

Post-earthquake pest control activities in and introduction

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Introduction

This report is a summary of the operating system for pest management (2) in the L'Aquila area in the seven months following the earthquake (06/04/2009 - 31/10/2009). The management system involved both purely technical aspects (equipment, pest control products, field operations, etc.) and the more human side (comfort, reassurance, playing down of the fears and anxieties that pests can cause in earthquake victims) (1). Pests are in fact both a public health risk and a source of psychological distress. Pest control activities aimed to achieve the following objectives: reduce the population density of pests in the area and reduce the risk of possible vector-transmitted diseases (8).

Participants and instruments

The Servizio Veterinario di Sanità Animale [Animal Health Veterinary Service] assisted by workers from the L'Aquila Azienda Servizi Municipalizzati [Municipal Services Agency] (ASMSpA) were the main participants in the pest control activities. IZSA&M provided a continuous critical evaluation service aimed at optimising field operations. Between 2 and 6 workers were involved in activities at any one time.

It should not be forgotten that local staff were both victims of the earthquake and irreplaceable workers, thanks to their experience of the affected area.

The following vehicles were used: 2 4x4 lorries (Bonetti), 1 pick-up (Land Rover), 1 pick-up (Fiorino) with sprayer system, 2 vehicles fitted with flashing lights. The insecticides included pyrethroids (Permex 22E, Cipex 10E), while anticoagulants (granules and lumps) were used for the rodenticides (Brodimax, Brodiblu). Rat boxes were used to distribute rodent bait.

Independent pest control activities were carried out by the regional Civil Protection agencies of Emilia Romagna (12) and Veneto (personal communication) or by non-profit organisations such as *Misericordia* of Florence (personal communication), always under the supervision of the L'Aquila Public Health Veterinary Service.

Systems for pest notification by the earthquake population

The choice of means of communication is of the utmost importance in an area hit by a natural disaster. After the L'Aquila earthquake, the only means available was the mobile phone, which was effective in all circumstances thanks to potentiation of the network capacity. A single 24-hour number was given to the various mixed operational centres (COMs), the emergency shelters and the command and control directorate (DI.COMA.C) and, once they had reopened, to the AUSL [Local Health Authority Unit] switchboard and to the emergency services. The attempt to keep a record of requests received by fax from the shelters to the respective COMs and from there to the Service was found to be extremely slow, due to delays in transfers of paper records.

Records of interventions were assured by their prompt (immediate) entry in the Animal Health Veterinary Service activities register, kept on-site alongside the material and vehicle store. The creation of intervention files, correlated with the field files as they were prepared, enabled optimisation of the system and the rational organisation of interventions. The concentration of calls to the 24-hour number could only be managed thanks to the continuous presence and availability guaranteed by the Service Director.

The decision to provide an immediate response to notifications was determined by the considerable importance of the psychological aspect in the perception of the problem and the prompt response thereto. This both comforted the public and was found to be effective (1, 4).

Continuous monitoring of interventions enabled the protocol to be planned and activated in all 175 emergency shelters and in the historic centres, including in areas from which no reports had been received.

Areas of action

Historic Centres - no-go areas

Characterised by the presence of difficult-to-access rubble (often containing rotting foods). The largest no-go area was in L'Aquila (4 km²), while the over 50 historic centres affected around L'Aquila and in nearby towns were much smaller (around ½ km²), even though the access problems were similar. The pest control teams in these situations consisted of the smallest possible number of people, equipped with suitable personal protective equipment (PPE). The presence of the Fire Brigade was obligatory.

Tent Cities - Emergency Shelters

In the area of AUSL 04 (L'Aquila) alone, 175 "tent cities" with canteens and sanitary services were set up; the largest housed 1700 people and covered 30,000 m². The average size was 10,000 m² with an average of 250 residents.

Closure of the emergency shelters began at the end of September and has reached 70% of the total. Each emergency shelter was managed by Civil Protection volunteers under the supervision of the shelter manager. The volunteer group generally turned over every week, causing difficulty in transferring previously imparted information and instructions.

Public facilities

When possible, the public facilities destroyed in many of the areas affected by the earthquake were replaced with facilities prepared ex novo. These facilities were found to have different problems and needs; requests for interventions were prioritised according to the number of people involved (employees and users). It is difficult to describe a typical public facility, as they varied from Portakabins used as schools to university libraries, from barracks to streets and open areas.

Private buildings

Various members of public also requested help with problems related to the presence of pests in their homes (both accessible and inaccessible). In this case, priority was given to interventions in inhabited areas and situations which might pose a risk to public health.

The most important pests

Table 1. Present/absence of major pests found in the reference period.

Pest/Month	April	May	June	July	August	September	October
1. Rodents							
3. Flies							
2. Ticks							
4. Locusts							
5. Mosquitoes							
6. Wasps							
7. Cockroaches and ants	Sporadic appearances throughout the reference period						

1. Rodents

Historic centres

The first rodent control plan was activated on 24/04/2009 in L'Aquila historic centre - a large, difficult-to-tackle area.

Work was carried out alongside the fire brigade with 2 teams of 3 people (AUSL/ASM) proceeding on foot from south to north on parallel routes (50 m apart) along accessible streets inside the walls of the city (no-go areas). "Rat boxes" were placed at the critical points (vicinity of attractive foods, drains and sewers, etc) (9) and marked on a map (taken from Google Maps) to enable subsequent controls. Various preparations were used as bait: loose granules, sachets, pellets, toffees. It was not considered necessary to position "rodent control area" signs, as public access to no-go areas was strictly prohibited and the rat boxes were printed with the required warning. 320 rat boxes were put down in the L'Aquila historic centre. A much lower number of baits was placed in the surrounding areas and nearby towns.

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Emergency shelters

There were constant reports of the presence of rodents, with widespread and repeated requests for action, all promptly dealt with within 24-48 hours.

All inspections revealed occasional, sporadic infestations. The consumption of rat bait resulted in the movement of rats from the outside towards the centre of the tent cities. Most of the bait was taken from the sides of the shelters bordering a water course or open country. A slightly but

constantly higher concentration was found near the kitchens/canteens. The rat boxes were placed accordingly, prioritising any tents reporting signs, the confines of the shelters and the kitchens.

Various types of baits (paraffin-based and other) were distributed in between 5 and 10 boxes per shelter. In some emergency cases, plastic tubes for use in the construction industry were used instead of the rat boxes.

Public facilities

Most reports were made by employees, who had to work in extremely precarious environmental conditions and a delicate psychological condition. Here too, actions were taken within 24 hours (maximum 48 hours), during working hours to maximise their visibility and thus their power of reassurance. In contrast, in schools boxes were placed when no children were present, to avoid excessive curiosity and disruption of lessons, in areas that could be controlled by teachers.

Private buildings

Numerous actions were carried out, mainly in inaccessible buildings. In these cases, access was carried out under the supervision of the Fire Brigade and using PPE. The only large-scale infestations were found in private homes. In all cases the entry point was from the sewers through the lavatory, which had generally been left without water. Once the baits had been placed the entry/escape points were closed.

2. Flies

The problem of flies (*Musca domestica*) and flying insects (synanthropic flies) is generally season-dependent. In the days immediately after the earthquake, the adverse meteorological conditions initially limited the problem. The first intervention, to sanitise the morgue at the Guardia di Finanza's School at Coppito (AQ), took place on the day of the earthquake itself, 06/04/2009. Two vehicles were used to spray high pressure pyrethroids and disinfectants, one after the other, on the inner and outer surfaces of an enormous hangar (over 2500 m²) in prefabricated concrete. This activity took up all the Service's resources until 05/04/2009, at which point the hangar was given over to another use.

The weather improved in early May and interventions began in the emergency shelters on 05/05/2009, helped by the end of the rain. No fly control was needed in the **historic centres**, except in various stables and farms, in which it was possible to work in daylight.

In closed **public facilities** and **private buildings**, pressurised sprayers and an electric mini-sprayer were used. These were again the areas where the most severe infestations were found: large flats containing rotting food enabled massive colonies to build up.

The method used for fly treatment was essentially that recommended for the use of insecticides in public areas (10):

- communication of the problem by the shelter manager;
- confirmation that the requested intervention would be scheduled within 24-48 hours;
- preliminary land clearance, if necessary (c/o ASM);
- warnings issued to the affected population;
- intervention (after 11:30 p.m., when most people had gone to bed);
- use of one vehicle with a flashing light and one lorry with a sprayer;
- presence of the supervisor and 2 workers;
- dilutions of pyrethroids to 2-3%;
- complete spraying of relevant tents, services and areas;
- mean consumption of 150 L of solution per emergency shelter;
- mean intervention time in emergency shelters: 3-4 hours per night;
- activities halted at 3 a.m.;
- vehicle and sprayer maintenance the following morning at the ASM garage.

3. Mosquitoes

Mosquitoes (*Culex* spp., *Aedes* spp) were controlled using the same procedures as for flies; the only difference was the seasonal and environmental conditions under which the problem arose. Clearly, vicinity to water courses and damp areas is a known risk factor, and reports also increased during the summer. No tiger mosquitoes (*Aedes albopictus*) were encountered.

4. Ticks

The ticks found locally (*Rhipicephalus* spp., *Ixodes* spp., *Dermacentor marginatus*, *Haemaphysalis punctata*, *Hyalomma marginatum*) (5) presented the first potential risk of infestation due to the high number of animals in the area. The use of pyrethroids distributed by pressurised sprayer proved effective, and contrary to expectations, there were few reported episodes. The problem was mainly reported in small historic centres. The public was given 24 hours' notice of pest control interventions, which were carried out in the daytime.

5. Locusts

The area affected by the earthquake suffered an invasion of locusts of between 7 and 10 cm in length with characteristic brown markings (*Decticus albifrons*). The swarm was first reported on 15/07/2009 and affected a public service (the new site of the courts), with a thick carpet of insects on the surrounding areas and walls. The psychological repercussions were very strong and the event was reported in both the local and national press. A similar episode had never been reported in the past. At the insistence of the court managers the infestation was dealt with using

pyrethroids, but this was the only treatment carried out against locusts. In fact, pyrethroids are generally ineffective against these insects but tend to aggravate the problem, as they delay migration and prolong the locusts' stay in the affected area. There is also the problem of removing the dead insects and possible secondary poisoning of non-target organisms, such as birds (14).

Over the following days the swarm's progression was traced from east to west along the river Aterno for about 30 km. It finally disappeared in the direction of Antrodoco. The mountainous terrain modified the route taken by the insects. The course of the event was standard, with reports ceasing after about 15-20 days. The locusts stayed between 4 and 10 days in each of the affected areas.

6. Wasps

Wasps (*Vespula germanica*, *Polistes gallicus*, *Vespa crabro*) were the pest most often reported during the hottest weeks, especially in the emergency shelters, i.e. after treatment had succeeded in controlling the fly population. Spraying with pyrethroids was ineffective and it was necessary to carry out a systematic search for the nests (tent connections, rooftops, etc) and treat them intensively with a pressurised sprayer. The correct management of water and damp waste, which are extremely attractive to this type of insect, was essential in controlling the problem. A limited number of people suffered wasp stings. There were no serious cases.

7. Cockroaches and ants

Although present in almost all areas, these insects did not produce any real problems. Cockroaches (*Blatta orientalis*, *Blattella germanica*) were initially found in the field kitchens by the drains. A few interventions with spray preparations (outside) or gel (inside) resolved the problem. Ants (*Tetramorium caespitum*, *Monomorium pharaonis*, *Linepithema (Iridomyrmex) umile*, *Crematogaster scutellaris*, etc.) caused more irritation than cockroaches, as they invaded the tents.

General comments on pest control activities

Rats

- Earth movements caused initially by the earthquake and subsequently by diggers undoubtedly contributed to the numerous migrations of the local rat populations.
- The most severe infestations seemed to affect the lower urban areas in the east of the city, near the ancient sewer system (under Terminal di Collemaggio).
- No infestations were reported in presumably attractive locations such as abandoned bakeries and sweet manufacturers, even though they were accessible.
- Manholes could not be used for the positioning of bait, as they were full of detritus.
- Paraffin-based baits were found to be unattractive in these circumstances.
- Land clearance and improvement around the shelters (to a distance of 3-5 m) was fundamental.
- Storage of rubbish bags about 40-50 cm above ground and outside the tents also discouraged visits from rats.
- Rat control in some areas of Italy is still based on obsolete or unconfirmed concepts (11). The provision of correct information to the beneficiaries of the service thus results in professionalism.

Flies

- Inhabitants often consider Fly (mainly *Musca domestica*) control intrusive. Consequently there is a need to be both decisive and convincing during operations and, above all, politeness is a must. In the case the presence of the local Health Officer well known by persons who can provide comprehensive explanations is quite useful.
- The presence of a familiar qualified health worker who can provide comprehensive explanations is useful.
- PPE should be used, but should be kept to a minimum (facemask) to avoid arousing concerns over the toxicity to humans of the insecticides used.
- The angle of the insecticide stream should be over 45° to avoid damage to tents and various objects.
- The operator should always take account of rain and wind direction. In the event of rain, re-treatment will be needed.
- Treatment of wooded areas around the shelter is useful.
- Pyrethroids are extremely toxic to fish. Care must therefore be taken when treating areas near watercourses or lakes (2).

Mosquitoes

- Land clearance and improvement was fundamental.
- Mosquito traps placement (e.g. BG-Sentinel) would be interesting, to evaluate the population, the species on the land and the breeding sites (13). The latter in order to provide focused insecticide spraying.

Ticks

- Disinfestation should always be carried out directing the insecticide stream from top to bottom. In this way, even ticks trying to escape from the repellent action of the preparation will be intercepted.
- Instruction in the correct way to remove ticks from humans is essential.

Locusts

- *Locusta migratoria* is considered an autochthonic species (3).
- Swarms are known in various areas of Italy and should be considered completely normal.
- The psychologists and volunteers successfully transformed the disinfestation into a game, and also recounted their experiences in tropical countries where the phenomenon is very frequent (7). No damage to fruit or vegetable crops or hayfields was reported.

Wasps

- Pools of water must be avoided around taps, washbasins and containers of moist foods; taps and washbasins should be located away from the most populated areas (canteen, meeting areas, etc).
- Automatic drink dispensers (which should preferably be avoided) may be a problem, as they attract wasps and increase the risk of being stung.
- Traps containing sweet liquids are recommended for their efficacy and low environmental impact.

Toxicology of the preparations used

- Workers should always be correctly informed (verbally, written signs, etc) of any hazards (including absence of hazards) related to the products used (6, 10).
- The correct use of PPE is seen as a reinforcement of the message to get across as well as protecting the users' health (6, 10).

Psychological observations

- The management of pests has a two-way psychological aspect that should not be under-valued.
- The presence and help of a suitably informed professional, such as a disaster psychologist, can support both the population affected by the disaster and professionals involved in pest control activities after the earthquake (1, 4).

Public assistance can be provided both:

- 1) as a psychological support in the management of communications during emergencies. Such communication links the public to people with specific skills: in fact, phenomena such as uncontrolled panic and the social exaggeration of the risk can be avoided only through the application of suitable techniques and instruments and psychoeducational activities aimed at trauma management through knowledge of behavioural reactions. Phenomena such as these would have a severe impact on emergency operations, giving rise to rumour and uncontrollable psychosocial and management risks.
- 2) as support in the management of behavioural reactions, beginning from knowledge of the basic elements that must be transmitted to the affected population concerning emotional reactions to the earthquake, experiences related to the emergency, feelings of intrusion triggered by pest control operations and the fears and anxieties that pests can cause in the earthquake victims.

In these cases a multidisciplinary (seismological, veterinarian, entomological, psychological) approach is desirable (1, 4) to help the affected population understand what has happened in the overall context of dangerousness and risk, providing information, resources and strategies to help emotional and psychosocial behavioural adaptation after the earthquake.

Conclusions

The 395 pest control operations carried out in L'Aquila enabled us to evaluate our professionalism in an extremely difficult situation. Specific training of the workers involved and post-action debriefing would also be useful in similar situations (9, 4, 15).

This experience has provided a stimulus to direct our efforts towards specialisation in non-epidemic emergencies.

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