EU NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: ***Herpestes javanicus***

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Risk Assessment Area: Europe

Date of finalisation: 30/06/2015

EU CHAPPEAU	
QUESTION	**RESPONSE**
1. In how many EU member states has this species been recorded? List them.	Croatia – islands and mainland coast, (Tvrtkovic and Krystufek 1990, Barun, Simberloff et al. 2010, Ćirović, Raković et al. 2011)
2. In how many EU member states has this species currently established populations? List them.	One - Croatia
3. In how many EU member states has this species shown signs of invasiveness? List them.	One - Croatia
4. In which EU Biogeographic areas could this species establish?	Mediterranean (European Topic Centre on Biological Diversity (EEA) October, 2009, http://biodiversity.eionet.europa.eu).
5. In how many EU Member States could this species establish in the future [given current climate] (including those where it is already established)? List them.	Romania, Italy Bulgaria, Cyprus, Malta, Spain, Slovenia, Portugal, France and Greece (according to the weather map in Peel, MC, Finlayson, BL, and McMahon, TA: Updated world map of the Köppen-Geiger climate classification, Hydrol Earth Syst Sci, 11, 1633-1644, doi:... 10.5194 / hess-11-1633-2007, 2007).
6. In how many EU member states could this species become invasive in the future [given current climate] (where it is not already established)?	Romania, Italy Bulgaria, Cyprus, Malta, Spain, Slovenia, Portugal, France and Greece (according to the weather map in Peel, MC, Finlayson, BL, and McMahon, TA: Updated world map of the Köppen-Geiger climate classification, Hydrol Earth Syst Sci, 11, 1633-1644, doi:... 10.5194 / hess-11-1633-2007, 2007).

SECTION A – Organism Information and Screening		
Stage 1. Organism Information	**RESPONSE** **[chose one entry, delete all others]**	**COMMENT**
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	No.	According to ITIS (Interagency Taxonomic Information System), *Herpestes javanicus* (É. Geoffroy Saint-Hilaire, 1818) EN: Small Asian Mongoose, Javan Mongoose, Small Indian Mongoose.
2. If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)	Yes.	According to UICN, Synonym: *Herpestes palustris* Ghose, 1965. Wozencraft (2005) considered *Herpestes auropunctatus* to be conspecific with *Herpestes javanicus*, but Taylor and Matheson (1999) and Veron *et al*. (in press) suggest a specific status. *H. palustris* is considered conspecific with *H. auropunctatus* (under *H. javanicus*) by Wozencraft (2005).
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	No	Some countries out of the EU have developed some RA: The State of Queensland, Department of Employment, Economic Development and Innovation, (2010). Pest animal risk assessment: Indian mongoose (*Herpestes javanicus*). https://www.daf.qld.gov.au/__data/assets/pdf_file/0013/71140/IPA-Indian-Mongoose-Risk-Assessment.pdf
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	No	
5. Where is the organism native?	The small Indian mongoose is native to northern Saudi Arabia, Iran, Iraq, Afghanistan, Pakistan,	

	India (south to Sind on the west and Orissa on the east), Nepal, Bangladesh, Burma, Thailand, Malaysia, Laos, Vietnam, and southern China including Hainan Island (Global Invasive Species Database, 2005).	
6. What is the global distribution of the organism (excluding Europe)?	According to Global Invasive Species Database (2005), the species has been introduced to (year of introduction in parentheses) Antigua, Barbados (1877). Beef Island, Buck Island (1910), Croatia (1910), Cuba (1866), Fiji (found on Viti Levu and Vanua Levu; introduced 1883), French Guiana, Grenada (1882), Guadeloupe, Guyana, Hawai'I (found on Hawai'I, Maui, Moloka'I, and O'ahu; introduced 1883), Hispaniola (1895), Jamaica (1872), Japan (found on Okinawa and Amami; introduced 1910), Jost Van Dyke, La Desirade, Lavango, Mafia (Tanzania), Marie- Galante, Martinique, Nevis, Puerto Rico (1887), St. Croix (1884), St. John, St. Kitts (1884), St. Lucia, St. Martin (1888), St. Thomas, St. Vincent, Suriname (1900), Tortola, Trinidad (1870), Vieques, and Water Island (Nellis, 1989, Hays and Conant, 2007).	*H. javanicus* is a major pest in many locations across the world and is listed among 100 of the "World's Worst" invaders by the IUCN (Roy 2006).
7. What is the distribution of the organism in Europe?	Introduced in Croatia in 1910 (Global Invasive Species Database, 2005).	Southern Croatian Adriatic including 7 islands.
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	Yes. It is invasive, particularly on offshore islands in Caribbean and Hawaiian islands, Mauritius, Fiji. Islands and coast of Adriatic- Mediterranean. Southern Japanese islands (Ryukyus). (Roy 2001, Barun, Simberloff et al. 2010) while its mainland distribution is limited to Mainland East Africa, Mainland South America (Haltenorth and Diller 1996).	Species considered to have been driven extinct through mongoose predation are the barred-wing rail (see *Nesoclopeus poecilopterus* in IUCN Red List of Threatened Species) in Fiji (Hays and Conant, 2007). The Critically Endangered (CR) and 'Possibly Extinct' Jamaica petrel (see *Pterodroma caribbaea* in IUCN Red List of Threatened Species) suffered drastic decline in

		numbers in the 19th century presumably due to predation by mongoose (capable of taking incubating adults) and rats (BirdLife International 2004). In the Caribbean, mongooses prey on the 'Critically Endangered (CR)' hawksbill turtle (see *Eretmochelys imbricata* in IUCN Red List of Threatened Species) eggs in fragmented beach habitat (Leighton *et al* 2008, 2009, 2010, 2011). Mongooses on Mauritius have been blamed for the extirpation of introduced game birds and the decline of endemic species such as the 'Endangered (EN)' pink pigeon (see *Nesoenas mayeri* in IUCN Red List of Threatened Species) (Roy *et al*. 2002). The mongoose has been shown to have a strong negative effect on the 'Endangered (EN)' Amami rabbit (see *Pentalagus furnessi* in IUCN Red List of Threatened Species) (Watari *et al*. 2008). (Global Invasive Species Database, 2005). Nose-horned viper (*Vipera ammodyte*) is listed as strictly protected under Appendix II of the Berne Convention, which sets out to conserve wild flora and fauna and their natural habitats by all member states of the Council of Europe, European Union and several other neighboring countries. Was high abundant on Mljet (Adriatic island) in 1910 warranted such concern among authorities that the mongoose was introduced to control this snake. Barun *et al.* (2010) did not find a single viper on Mljet or Korcˇ ula, where the mongoose has been present since 1910 and 1927, respectively (Tvrtkovic´ & Krysˇtufek, 1990), but Budinski et al. (2008), after extensive search, found one on Mljet in 2007.
9. Describe any known socio-economic benefits of		This mongoose was introduced into many nations

the organism in the risk assessment area.		of the West Indies, in the 1870s, for the purpose of controlling rats in sugar cane plantations. In 1883 they were imported to the Hawaiian Islands for the same reason. In both instances the mongoose not only did tremendous damage on its own account (extirpating many native species) but at best only partially reduce the populations of rats (Hinton & Dunn, 1967), according to Animal Diversity Web.

SECTION B – Detailed assessment

PROBABILITY OF ENTRY

Important instructions:

- Entry is the introduction of an organism into Europe. Not to be confused with spread, the movement of an organism within Europe.
- For organisms which are already present in Europe, only complete the entry section for current active pathways of entry or if relevant potential future pathways. The entry section need not be completed for organisms which have entered in the past and have no current pathways of entry.

QUESTION	RESPONSE [chose one entry, delete all others]	CONFIDENCE [chose one entry, delete all others]	COMMENT
1.1. How many active pathways are relevant to the potential entry of this organism? (If there are no active pathways or potential future pathways respond N/A and move to the Establishment section)	few	very high	According to IUCN, this species is often captured and sold as pets (Shekhar 2003) and there is some commercial trade in China, India and Nepal. (A. Choudury pers. comm.). In northern Viet Nam it is hunted and sold in wild meat markets in both Vietnam and China (S. Robertson pers. comm.).It is easy to trap large numbers and bring them into captivity. This has been done in Croatia already (Tvrtkovic and Krystufek 1990), and there were attempted introductions of mongooses into Rome. This is believed to be of a related species *H. edwardsii* which was a fashionable pet in Roman times (Mallory and Adams 1997), but whose deliberate introduction failed in the 1950s (Gaubert and Zenatello 2009). According to Global Invasive Species Database, this species was introduced for biological control of rats and snakes in agricultural habitats, from which the animals spread throughout local areas within decades.
1.2. List relevant pathways through which the organism	[Pet-trade and		This mongoose was introduced into many nations of the

could enter. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 1.3 to 1.10 (copy and paste additional rows at the end of this section as necessary).	biological control]		West Indies, beginning in the 1870s, for the purpose of controlling rats in sugar cane plantations. In 1883 they were imported to the Hawaiian Islands for the same reason. Both cases proved to be among the most disastrous attempts ever made at biological control. In both instances the mongoose not only did tremendous damage on its own account (extirpating many native species), but at best only partially reduced the populations of rats (Hinton & Dunn 1967). (Hinton and Dunn, 1967) Possible food and hunting. In northern Viet Nam it is hunted and sold in wild meat markets in both Vietnam and China (S. Robertson pers. comm. to Wozencraft, C. et al, 2008). Small Asian Mongoose had not been recorded in Hong Kong until recently, are suspected to have colonized Hong Kong by expanding from nearby areas of their natural range or by accidental or deliberate release of individuals (https://www.afcd.gov.hk/english/conservation/hkbiodiversity/speciesgroup/speciesgroup_mammals).
Pathway name:	[Pet-trade and biological control]		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	Intentional	very high	Indian mongoose populations are not likely to become established without human agency, though this could occur unintentionally (e.g., by release of pet mongooses) (Warren S. T, 2006). According to IUCN, often taken aboard ships, indirectly introducing them to new areas (J.W. Duckworth pers. comm.).
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the	likely	high	Pet trade is an enormous pathway. Using this species as biological control may happen in poor management pest control. Accidentally sometimes is taken aboard ships. The recent "trends" create high demands of alien

organism is to get onto the pathway in the first place.			species as pets and that can make large numbers of individuals entering this way in a short time. This is facilitated by the apparent abundance in places of origin and their ease of capture
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.7. How likely is the organism to enter Europe undetected?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	very likely	very high	In the Adriatic Sea, the mongoose was introduced in 1910 to Mljet Island and subsequently to several other islands (Korĉula, Hvar, Ĉiovo, Škrda) and the mainland Pelješac Peninsula. It is currently spreading along the Dalmatian coast and has reached the Neretva River in the north (Barun, Budinski & Simberloff, 2008) and Albania in the south. Spread to neighbouring islands by cane planter (Cabi, 2013).The species recently reached Hong Kong (M. Lau pers. comm. to Wozencraft, C. et al), and has also been

			recorded from the island of Madura, Indonesia (Meiri 2005), but it is not known whether this was due to human introduction or natural dispersal (IUCN).
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	likely	high	It is already established in Croatia, if same conditions are met and not measure is taken, it can be introduced as a pet or for biological control.
End of pathway assessment, repeat as necessary.			
1.11. Estimate the overall likelihood of entry into Europe based on all pathways (comment on the key issues that lead to this conclusion).	likely	high	In the Adriatic Sea, the mongoose was introduced in 1910 to Mljet Island and subsequently to several other islands (Korĉula, Hvar, Ĉiovo, Škrda) and the mainland Pelješac Peninsula. It is currently spreading along the Dalmatian coast and has reached the Neretva River in the north (Barun, Budinski & Simberloff, 2008) and Albania in the south.

PROBABILITY OF ESTABLISHMENT

Important instructions:

- For organisms which are already well established in Europe, only complete questions 1.15 and 1.21 then move onto the spread section. If uncertain, check with the Non-native Species Secretariat.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.12. How likely is it that the organism will be able to establish in Europe based on the similarity between climatic conditions in Europe and the organism's current distribution?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.13. How likely is it that the organism will be able to establish in Europe based on the similarity between other abiotic conditions in Europe and the organism's current distribution?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.14. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Europe? Subnote: gardens are not considered protected conditions	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Europe?	widespread	very high	It occupies various areas like agricultural areas, coastal, desert, natural forests and reforested, grasslands, riparian zones, ruderal, landfills, urban areas and wetlands (Global Invasive Species Database).Within its introduced range, the small Asian mongoose has been recorded from sea level to maximum elevations of 3,000 m on the Hawaiian Islands (Baldwin *et al.* 1952). This

			species is terrestrial, seldom climbing trees and feeds, during both the day and the night, on a wide diet, which includes rats, birds, reptiles, frogs, crabs, insects, and even scorpions (Lekagul and McNeely 1977 in IUCN). The mongoose has generalist feeding habits, it also preys on non-target, native species (Pimentel 1955; Gorman 1975; Cavallini and Serafini 1995; Vilella 1998; Abe et al. 1999), and it is now largely blamed for the historical declines and extirpations of many native species on islands (Gorman 1975; Roots 1976; Honegger 1981; Nellis and Small 1983; Nellis et al. 1984; Cheke 1987; Case and Bolger 1991; Henderson 1992).
1.16. If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in Europe?	NA very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.17. How likely is it that establishment will occur despite competition from existing species in Europe?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.18. How likely is it that establishment will occur despite predators, parasites or pathogens already present in Europe?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.19. How likely is the organism to establish despite existing management practices in Europe?	very unlikely unlikely moderately likely likely very likely	low medium high very high	

1.20. How likely are management practices in Europe to facilitate establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in Europe?	likely	high	Eradication of introduced mammals is a powerful conservation tool (Genovesi 2007), but mongoose eradication has been attempted on few occasions and with limited success. A known total of eight eradication campaigns and many control campaigns have been conducted to remove or reduce island mongoose populations. However, even with their limited scope, these attempts probably prevented further declines or even extirpations of native species, although definitive data are lacking. Traps are commonly used to reduce mongoose populations over relatively small areas (The State of Queensland, Department of Employment, Economic Development and Innovation, 2010).However, trapping needs to be on-going since populations quickly recover if trapping ceases (Hays & Conant 2007). Although mongooses are easily trapped and are susceptible to several rodenticides, mongoose eradication has proven extremely difficult with few successes (Roy et al. 2002; Long 2003; Sugimura et al. 2004). Risk of non-target carnivore species confounding detection and capture techniques on continental Europe, such as stone and pine martens, and small mustelids (Mitchell-Jones, Amori et al. 1999). According to Barun et al. (2011) the mongoose is

			entirely diurnal (AB pers. obs.) and can swim and climb trees (Nellis and Everard 1983), but rarely does so. Mongooses avoid water when possible; they reduce their activity during rainy periods and will not voluntarily enter water deeper than about 5 cm (Nellis and Everard 1983). Such characteristics may account for the failure of mongoose to invade islands only 120 m from occupied sites (Nellis and Everard 1983). However, in Fiji, mongooses get fish out of nets in the water (Craig Morley pers. obs.). This may be a behavioural adaptation specific to that site. Mongoose home ranges average 2.2 - 3.1 ha for females and 3.6 - 4.2 ha for males; home ranges often overlap and can be as small as 0.75 ha (Nellis and Everard 1983). Areas in the Caribbean may harbour 1-10+ mongoose/ha (Nellis 1989), but populations generally average 2.5 individuals/ha (Pimentel 1955a). On O‘ahu, Hawai‘i, mean home ranges were 1.4 ha for females and five males shared a region of about 20 ha (Hays and Conant 2003). Females are pregnant from February through August in Fiji (Gorman 1976b), the US Virgin Islands (Nellis and Everard 1983), and Hawai‘i (Pearson and Baldwin 1953), but the mongoose on Grenada has a 10-month breeding season (Nellis and Everard 1983). Gestation takes 49 days, with litter size of 2.2 on average (range = 1 – 5) (Nellis and Everard 1983). The number of litters produced annually has not yet been determined. Pups begin accompanying their mother on hunting trips at six weeks of age (about 200 g body mass). The youngest wild-caught pregnant female was four months old (Nellis and Everard 1983).

			H. javanicus can breed up to two to three times each year, with breeding being most frequent when food is abundant. Average litter size is two to three young. Females become sexually mature at 10 months of age and males at four months (de Magalhaes & Costa 2009). *H. javanicus* is carnivorous but has a varied and opportunistic diet. Depending on habitat and food availability its diet can include a range of small mammals, birds, reptiles, invertebrates and plant matter. Some populations are largely insectivorous while others consume a diet largely consisting of fruit for part of the year (Hays & Conant 2007). The Adriatic island populations all derive from seven males and four females, probably from western India, introduced in 1910 (Tvrtkovic and Krysˇ-tufek 1990). In 1872, four males and five females arrived in Jamaica from Calcutta (Espeut 1882, Hoagland et al. 1989), where they were released on Espeut's Spring Garden Estate and, within a few months, establishment and reproduction were obvious. The small Indian mongoose population in the Fiji Islands was established by an independent introduction of a single founding pair from the Calcutta region in 1883 (M. Gorman, *personal communication* to Simberloff, D., 1999) after an attempted introduction in 1870 failed.
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	

1.23. How likely is the capacity to spread of the organism to facilitate its establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.24. How likely is the adaptability of the organism to facilitate its establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.26. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Europe? (If possible, specify the instances in the comments box.)	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.27. If the organism does not establish, then how likely is it that transient populations will continue to occur? Subnote: Red-eared Terrapin, a species which cannot re-produce in GB but is established because of continual release, is an example of a transient species.	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).	very unlikely unlikely moderately likely likely very likely	low medium high very high	

PROBABILITY OF SPREAD

Important notes:

- Spread is defined as the expansion of the geographical distribution of a pest within an area.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
2.1. How important is the expected spread of this organism in Europe by natural means? (Please list and comment on the mechanisms for natural spread.)	major	high	Several authors have suggested that ecological release in the absence of competitors is more likely to be accomplished by increased sexual dimorphism than by the increased intrasexual variation envisioned by Van Valen (1965) in the niche-variation hypothesis (references in Dayan and Simberloff [1994]). In fact, It is known so little about the trophic niche of *H. javanicus* in its native range that it is impossible to say if it has expanded in its introduced range. If it has, perhaps the increased sexual dimorphism we have documented is associated with the expansion (Simberloff, D *et al,* 1999). At a local level however, populations are highly transient and not always territorial, so populations are highly mobile (Roy 2001) (Tomich 1969). Population densities have not been determined with certainty but may be extremely high in some regions of introduction, judging by the small size of individual home ranges found in a few studies (Hays and Conant, 2006). Nellis and Everard (1983) reported mean home ranges of 2.2 ha for two radio-tracked females and 3.6 ha for five radio-tracked males on St. Croix. Hays and Conant (2003) found mean home ranges of 1.4 ha for seven radio-tracked females on O‘ahu. In 1979, it is said that 30 mongooses were released

			to control snakes around a new facility opened for public education in a forested suburb of Naze City on Amami-Ohshima Island no official record of the release. Since then, the mongoose has been expanding its distribution from the release site, covering an approximately 10 km radius by 1989 and a 20 km radius by 1997, encompassing half of the mountainous areas occupied by many threatened species, such as the Amami rabbit, *Pentalagus furnessi*. The rate of range extension is estimated to be *ca*. one kilometer per year. After 20 years the population was estimated to be 5,000-10,000 mongooses in 1999 (Environment Agency, 1999). Even in places like Okinawa, with favourable habitats and climate, the species has taken decades to spread across the island (Yamada and Sugimura 2004). It has already spread to accession countries neighbouring Croatia. It can remain undetected at low densities (Watari, Nagata et al. 2011). It has spread along the Croatian Mainland coast very slowly (Ćirović, Raković et al. 2011).
2.2. How important is the expected spread of this organism in Europe by human assistance? (Please list and comment on the mechanisms for human-assisted spread.)	major	high	This species is often captured and sold as pets (Shekhar 2003) and there is some commercial trade in China, India and Nepal. (A. Choudury pers. comm.). Mongooses hitchhike between islands on cargo shipments or are illegally-released pets (http://www.reportapest.org/pestlist/herjav.htm). According to IUCN, often taken aboard ships, indirectly introducing them to new areas (J.W. Duckworth pers. comm. to Wozencraft, C. et al, 2008). Water barriers can be compromised by bridges and by people in advertently carrying mongooses to new areas. It is illegal in Croatia to introduce the

			mongoose to an uncolonized island, but there is the prospect that people can deliberately transport mongooses by ferry and/or car, for whatever purpose (Barun, A., 2008)
2.3. Within Europe, how difficult would it be to contain the organism?	very difficult	high	A number of control methods have been applied, but are principally focused on the use traps or poisons. The mongoose can be eradicated with current approaches on small islands with the aim of benefiting endemic species or preventing further introductions. More efficient methods and strategies are needed for successful eradication on larger islands and may facilitate containment of mongoose on the European and South American mainlands. (Barun et al, 2011)
2.4. Based on the answers to questions on the potential for establishment and spread in Europe, define the area endangered by the organism.	[Black Sea and Mediterranean countries, and neihgbouring countries]	high	The species has recently spread along the coast in Croatia, Bosnia and Herzegovina, and Montenegro at least as far as the Albanian border (Barun *et al.* 2008), but the full extent of the range is unknown. But it is quite possible that *H. javanicus* colonize neighbouring countries and Mediterranean countries (Italy, Spain, Portugal, France, Cyprus, Malta, Romania, Bulgary, Albania, Slovenia, Serbia, Hungary, Greece, Macedonia and Kosovo).
2.5. What proportion (%) of the area/habitat suitable for establishment (i.e. those parts of Europe were the species could establish), if any, has already been colonised by the organism?	0-10	high	On Adriatic Islands, the mongoose was introduced in 1910 to Mljet Island to control a poisonous viper (*Vipera ammodytes*) and subsequently to several other islands (Korčula in 1921 , Hvar (early 1950's), Čiovo (ca. 1950's), Škrda (ca. 1950's), Kobrava (unknown) (Tvrtković and Kryštufek 1990, Barun et al. 2008).It was introduced to the Pelješac Peninsula repeatedly from 1921 to 1927, and it is spreading along the southernmost part of the Dalmatian coast and has reached the Neretva River in the north (Barun et al. 2008) and Albania in the south (Ćirović et al. 2011).

2.6. What proportion (%) of the area/habitat suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	0-10	medium	In 1979, it is said that 30 mongooses were released to control snakes around a new facility opened for public education in a forested suburb of Naze City on Amami-Ohshima Island no official record of the release. Since then, the mongoose has been expanding its distribution from the release site, covering an approximately 10 km radius by 1989 and a 20 km radius by 1997, encompassing half of the mountainous areas occupied by many threatened species, such as the Amami rabbit, *Pentalagus furnessi*. The rate of range extension is estimated to be *ca*. one kilometer per year. After 20 years the population was estimated to be 5,000-10,000 mongooses in 1999 (Environment Agency, 1999). If the species spreads to Greece it could survive inland also what increases the speed of occupying area. The same is for e.g. Southern Italy.
2.7. What other timeframe (in years) would be appropriate to estimate any significant further spread of the organism in Europe? (Please comment on why this timeframe is chosen.)	20	medium	Bear in mind the distance from the introduction sites to Neretva River and Albania border, it is possible *H. javanicus* will colonize Albania, Italy and Greece areas as well as Serbia and Kosovo territories. The appearance and rapid spread of the mongoose throughout the whole coastal area of Montenegro in arelatively short period of time characterize it oncemo re as a highly adaptable, invasive species thatshould be given some special attention. The trend of rapid recent increase of the European part of theran ge necessitates the trans-border monitoring and anurgent action on the control of the populationnumbe rs and limiting the further spread toward thesouth of Balkan Peninsula (Cirovic´ et al , 2011)
2.8. In this timeframe what proportion (%) of the endangered area/habitat (including any currently occupied areas/habitats) is likely to have been invaded by this	10-20%	medium	If the species spreads to Greece it could survive inland also what increases the speed of occupying area. The same is for e.g. Southern Italy.

organism?			
2.9. Estimate the overall potential for future spread for this organism in Europe (using the comment box to indicate any key issues).	moderately	medium	*H. javanicus* is a major pest in many locations across the world and is listed among 100 of the "World's Worst" invaders by the IUCN (Roy 2006). Its habitat range is the largest in the family *Herpestidae* (Csurhes & Fisher 2010). Their normal body temperatures are 39.5 ºC and they are able to maintain their inner temperature in environments ranging from 10 to 41o C (Nellis & McManus 1974). It occupies various areas like agricultural areas, coastal, desert, natural forests and reforested, grasslands, riparian zones, ruderal, landfills, urban areas and wetlands (Global Invasive Species Database).Within its introduced range, the Small Asian Mongoose has been recorded from sea level to maximum elevations of 3,000 m on the Hawaiian Islands (Baldwin *et al.* 1952). Carnivorous, with a varied and opportunistic diet, this diet is dependent on the habitat it is in and the food availability. This diet includes small mammals, birds, reptiles, invertebrates and plant matter. Some of the populations are insectivorous while others have a diet consisting of fruit (Hays & Conant 2007). Although mongooses are easily trapped and are susceptible to several rodenticides, mongoose eradication has proven extremely difficult with few successes (Roy et al. 2002; Long 2003; Sugimura et al. 2004).

PROBABILITY OF IMPACT

Important instructions:

- When assessing potential future impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Where one type of impact may affect another (e.g. disease may also cause economic impact) the assessor should try to separate the effects (e.g. in this case note the economic impact of disease in the response and comments of the disease question, but do not include them in the economic section).
- Note questions 2.10-2.14 relate to economic impact and 2.15-2.21 to environmental impact. Each set of questions starts with the impact elsewhere in the world, then considers impacts in Europe separating known impacts to date (i.e. past and current impacts) from potential future impacts. Key words are in bold for emphasis.

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range, including the cost of any current management?	major	very high	The mongoose has caused great damage to crop production (taros, sweet potatoes, melons, watermelons, loquats, etc.) and poultry on both islands. On Amami-Ohshima Island, for instance, economic losses caused by the mongoose rapidly increased, then declined slightly as follows: 1994 (US$7,000), 1995 (US$32,000), 1996 (US$64,000), 1997 (US$110,000), 1998 (US$100,000) and 1999 (US$80,000) (Yamada, F. and Sugimura, K., 2004). On Hvar (Croatia), under the guise of predator control, hunters are required annually either to pay a fee (equivalent to ca. $US100) or to submit three mongoose tails (Barun, A. 2011). Global costs- up to $50 million/year (both direct damage and control costs) in the US (Pimentel, Zuniga et al. 2005). In Jamaica, the Jamaican Iguana Recovery Group collaborated in 1997 with Fort Worth Zoo, Milwaukee County Zoo, Zoological Society of San Diego and the

			University of the West Indies, Mona, to initiate a mongoose control operation in the central Hellshire Hills to protect the critically endangered Jamaican iguana (*Cyclura collei*). Live traps are operational every day and >1000 mongooses have been trapped to date. The approximate cost is US$ 400/month for the salary for one person (Byron Wilson pers. comm. to Barun, A. 2011). On the main island of Mauritius, the Mauritian Wildlife Foundation started a control programme in the Black River Gorges National Park in 1988 as part of the Pink Pigeon Project of reintroduction and predator control (cats, rats, mongooses). Year-round control is conducted with 10-12 students, staff, and volunteers. Wooden box traps (live drop traps) baited with salted fish are primarily used, but for elusive individuals a mix of live/kill traps and change of bait is employed. Estimated total cost is ca. US$ 20,000 per year (Roy *et al*. 2002; Carl Jones and Vikash Tatayah pers. comm. to Barun, A. 2011). In Puerto Rico, the US Forest Service and USDA APHIS Wildlife Services livetrapped in El Yunque National Forest to protect the critically endangered Puerto Rican parrot (*Amazona vittata*). The US Forest Service annually spends about $10,000 a year with two personnel who trap periodically, so the cost for mongoose control alone is difficult to estimate (Everard and Everard 1992; Pimentel 1955b; Felipe Cano pers. comm. to Barun A., 2011). On Amami-Oshima, the Japanese Ministry of the Environment began intensive mongoose control in 2000. The trappers were paid about US$ 20 per mongoose the first year, about US$ 36 the second and third years, and about US$ 45 the last year to try to increase incentives at low abundance. From 2000 until

			2004 about US$ 1,140,000 (122,000,000 JPY) was spent on the Amami-Alien control programme and from 2005 to 2009 about US$ 7,224,000 (695,000,000 JPY) on the Amami-Mongoose eradication programme (Abe *et al.* 1991; Ishii 2003; Yamada 2002; Yamada and Sugimura 2004; Shintaro Abe pers. comm. to Barun A. 2011). On Okinawa, the Okinawa prefecture and the Japanese Ministry of the Environment initiated an alien control programme (2000-2004) in the Yambaru area of the northern part of the island, and in 2005 this became an eradication campaign. From 2000 until 2004, 1831 mongooses were captured with 555,000 trap-nights, and from 2005 until 2009 the Yambaru Mongoose Busters captured over 2680 mongooses with 2,431,000 trap-nights. The total cost for the eradication programme from 2005 until 2009 in the Yambaru area by Okinawa prefecture was about US$ 5,058,000 (486,000,000 JPY including fence construction) and for the mongoose eradication programme by the Ministry of the Environment was about US$ 2,352,000 (226,000,000 JPY) (Yamada and Sugimura 2004, Shintaro Abe pers. comm. to Barun A., 2011). In Mauritius any improvements in ecological management of *H. javanicus* will require a greater understanding of its ecology, and this requires more information on the population and behavioural ecology of the species in both its native and introduced range. In particular, we need to investigate the uptake of baits in the field and the interactions between mongooses and other predator species. If management regimes can be made more cost-effective and efficient, in time larger areas could be managed. The work on Mauritius carried out so far adds to our knowledge of the species, and can be applied to other islands where the species has not

			been studied. In islands aerial baiting may be the most cost-effective, efficient, scalable, and replicable method, because mongooses forage almost exclusively on the ground, where most bait will fall, and they readily take bait. Aerial baiting has successfully delivered baits to eradicate rodents and cats, reducing costs and overcoming issues with access caused by terrain and vegetation (Algar et al. 2001; Howald et al. 2007). Handbaiting could be used inexpensively on a small area to mimic an aerial baiting programme and provide proof of concept (Barun et al.,2011). Pimental et al. (2000) estimated that the mongoose causes about $50 million in damages each year in Hawaii and Puerto Rico alone.
2.11. How great is the economic cost of the organism currently in Europe excluding management costs (include any past costs in your response)?	moderate	medium	No specific data have been published in Europe, economic cost can be guess from costs in other countries and impacts in Europe. In Croatian island rats become less vulnerable to mongoose predation through modification of their activity time, the mongoose may increase predation pressure on amphibians, reptiles, and poultry (Barun et al. 2010). The species is considered dangerous to ground nesting gamebirds, especially Phasianidae.
2.12. How great is the economic cost of the organism likely to be in the future in Europe excluding management costs?	major	very high	Beyond native wildlife, mongooses may have a great effect on poultry production and are a reservoir of rabies, leptospirosis and other diseases (Everard and Everard 1988; Pimental et al. 2000; Long 2003). The Pest Risk Assestment by Queensland Government (Australia) in the section “Commodity Damage Score” points out poultry and eggs and other livestock damages by *Herpestes javanicus*. Populations of mongooses can pose a serious threat to native wildlife, several bird species and various crops (Rakhshandehroo, E. *et al*,

			2014).
2.13. How great are the economic costs associated with managing this organism currently in Europe (include any past costs in your response)?	major	high	On Hvar (Croatia), under the guise of predator control, hunters are required annually either to pay a fee (equivalent to ca. $US100) or to submit three mongoose tails (Barun, A. 2011). Management info on the Global Invasive Species Database shows different options: Physical: Trapping is commonly used to remove small Indian mongooses from sensitive areas. It is often very successful at removing animals in the short term. Unfortunately, trapping programmes need to be run almost constantly as mongooses re-colonise trapped areas very quickly (Roy et al. 2003; Hays and Conant, 2007). Fencing has been proposed as a possible control method in Mauritius but predator proof fences are expensive and inflexible should the area that needs to be protected change (Roy et al. 2002); Chemical: Diphacinone anticoagulant poison has been used to control mongooses in Hawai'I (Hays et al. 2007). The use of this toxin has been considered in Mauritius but poisoning methods would have to be adapted to prevent poisoning of non-target species (Roy et al. 2002); Integrated management: There is concern in Mauritius that removing mongooses without also removing cats and rats will be disastrous for native species because it may lead to increased rat and cat populations (Roy et al. 2002)
2.14. How great are the economic costs associated with managing this organism likely to be in the future in Europe?	major	medium	The costs will be high and it is expected the expansion of the species in large areas in addition trapping methods are expensive and the resilience of the species to the control measures also seems evident because of their biological characteristics. On Hvar (Croatia), under the guise of predator control,

			hunters are required annually either to pay a fee (equivalent to ca. $US100) or to submit three mongoose tails (Barun, A. 2011).
2.15. How important is environmental harm caused by the organism within its existing geographic range excluding Europe?	major	very high	Mongooses have been implicated in the demise of ground nesting birds and ground nesting bird reproduction has ceased in cases where mongooses are present (Baker and Russell 1979; Stone et al. 1994; Long 2003). In addition to the extinction or local extirpation of ground nesting birds worldwide, they have been implicated in the demise of frogs in Fiji, ground lizards and snakes on St. Croix, turtles on St. John, and small mammals in Japan and Puerto Rico (Seaman and Randall 1962; Gorman 1975; Nellis and Small 1983; Coblentz and Coblentz 1985; Vilella 1998; Sugimura et al. 2004). In Japan Amami rabbit (*Pentalagus furnessi*), shows a decline in its distribution concurrent with the expansion of the mongoose distribution (Sugimura et al. 2000; Yamada et al. 2000). In Mauritius, seabird populations have also become locally extinct (Cheke 1987, Jones 1987, Roy 2001).
2.16. How important is the impact of the organism on biodiversity (e.g. decline in native species, changes in native species communities, hybridisation) currently in Europe (include any past impact in your response)?	major	very high	Our evidence is strong that the small Indian mongoose considerably affects several species, in particular several snake species, the Balkan green lizard, and the European green toad. Noteworthy is that the horned viper (*Vipera ammodyte*) (a protected species) and the Balkan green lizard, though rare on Hvar, are apparently more common there than on the other two mongoose-infested islands (Korcˇula and Mljet) (Barun et al., 2008). It is in a region with other small carnivores. It is unknown how it will fulfil its niche on mainland Europe. However, on island ecosystems in Croatia, declines have been seen in reptiles and amphibians (Tvrtkovic and Krystufek 1990, Barun, Simberloff et al. 2010). No other small carnivore in EU is a diurnal reptile

			hunter. The species has a high impact on ground-dwelling songbirds wintering in Mediterarranean. Several studies have revealed that mongoose depends primarily on arthropod prey and also preys on most rare vertebrates (Abe et al. 1999; Environmental Agency et al. 2000; Yamada et al. 2000). Abundances of the Balkan green lizard, the European glass lizard and most snake species are much higher on islands with just the stone marten, rats and cats, but not the mongoose (Lastovo, Dugi Otok, Bracˇ , Cres, Krk, Losˇinj) (A. Barun & I. Budinski, pers. obs. to Barun, 2010). The horned viper (*Vipera ammodyte*) was high abundant on Mljet (Adriatic island) in 1910 warranted such concern among authorities that the mongoose was introduced to control this snake. Barun *et al.* (2010) did not find a single viper on Mljet or Korcˇ ula, where the mongoose has been present since 1910 and 1927, respectively (Tvrtkovic´ & Krysˇtufek, 1990), but Budinski et al. (2008), after extensive search, found one on Mljet in 2007.
2.17. How important is the impact of the organism on biodiversity likely to be in the future in Europe?	major	very high	If the mongoose continues to spread along the coast it will threaten not only amphibians and reptiles but also many other conservation projects. The demonstrated impact of the mongoose on island herpetofauna should be considered in light of the recent spread of this predator to the European mainland (Barun et al., 2008). In Croatia Experimental conditions and our protocol do not allow us to address rigorously the question of the specific consequences of the introduction of the two major alien species, *Herpestes auropunctatus* and *Rattus rattus*, on the native mammals. Nevertheless, the number of individuals

			captured of native species was more than three times greater on islands without the mongoose (107) than on islands with the mongoose (33) (Barun et al, 2011b). If the mongoose continues to spread along the coast it will threaten not only amphibians and reptiles but also many other conservation projects. The demonstrated impact of the mongoose on island herpetofauna should be considered in light of the recent spread of this predator to the European mainland (Barun et al., 2008). Long-term survival of amphibian and reptile species with low densities, such as several of those recorded on Adriatic islands, is questionable, and in the long run those species may be doomed to local extinction (Vitousek, 1988). Once introduced elsewhere, the mongoose has spread very rapidly, and its presence on the Balkan Peninsula, which is a hotspot of European biodiversity, should raise alarms for other faunas too (see Hays & Conant, 2007 for a review of the impact on other groups).
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism currently in Europe (include any past impact in your response)?	massive	very high	Due to their high option value, genetic resources, biochemicals, pharmaceuticals, and the like are at risk whenever there is a loss of biodiversity. Invasives that lead to species extinctions, such as the small Indian mongoose (*Herpestes javanicus*), may irretrievably alter these services. In addition, invasions into hotspots of biodiversity such as the tropics and aridlands pose significant risks to current and future sources of these provisioning services (Charles & Dukes, 2007)
2.19. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism likely to be in Europe in the future?	massive	very high	Watari et. al: In Koike et al (2006) results showed that the mongoose appears to cause a reduction in, or even local extinction of, many native vertebrates through a strong top-down effect. Forest crickets and small

			cockroaches are prey of the Amami tip-nose frog and the Otton frog (Watari, unpublished data). It is therefore likely that the increase in these insects is due to indirect effects of increased mongoose predation on the native predators. This trophic cascade may only be one of many wider and unpredicted community effects. It is, therefore, important to carefully monitor the dynamics of these interactions and to consider not only the direct effects but also the indirect effects of mongoose predation. It seems clear that many native vertebrate species will continue to decline if the mongoose is allowed to spread and establish over the whole island. Thus, to protect the remaining native animals, it is essential to prevent further expansion of the mongoose's distribution.
2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism currently in Europe?	major	very high	*Vipera ammodyte* is listed as strictly protected under Appendix II of the Berne Convention, which sets out to conserve wild flora and fauna and their natural habitats by all member states of the Council of Europe, European Union and several other neighboring countries. Most amphibian and reptile species in Croatian islands where *H. javanicus* is presented also occur on the mainland and are already in low numbers, and some are strictly protected under Appendix II of the Berne Convention. Amphibian populations along the Croatian coast are mostly isolated in small karstic ponds and threatened with local extinction because of the drying up or overgrowth of these ponds (Janev Hutinec et al., 2006). IAS impact bird species protected under CMS I and II: cats , dogs, Rattus spp. (Norway rat (*R. norvegicus*) and black rat), house mouse, feral pigs, small Indian mongoose (*Herpestes javanicus*), are the major predators (CMS, 2013). Impacts on birds and reptiles, especially on island

			ecosystem (Morley and Winder 2013). Moderate has been given as score because its impacts on island ecosystems are large but on the mainland is not yet known. It may have an impact on native mammal/carnivore communities through disease transmission (Everard and Everard 1985, Mowlavi, Massoud et al. 2000, Lahmar, Boufana et al. 2009)
2.21. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism likely to be in the future in Europe?	major	very high	The recent spread of the mongoose to the European mainland suggests the need for urgent control to protect vulnerable herpetofauna (Barun, A. 2011) and also birds and amphibians.
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their genetic nature and making their economic, environmental or social effects more serious?	minimal	very high	None related native species in range, although there may have been hybridization with *H. edwardsii* in the past (Patou, Mclenachan et al. 2009)
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range?	major	very high	Beyond native wildlife, mongooses are a reservoir of rabies, leptospirosis and other diseases (Everard and Everard 1988; Pimental et al. 2000; Long 2003). Invasive mammals can be important reservoirs for human pathogens. A recent study showed that 12% of mongooses carried Salmonella spp. in their large intestines. Miller et al. (2015) investigated whether anthropogenic, environmental and climatic variables predicted Salmonella status in mongooses (*Herpestes auropunctatus*) in Grenada. Although the overall prevalence of Salmonella in mongooses was moderate, the strong patterns of ecologic correlates, combined with the high density of mongooses throughout Grenada suggest that the small Indian mongoose could be a useful sentinel for Salmonella surveillance. Its affinity for human-associated habitats suggests that the small

			Indian mongoose is also a risk factor in the maintenance and possible spread of Salmonella species to humans and livestock in Grenada (Miller et al, 2015).
2.24. How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	massive	very high	Beyond native wildlife, mongooses are a reservoir of rabies, leptospirosis and other diseases (Everard and Everard 1988; Pimental et al. 2000; Long 2003). Because the animal can invade and appear in the habitat of other animal populations including omnivores or carnivores, it seems that mongooses in this area could have a high potential for the transmission of the infection with the spirurid nematodes to a large range of animals (Rakhshandehroo, E. *et al*, 2014). Other results indicate that mongooses in Barbados are carriers and shedders of *Salmonella* and *Campylobacter* spp. and are a potential wildlife reservoir for these enteropathogens (Kamara J.R. Rhynd *et al*., 2014). Some mongooses carry *Echinococcus multilocularis* (Lahmar, Boufana et al. 2009)
2.25. How important might other impacts not already covered by previous questions be resulting from introduction of the organism? (specify in the comment box)	NA	NA	
2.26. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Europe?	NO DATA	NO DATA	

2.27. Indicate any parts of Europe where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible).		high	

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Entry	very likely	very high	In the Adriatic Sea, the mongoose was introduced in 1910 to Mljet Island and subsequently to several other islands (Korĉula, Hvar, Ĉiovo, Škrda) and the mainland Pelješac Peninsula. It is currently spreading along the Dalmatian coast and has reached the Neretva River in the north (Barun, Budinski & Simberloff, 2008) and Albania in the south. Entry to some other Member State countries is possible along the coast.
Summarise Establishment	very likely	very high	The species is already established in Croatia. The Adriatic island populations all derive from seven males and four females, probably from western India, introduced in 1910 (Tvrtkovic and Krysˇ-tufek 1990). Based on this information, climatic conditions, at least, of all Mediterranean countries are suitable for *H. Javanicus*. It occupies various areas like agricultural areas, coastal, desert, natural forests and reforested grasslands, riparian zones, ruderal, landfills, urban areas and wetlands (Global Invasive Species Database).
Summarise Spread	slowly	high	The rate of range extension is estimated to be ca. one kilometer per year. After 20 years the population was estimated to be 5,000-10,000 mongooses in 1999 (Environment Agency, 1999). According to Yamada y Sugimura (2004) in 1979, it is said that 30 mongooses were released to control snakes around a new facility opened for public education in a forested suburb of Naze City on Amami-Ohshima Island. However, there is no official record of the release. Since then, the mongoose has been expanding its distribution from the

			release site, covering an approximately 10 km radius by 1989 and a 20 km radius by 1997, encompassing half of the mountainous areas occupied by many threatened species, such as the Amami rabbit, *Pentalagus furnessi.* It is currently spreading along the Dalmatian coast and has reached the Neretva River in the north (Barun, Budinski & Simberloff, 2008) and Albania in the south. Control activities are being carried out on Hvar (Croatia), under the guise of predator control, hunters are required annually either to pay a fee (equivalent to ca. $US100) or to submit three mongoose tails (Barun, A. 2011). These management actions may be not effective and spreading will be quicker. In islands aerial baiting may be the most cost-effective, efficient, scalable, and replicable method, because mongooses forage almost exclusively on the ground, where most bait will fall, and they readily take bait. Aerial baiting has successfully delivered baits to eradicate rodents and cats, reducing costs and overcoming issues with access caused by terrain and vegetation (Algar et al. 2001; Howald et al. 2007). Handbaiting could be used inexpensively on a small area to mimic an aerial baiting programme and provide proof of concept (Barun et al., In: Veitch 2011).
Summarise Impact	major - massive	very high	The magnitude of present and future impacts will depends on the results of ongoing management activities and the possible establishment of new populations. In Croatia small Indian mongoose considerably affects several species, in particular several snake species, the

			Balkan green lizard, and the European green toad. Noteworthy is that the horned viper (*Vipera ammodyte*) (a protected species) and the Balkan green lizard, though rare on Hvar, are apparently more common there than on the other two mongoose-infested islands (Korcˇula and Mljet) (Barun et al., 2008). Beyond native wildlife, mongooses may have a great effect on poultry production and are a reservoir of rabies, leptospirosis and other diseases (Everard and Everard 1988; Pimental et al. 2000; Long 2003).
Conclusion of the risk assessment	high	very high	Establishment and spreading along Croatia is confirmed. There are also scientific reports on small Indian mongoose impacts in this Member State.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	[sea level rise and low mean monthly precipitation]	medium	*H. javanicus* is a major pest in many locations across the world and is listed among 100 of the "World's Worst" invaders by the IUCN (Roy 2006). Its habitat range is the largest in the family *Herpestidae* (Csurhes & Fisher 2010). Their normal body temperatures are 39.5 ºC and they are able to maintain their inner temperature in environments ranging from 10 to 41o C (Nellis & McManus 1974). It occupies various areas like agricultural areas, coastal, desert, natural forests and reforested, grasslands, riparian zones, ruderal, landfills, urban areas and wetlands (Global Invasive Species Database).Within its introduced range, the Small Asian Mongoose has been recorded from sea level to maximum elevations of 3,000 m on the Hawaiian Islands (Baldwin *et al.* 1952). Carnivorous, with a varied and opportunistic diet, this diet is dependent on the habitat it is in and the food availability. This diet includes small mammals, birds, reptiles, invertebrates and plant matter. Some of the populations are insectivorous while others have a diet consisting of fruit (Hays & Conant 2007). Experts on Climate Change (IPCC) estimates that the average temperature of the earth's surface will rise between 1.4 and 5.8 ° C by the end of the century, the land areas will experience higher increase than ocean and that high latitudes will warm more than the tropics. It is estimated that sea level rise associated with such changes is between 0.09 to 0.88 m (Intergovernmental Panel on Climate Change (CBD), 2002). This aspect will affect coastal and island ecosystems.

			Low rainfall may aggravate some of its harmful effects: "Three factors were significantly correlated with an increased probability of a mongoose carrying *Salmonella*: closeness to roads, increased human density, and low mean monthly precipitation" (Miller, S. *et al.*,2015).
3.2. What is the likely timeframe for such changes?	100 years	very high	
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	[continental spread and the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms]	high	Study of Miller et al (2015) shows that in addition to anthropogenic variables, precipitation has been implicated as an important contributing factor pertaining to the overall incidence of bacterial waterborne infection in humans. Seasonal precipitation patterns influence the occurrence of spring outbreaks of waterborne infection worldwide (Charron et al. 2004). Although no significant difference was found for mongooses testing positive for Salmonella between wet and dry seasons in Grenada, a correlation was detected within local precipitation patterns: mongooses trapped in months and at sites with an average of 50 mm precipitation had a 24% probability of carrying Salmonella compared to a 5% probability when mongooses were trapped in months and at sites with an average of 250 mm precipitation. Lack of rainfall reduces water sources, leading to animal aggregates which can concentrate microbes in the environment. Both factors can facilitate the spread of pathogens among mongooses during dry conditions. Conversely, periods of heavy rainfall can help flush *Salmonella* out of the environment, explaining the lower probability of mongooses carrying Salmonella in months with higher precipitation. South Europe can have low precipitations due to climate

			change that can multiply spread of microbes by this species.
ADDITIONAL QUESTIONS - RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	NA	NA	

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