed it from kill site. The carcass was seen the next day by one of the authors (I.K.) in a cold-storage chamber of the local hunting club, where it was cleaned and ready to be used for food. After some discussions, the body was taken back to the kill site, but the lynx did not return to feed.
- In May 2007, a roe deer killed by uncollared lynx was found by hunters on Mt. Nanos near Postojna (Central Slovenia, UTM VL27) and removed from kill site (source: personal communication with the hunter).
- In June 2007, a roe deer killed by an uncollared lynx was found by hunters near Koritnice in the Pivka Valley (S Slovenia, UTM VL45) and removed from kill site (source: personal communication with the hunter).
- In November 2007, lynx prey remains were found near Draga in Kočevska (S Slovenia, UTM VL75) and were taken to a brown bear feeding site to be used as bait (source: personal communication with the hunter).

We also observed a case of removal of prey remains by humans on a kill made by grey wolves (*Canis lupus*). On March 15, 2005, one of the authors (M.K.) was snow-tracking a pack of wolves on Menišija plateau above Borovnica (Central Slovenia, UTM VL58). Near a place called Pekel, the remains of a red deer (*Cervus elaphus*) killed by wolves were found. From the tracks in the snow it was determined that humans dragged the carcass to the car and drove it away.

3.1.3 Estimation of the amount of prey remains found by people in Slovenia

According to the reports presented by Slovenia Forestry Service, the number of carcasses of ungulates killed by carnivores and found by hunters in regional hunting areas covering the approximate lynx distribution range in Slovenia for a period of 5 years was: 520 roe deer, 1145 red deer, and 9 chamois (*Rupicapra rupicapra*) (Zavod za gozdove Slovenije 2006a, 2006b, 2007a, 2007b). The available data do not include information about the species of carnivore that killed the animal.

From data on lynx densities and the sizes of each regional hunting area we can calculate the number of prey remains found annually by hunters per lynx living in the area. The results for each of the four regional hunting areas are presented in Table 1. The highest numbers of prey remains were found in the Kočevsko – Belokranjsko and Notranjsko hunting grounds. For roe deer, most prey remains were found in the Notranjsko hunting grounds.

Table 1: Numbers of three species of ungulates killed by carnivores and found by hunters in four regional hunting grounds. The figures were calculated to correspond to the number of found carcasses per lynx per year under the assumption that lynx densities correspond to one lynx per 106 km^2.
Tabela 1: Število trupel treh vrst parkljarjev, ki so jih uplenile zveri in so jih našli lovci v štirih lovsko upravljalskih območjih. Vrednosti so bile preračunane tako, da ustrezajo številu ostankov najdenega plena na enega risa ob predvidevanju, da gostota znaša 1 ris / 106 km^2.

Regional hunting ground / Lovsko upravljalno območje	**Area of hunting grounds [ha] / Lovna površina [ha]**	**No. of prey remains found by hunters per lynx per year / Št. letno najdenih ostankov plena zveri na risa**		
		roe deer / srnjad	red deer / jelenjad	chamois / gams
Kočevsko–Belokranjsko	203 120	7.1	43.1	0.1
Notranjsko	142 143	22.5	23.4	0.2
Zahodno visoko kraško	154 696	2.5	0.2	0.3
Primorsko	133 162	3.7	0.2	0.0

3.2 NORWAY

3.2.1 Video monitoring of simulated prey remains

From 29 carcasses of roe deer killed in traffic and placed in the forest as simulated lynx kills, four (14%) carcasses were found by local people during the first seven days (corresponding to the period when lynx might use a kill). None of the carcasses were removed.

3.2.2 Observations of human presence at lynx kill sites

A total of 225 ungulates killed by lynx were found between 1995 and 2007 in SE Norway by systematic snow-tracking or radio-telemetry during a lynx-roe deer ecology study. Based on the tracks in snow and personal communication, we have detected that at least 70 (31%) of the prey remains were discovered by people. It has to be noted that the majority of these observations took place during winter time, when prey remains are more easily discovered by

people due to the lynx tracks in snow leading to the kill site. Most of the carcasses were found during lynx hunting in February and March, and when lynx killed roe deer close to houses. None of these 70 carcasses found by local people were subsequently removed.

In addition to the 225 prey remains found using unbiased methods concerning discovery by local people, we received information from the public of about 180 more lynx kills found by local people. From these, at least 12 carcasses (5%) were removed:

- In February 1995, a roe deer carcass killed by an uncollared lynx was removed by a local hunter in Hedmark County to be used as a bait for red fox (*Vulpes vulpes*) hunting (source: personal communication with the hunter).
- In March 1995, a roe deer carcass killed by an uncollared lynx was removed by a local hunter in Hedmark County to be used as a bait for red fox hunting (source: personal communication with the hunter).
- In December 1996, a roe deer killed by an uncollared lynx was removed by a local hunter in Hedmark County. He expressed the desire to get »revenge« on the lynx for killing a valued game species; he felt that by removing the carcass the lynx would be denied the benefit of the kill (source: personal communication with the hunter).
- In December 2002 and January 2003, 3 lynx-killed roe deer were removed by a local hunter in Akershus County. He expressed the desire to get »revenge« on the lynx for killing a valued game species (source: personal communication with the hunter).
- In August 2005, a lynx-killed roe deer was removed by local hunters in Østfold County. They removed it to get an autopsy by local managers in order to ascertain who was the predator and also expressed that they wanted to 'clean' the environment (source: personal communication with the hunter).
- In March 2007, a roe deer killed by a young radio collared male lynx was removed by local mangers in order to 'clean' the environment.
- In October 2007, 2 roe deer killed by a young radio collared male lynx were removed by local mangers in order to 'clean' the environment.
- In December 2007, a roe deer was removed by a local hunter in Akershus County to be used as a bait for red fox hunting (source: personal communication with the hunter).

4. DISCUSSION AND CONSERVATION IMPLICATIONS

While the motivation for human kleptoparasitism on felids in Africa is usually the acquisition of meat for human consumption (Treves et Naughton-Treves 1999), the reasons for removal of prey remains of Eurasian lynx in Slovenia and Norway appear to be more diverse. It also seems that the percentage of lynx kills removed by people differs substantially in different regions.

According to the data presented above, it appears that in Slovenia the carcass is usually removed when people come upon an animal recently killed by lynx or other carnivores. The meat is used as food for dogs or even for humans or transferred to the feeding place for brown

bears as bait. We were also told that the carcasses had been removed and buried at another place in order to 'clean' the environment. Unfortunately, it is hard to estimate the frequency of cases of human kleptoparasitism on lynx in Slovenia, since the sample size of video monitored prey remains is too low. Some indications may be gained from the numbers of wild game killed by carnivores, which were found by hunters. According to the available statistics, these numbers appear to be relatively high, but unfortunately these data do not contain the information of the species of predator, so it is not possible to know what proportion of these carcasses were lynx prey. Also it is impossible to estimate what proportion of prey remains found were actually removed during the period that lynx would have been consuming them. The main prey of lynx in Slovenia is roe deer (Krofel 2006), while the wolf selects mostly red deer (Adamič et al. 2004). From this we may assume that in the Notranjska hunting ground where 22.5 roe deer killed by carnivores are found by hunters per lynx per year, there is the highest number of lynx prey remains potentially removed by people. However, the data do provide an indication that humans find a lot of carnivore kills. Due to veterinary regulation and in order not to attract bears to human settlements, the carcasses found in proximity of villages or roads are supposed to be removed and destroyed.

For Norway, the available data indicate that a relatively high proportion of lynx kills are found by people at least in the southern and central part of the country. In contrast to the situation in Slovenia, in Norway it appears that only a small proportion of carcasses found by people are also removed from the kill site. However, it must be noted that sometimes just the presence of people at the kill site might deter lynx from returning to continue with consumption even if the carcass is not removed or otherwise disturbed (J. Linnell, M. Krofel et I. Kos, personal observations). For example in Norway, on 94% of lynx kills that were not found by people, >75% of the edible biomass was consumed. In contrast, only 27% of those that were found by people (but not removed) were utilized to the same extent (Øvrum 2000). This indicates that lynx are often reluctant to return to kills that have been disturbed by people.

A very limited amount of data concerning the removal of Eurasian lynx prey remains by people is available for other countries. In Białowieża Forest in Poland, from 214 carcasses monitored (approximately a third of them were prey remains from lynx and wolves) 10 per cent were scavenged by people, in most cases for trophy skulls of male ungulates and in two cases for meat (Selva 2004). For Switzerland, Jobin et al. (2000) reported that 2% of lynx kills were removed by humans. These prey remains were usually removed and destroyed only when they were close to human settlements or frequently used roads (F. Zimmermann, pers. comm). For other countries, as far as we know, no published data are available on the frequencies of people finding prey remains, although we conducted a survey among our colleagues to obtain some anecdotes and impressions. In Croatia and Slovakia it seems that the situation is similar to Slovenia, as people usually remove the prey remains whenever they find them (V. Slijepčević et T. Pataky, pers. comm.). In Croatia, hunters usually transfer lynx prey remains to the brown bear feeding sites (V. Slijepčević, pers. comm.). In NE Italy, hunters often remove lynx kills, as they are obliged to transfer them to the regional forestry service (S. Filacorda, pers. comm.).

Due to the relatively large size of their prey, the process of consumption by lynx can take a considerable amount of time, even up to a week (Jobin et al. 2000, Krofel et al. 2006). If the carcass is removed by people before the lynx has finished with its consumption, lynx would have to search for new prey sooner than if the carcass had not been removed. This will lead to higher kill rates and consequently increase their energetic requirements as well as the probability of injuries sustained during hunting. The upper limit beyond which lynx are able to compensate for the losses with increased predation rate is not known.

On the basis of available information it appears that kleptoparasitism by people is not so extensive that it could lead to starvation of individual lynx (although it may have stronger effects on females with dependent kittens), but in areas were the removal of prey remains is frequent (e. g. in Slovenia, Croatia, and Slovakia), it may substantially affect lynx predation rates. This in turn increases the probability of injury sustained during hunting and may also increase conflicts with local hunters, due to higher predation pressure on game species. This could potentially increase hunters' antagonism towards lynx, which in turn could potentially lead to increased rates of illegal killing of lynx. The possible mitigation actions include education of local people, especially wildlife managers and hunters, of the effects which carcass removal can have on large predators (and also scavengers), as it is usually in their interest to keep the predation rate of large carnivores as low as possible.

5. POVZETEK

Kleptoparazitizem je oblika medvrstne ali znotrajvrstne interakcije, pri kateri osebek ukrade že prisvojeno hrano drugemu osebku, ki je v njeno pridobitev vložil energijo. Človek in njegovi predniki se že od pliocena prehranjujejo z mrhovino, med drugim tudi z ostanki plena velikih zveri. Obstaja več poročil, ki nakazujejo, da se kleptoparazitizem s strani človeka še danes bolj ali manj redno pojavlja v Afriki in Aziji, čeprav ni več nujno povezan samo s prilastitvijo mesa kot hrane. Precej manj podatkov kot za ti dve območji je na voljo za območje Evrope. Zaradi relativno majhne velikosti in podaljšanega časa konzumacije plena je največja evropska mačka – evrazijski ris (*Lynx lynx*) – še posebej dovzeten za kleptoparazitizem s strani človeka. V prispevku smo iz različnih virov zbrali podatke o tem pojavu v Sloveniji in na Norveškem, da bi ocenili vpliv kleptoparazitizma s strani človeka na to zavarovano živalsko vrsto, določili motive za odstranjevanje ostankov plena in naredili primerjavo situacije v obeh državah.

Podatke smo zbirali s pomočjo video nadzora risovega plena preko avtomatske infrardeče kamere, s pregledovanjem mest, kjer so risi uplenili svoj plen, s pomočjo sledenja v snegu, preko analize podatkov o odkritih izgubah na divjadi ter preko pogovorov z lokalnim prebivalstvom. Izkazalo se je, da ljudje relativno pogosto najdejo ostanke risovega plena tako v Sloveniji kot na Norveškem. Za Notranjsko lovsko upravljalsko območe smo na primer ocenili, da je letno na posameznega risa najdenih okoli 22.5 ostankov srnjadi, ki so jih uplenile zveri (volk, medved in ris skupaj). Bolj natančni podatki so na voljo za Norveško, kjer so

ljudje našli 13,8 % simuliranih ostankov risovega plena, ki so bili nadzorovani s pomočjo video kamere, in približno 32 % ostankov plena, ki smo jih večinoma v zimskem času našli s pomočjo sledenja v snegu ali radio-telemetrije.

Na Norveškem ljudje, ki najdejo plen, truplo večinoma pustijo na mestu uplenitve, saj ni bilo odstranjeno nobeno izmed 254 trupel spremljanih z video kamero ali preko sledov v snegu (vsaj 74 so jih ljudje našli). Poudariti pa je potrebno, da je lahko dovolj že sama prisotnost ljudi ob plenu, da se ris ne vrne več k ostankom plena. Od nadaljnjih 180 ostankov risovega plena, za katere smo izvedeli od lokalnega prebivalstva v južnem delu Norveške, jih je bilo odstranjenih okoli 5 %. V Sloveniji je stanje precej drugačno, saj so ljudje odstranili večino najdenih ostankov risovega plena, za katere smo dobili informacijo o tem, kaj se je zgodilo po odkritju ostankov plena. Na podlagi komuniciranja z raziskovalci iz drugih evropskih držav do podobnih razlik kot med Slovenijo in Norveško prihaja tudi v ostalih delih Evrope. Glavni razlogi za odstranitev plena v Sloveniji je uporaba mesa za prehrano psov ali ljudi ter uporaba za vabo za druge zveri (odvoz na mrhovišča). Zaradi veterinarskih predpisov in preprečevanja zadrževanja medveda v bližini človeških bivališč naj bi ostanke trupel najdenih v bližini naselij ali cest odpeljali v sežigalnico, vendar za sedaj še nismo dobili podatka, da bi se to zgodilo tudi s kakšnim risovim plenom. Na Norveškem ostanke plena večinoma odstranijo 1.) zaradi uporabe trupla kot vabe za lov na lisice, 2.) zaradi zanimanja, da bi kasneje odkrili, kdo je uplenil žival, 3.) iz maščevanja do risa ali 4.) ker želijo »očistiti« okolje. Slednje se pojavlja predvsem, kadar ostanke plena najdejo v bližini naselij ali cest.

Ker se risi običajno vračajo k istemu plenu več dni, odstranitev trupla pomeni direktno izgubo hrane za risa. Zaradi tega mora naslednji plen ujeti prej, kot bi ga sicer, da si zagotovi nemoteno oskrbo s hrano. Zaradi tega se poveča stopnja plenjenja, kar poveča potrebe po energiji, zaradi povečanja števila poskusov lova pa poveča možnost poškodb. Zaenkrat še ni znana zgornja meja, do katere so risi sposobni kompenzirati izgube plena s povečanjem stopnje plenjenja. Na podlagi zbranih podatkov menimo, da kleptoparazitizem s strani človeka ni tolikšen, da bi lahko privedel do stradanja posameznih osebkov, bi pa lahko, vsaj v Sloveniji, pomembno vplival na stopnjo plenjenja. S povečanjem stopnje plenjenja divjadi se poveča tudi njena konfliktnost z vidika lovcev, kar lahko privede do povečanja ilegalnega odstrela. Eden izmed možnih varstvenih ukrepov bi bil izobraževanje lokalnega prebivalstva, predvsem upravljalcev lovišč, lovcev in gozdarjev, o vplivu odstranjevanja trupel na plenilce in mrhovinarje. Predvidevamo, da bi imelo to pozitivne učinke, saj je večinoma v njihovem interesu, da ostane stopnja plenjenja plenilcev čim nižja.

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7. LITERATURE

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