The Small Indian Mongoose *Herpestes auropuncatus* (Hodgson 1836)in the Balkans

A synopsis of it's introduction and recent information.

David Bird

Background 1.The Area

- The Mediterranean basin to which the Balkans and the Adriatic sea belong is regarded as a one of the biodiversity hotspots especially where Reptiles and Amphibians are concerned (Myers,N.et.al 2000) with several endemic species and subspecies so should be a conservation priority for Europe. The Balkans is not only important for herpetofauna but for many other taxa and has a book dedicated to it (Griffiths,H.I *et al. 2004).* Chapter 10 of the book concerns the herpetofauna giving details of the number of endemic species for specific areas (Džukić & Kalezić 2004) the so called "Adriatic triangle" which covers Montenegro and adjacent Albania & Croatia having 10 endemic species. A recent checklist and bibliography has been produced for Croatia (Jelić 2014). Any invasive alien predator becoming widespread in this region may have dire consequences for its herpetological biodiversity .

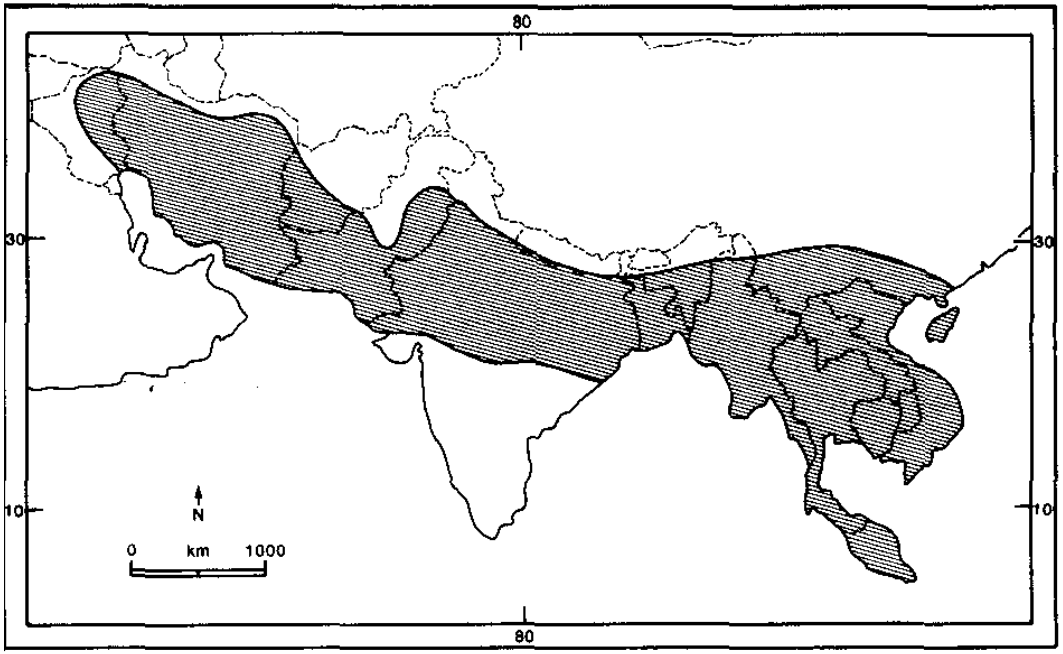
2. The Problem itself

- The Small Indian Mongoose has been successfully introduced into many areas around the World especially on islands for biological control of pest and unwanted species especially snakes but is now considered to be one of the worst invasive animals appearing on the I.U.C.N.'s worst 100 invasive species list (I.U.C.N. 2000). Island species with no experience of predatory mammals have been badly affected with some species of herpetofauna having become extinct (Honneger,R.E. 1981). At least 64 islands around the World have this mongoose on them and they have been eradicated from 6 islands. Until recently most of the scientific research on the mongoose has been carried out in the tropical areas where it has been introduced so some data is missing or may not be correct for populations along the Adriatic coast with its Mediterranean climate.

The Beast itself
Herpestes auropuncatus

The Small Indian Mongoose is native to the Middle East across to South East Asia

Fig 1. Range of *H.auropunctatus* in the wild From Nellis 1989.



The Northern most part of the distribution is in N.Iraq which is a lot further south than the Balkans especially the Adriatic islands and coast but the maritime climate has aided its survival. Temperatures less than 0°C severely stress it (Nellis & Everard, 1983, Nellis & McManus, 1974) so the most northerly distribution predicted corresponds with the January 10°C isotherm. In Nepal the mongoose can persist at over 2000m as in Hawaii near the peak of Haleakala on Maui in Hawaii so could move through the mountains in summer and reach more favourable climatic conditions inland at far lower altitudes

Introductions. N. Dalmatia

(1) 1910 Mljet 7 ♂ 4 ♀ introduced. Released 26.08.1910. 5 Days later one specimen was seen 17 km away.

(2) 1921-7 Pelješac Peninsula on Mainland, various sites.

(3) 1921-7 Korčula Very frequent at present.

(4) 1926 Brač Did not seem to colonise Brač no recent data in 1936.

(5) 1950's Škrda (Barun,Simberloff & Budinski 2008) A small uninhabited island off Pag.

(6) 1970 Hvar

(7) Introduction date unknown. Čiovo . Connected to mainland at Trogir by a small bridge. First reported to be common in 1991.History unknown.

(8) Introduction date unknown. Vicinity of Mostar (Bosnia-Hercegovina) 1990 (T & K 1990),2006, winter of 2007-8 individuals seen.(B,S & B 2008) also along coast to south of Pelješac peninsula

(9) Introduction date unknown. Kobrava, an islet just of the north coast of Mljet. No other information

Introductions. S. Dalmatia

(10) Island of Golem Grad less tham 1km^2 Lake Prespa Macedonia. Origin and fate unknown, area does have cold winters.

The recent paper (Ćirović et al 2011) maps the localities in S.Croatia & Montenegro in the past 25 years with a lack of evidence or history of introductions is far more worrying.

(11) 1988 Rose, Tip of Luštica peninsula was the first sighting in Montenegro

(12) 1990 Njivice. Sighting Croatian/Montenegro border

(13) 1997 Šasko Lake Montenegro close to Albania which is a long way from the first two sightings approximately 115 km. There have been a lot of sightings on the Luštica peninsula and in the (14)Tivat area close by and then down the valley to (15)Jaz beach and onto Budva in the decade starting in 2000, only 4 records are known from the area from Budva down to Albania which is 70 km long.

Budva

Buljarica

Nr. Durovici

Nr. Durovici Buljarica fields and marshland Adriatic highway

Food.

The original description of the feeding behaviour of the species was that it was a carnivore but with more information it is now known to be extremely omnivorous and able to survive on a variety of foods, it is extremely adaptable animal so the diet may change with the habitat it is inhabiting and at different times of the year when certain foods become available or in larger quantities. There have been numerous sightings along the Adriatic around human habitation where chickens are taken as are grapes from the vineyards, they are also known to scavenge from waste bins and they are numerous around rubbish tips which would provide them with waste food as well as a higher density of rats, mice and some insects that also there to feed on discarded food. This supply is similar through the year and not really affected by the seasons, which allows the populations to become quite dense.

More possible food

H.auropunctatus are also known to predate marine turtle nests eating both the eggs and hatchling turtles on many of the islands where turtles breed (Nellis & Small 1983). The mongoose is usually a solitary feeder but in the case of nests groups will feed together most probably learning from each other, some beaches had been recorded where there was no predation of nests whereas on other beaches every nest was destroyed. In the Balkans the problem with Sea Turtle nests will only occur in Greece but there is a possibility that there may be predation on freshwater turtle nests where the eggs are far closer to the surface although so far nothing has been seen, or most probably has not been looked for as freshwater turtles are much smaller and can lay unobserved in much smaller areas. In Croatia and Montenegro the Balkan Turtle *Mauremys rivulata* is an endangered species, the Montenegrin Ecologists Society have a project on at the moment mapping it's distribution and do have some concern about mongoose predation and turtle nests, whilst out surveying 2 weeks ago at Šasko lake close to the Albanian border a mongoose was seen (Iković,V. 2015 personal comm.), this is a site that mongoose were first recorded in 1997 (Ćirović et al 2011) which is a long way 100 km. from the main population close to Tivat and almost certainly a separate introduction. One of the reasons they have been introduced is that they kill and eat snakes, they are quite good at this and feeding on lizards and amphibians in the tropics but also on the Adriatic islands. Various reptiles were found in the stomachs of mongoose in the study by Barun *et al* 2010

Losses of reptile populations.

- The decrease in any population due to an invasive alien is usually anecdotal until the population is almost gone and then some scientific evidence is sought, quite often it is then too late. Snakes are described as rare on Mljet a personal observation (Tvrtković & Kryštufek 1990) and *Vipera ammodytes* absent. A recent study on the herpetofauna of Mljet over 3 years (Jelić, Budinski & Lauš 2012) found no *V.ammodytes* although a single specimen was reportedly seen in 2008 near Nerezni dol. Several snake species particularly *Hierophis gemonensis* and *Elaphe quatorlineata* were found to be uncommon, more so than on other islands where mongoose are not found *Natrix natrix* and *Lacerta trilineata* were not found at all. The authors recommend that a plan for eradication be set up as soon as possible, or at least a plan for the reduction of the number of small Indian Mongoose on the island to reduce the pressure on the indigenous fauna. A study comparing the abundance of herpetofauna on 3 islands with mongoose with 3 islands where they were absent, the islands were all of a similar size found that on the islands with mongoose, reptiles and some amphibians were less abundant and some species were not found and were possibly extinct. On Mljet *Vipera ammodytes, Elaphe quatuorlineata, Hierophis gemonensis* , *Telescopus fallax* and *Bufotes viridis* were not found despite having records previously. On Korčula *Lacerta trilineata, T. fallax, E.quatuorlineata, V.ammodytes* and *Natrix natrix* were also now absent. On Hvar *Dalmatolacerta oxycephala, Natrix natix* and *Hyla arborea* were absent (Barun,Simeberloff & Budinska 2010). Another study by students from Slovenia who went on field trips over 11 years to various sites in the Western Balkans including Korčula and Mljet also came up with similar results (Žagar,A. *et al* 2013). On Hvar which has been the most recent introduction the locals have been controlling the mongoose for many years and it is noticeable that this island shows the least species absent. It is not noted where on the islands the transects were made but (Bird. 2000 pers. obs.) found numerous *D.oxycephala* in the Jelsa to Stari Grad area There is always the possibility that some of these species were just not found on the survey period especially with the snakes which are often difficult to find but when all of these are taken together it does seem that certain species are no longer present or in such small numbers that a population is no longer viable. (Bird 2000 pers.obs.) noticed the lack of road killed herpetofauna on the island of Hvar around Jelsa in 2000, not from a lack of reptiles being present although very few snakes were seen, but probably that the mongoose were finding them and removing them before they became a valid herpetological sighting. A German Botanist/herbalist living on Hvar and running guided walking tours commented that he now sees only about 30 % of the reptiles that he formerly saw and that *Vipera ammodytes* was now only present on the top of the mountainous ridge running along the centre of the island. (Bird. 2005. Pers.obs.) also found a lack of *Natrix* species along the water filled ditches behind Jaz beach, Montenegro in 2005 when compared with 1998 also a total lack of *Dalmatolacerta oxycephala* on the walls of culverts at the side of a zig-zag road coming from Budva to the Tivat road over the hillside whereas everyone had several individuals in 1998.

Endemic Reptiles

Dalmatolacerta oxycephala
Bosnia

Dalmatolacerta oxycephala
Montenegro

Pseudopus apodus

Anguis graeca

Elaphe situla

Podarcis melisellensis pair

Algyroides nigropunctatus male

Vipera ammodytes

Mauremys rivulata

Lacerta trilineata Juvenile

Lacerta trilineata Adult

Lacerta viridis/bilineata ?

Lacerta viridis/bilineata ?

Platyceps najadum

Hierophis gemonensis

Elaphe quatuorlineata Juvenile

Elaphe quatuorlineata Adult

Elaphe quatuorlineata & Cat

Snake now threatening me

Natrix natrix Melanistic

Natrix tessellata

Zamenis longissimus

Zamenis longissimus DOR

Emys orbicularis

Bufotes viridis

Methods of eradication

- The methods that have been used have been 1. Live trapping 2. Kill trapping 3. Poison bait :- all have been successful but they do have their own benefits or problems.
- 1. Live trapping is very labour intensive with traps having to be set out by hand and then checked daily for captures or closed down. The animals captured then have to be killed humanely usually by gas, lethal injection or shooting, the benefit of this method is that any animal that is not a mongoose is caught it can be released unharmed. On the island of Amami, Japan where the original introduction was 1979 trapping with cage traps and wooden box traps using fish sausage as bait were used. The estimate of the population was 5-10,000 individuals in 1999 with an annual growth rate of 30%. 3886 mongoose were trapped in the 1st year, 12-22 trappers were involved in the 1st year and a total of U.S.$50,000 was spent directly on the island (Yamada 2002). Ratiere, Tomahawk, INRA as well as custom built wooden box traps have all been used for captures of mongoose.
- 2. Kill traps have been used and tested in Hawaii using the DOC 250 kill trap which conformed to National Animal Welfare Advisory committee (NAWAC) humane guidelines (Peters et al 2011). It is not known if this American standard would be suitable for use in Europe. The traps are set in wooden boxes and the entrance has to be made to suit the non capture of larger animals. These do not have to be checked daily for animal welfare reasons and only to remove carcases and reset the trap.
- 3. Poison baits. It has been found that Mongoose are highly susceptible to Diphacinone ,an anticoagulant toxin, LD50 0.2 mg/kg B.W. and is currently the toxin of choice. On Hawaii in 1998 a trial was started using Fish flavoured Diphacinone bait blocks placed in a 4 inch diameter 2 ft long ABS plastic pipes. Each pipe was fixed to the ground and had 8 x 2 ounce blocks of 0.005% diphacinone placed in the centre. Dead animals were found in burrows or in dense cover so unlikely to be found and eaten by a scavenger. The design of bait stations could avoid removal of bait by rats or other animals. The bait is relatively cheap, is easy to use and less labour intensive than traps which have to be checked and/or reset (Smith *et al* 2000) (Barun et al 2011) states that poisoning is illegal in Croatia but does not say if this is a blanket ban or only if carried out by non qualified workers or certain poisons, this may require a change in the law or special permission and should be checked in each country.
- It would probably be best to use all 3 methods if this is at all possible or at least the kill traps and poison bait.

Other implications

- The species that would be endangered from poison bait would be the Stone Marten and if pipe could not be used of a size that stops them from reaching the bait but still allows mongoose to take it the pipe could be closed at dusk and opened at dawn. The most appropriate time of the year for control would be the winter especially around human habitation and on rubbish tip sites when natural food is at a minimum and such sites are important for the mongoose. Čiovo apparently does not have *Martes foina* so there is no problem on that island.
- As well as the implications to biodiversity there have also been cases of impact on agriculture. On Amami Island, Japan the cost has been $110,000 in 1997, $100,000 in 1998 and $80,000 in 1999. Control was being carried out by local trappers over this period solely to reduce crop damage (Yamada 2002) In Croatia damage to wildfowl has caused hunting organisations to try to exterminate mongoose but probably not enough effort has been put in to have any real effect. Vegetables, figs, grapes and poultry have also been damaged so local trapping on Hvar has probably just been around fields to catch individual animals but on Hvar such large areas of uncultivated maquis are perfect habitat for mongoose between villages and does make the localised trapping almost pointless from the point of view of eradication.
- If there is damage to commercial agriculture in the Balkans then agreement with the government department dealing with this to share the planning and cost may be an ideal way to go.

Legislation

- (Scalera,R 2011) has produced a National strategy on Invasive species in Croatia for the Croatian government that mentions the mongoose and notes that it is the oldest known I.A.S. problem dating back to 1910, it is not known if this has been accepted or not but mention is made of the present legislation
- In Croatia the law that deals with Invasive Alien species is
- **Nature Protection Act (Official Journal 70/05, 139/08)**
- **Article 91**
- (1) It shall be forbidden to introduce alien wild taxa into nature on the territory of the Republic of Croatia and into ecological systems which they do not populate naturally. (Scalera 2011)
- This has many other parts but basically this is the section that makes it illegal to introduce any mongoose to anywhere in Croatia.
- The only mention that I have been able to find in the other literature on mongoose is "It is illegal to introduce mongoose to an uncolonized island in Croatia" (Barun,Simberloff & Budinski 2008).

- **C of Europe countries**. Macedonia, Croatia, Slovenia, Bosnia-Hercegovina, Serbia, Montenegro, Albania , Greece are all members. So therefore party to the Recommendation N0.140 (2009) Standing committee on the European Strategy on Invasive Alien Species Mongoose. The countries that would have the favourable climate at the moment and need to worry are in red.

- There was no mention of any legislation or work being carried out on control of the Small Indian Mongoose on any of the National reports on Reptiles & Amphibians so far received for 2015.

- **Contacts.** There does seem to be a list of contacts, which one cannot copy, on the East and South Europe network for Alien species but does give contacts for all the countries involved. Obviously the papers that are in the bibliography are by workers in the particular field either on the mongoose or Herpetologists and mostly for the Adriatic are fairly recent and contact details can be found on the various papers.
- http://www.esenias.org/index.php?option=com_content&view=article&id=73&Itemid=82
- My e-mail address is drbird_herp1@yahoo.co.uk If anyone wants PDFs of any of the papers that are in the bibliography please let me know.

Final thought for the day

- I am just a field biologist and voluntary herpetological society librarian but I hope that I have presented enough information here today to persuade you that there is a serious problem for herpetofauna that could quickly become a lot worse. It is up to the political and administrative side of this meeting to ensure that when recommendations are put forward that there will enough finances available for further surveys and then a program of control to eradicate the mongoose completely from the Balkans. There must also be a program of education and policing to ensure that there is no further human involvement in the introduction or spread of this or any other similar species in the future and that snakes are an important part of the ecosystem and not something just to be killed off.