UNIVERSITY OF CAPE TOWN

CENTRE FOR
SOCIAL SCIENCE RESEARCH

The Rat Trap: Contestation over rodent control in Cape Town

Nicoli Nattrass, Jed Stephens and Jorich Loubser

CSSR Working Paper No. 410

February 2018

Institute for Communities and Wildlife in Africa

Centre for Social Science Research

Published by the Centre for Social Science Research
University of Cape Town
2018

http://www.cssr.uct.ac.za/

This Working Paper can be downloaded from:

http://www.cssr.uct.ac.za/cssr/pub/wp/410

ISBN: 978-1-77011-397-8

About the authors:

Nicoli Nattrass is Professor of Economics, co-director of the Institute for Communities and Wildlife in Africa (iCWild) and Principal Investigator of the Khayelitsha Rodent Study at UCT. Jorich Loubser and Jed Stephens are graduate students at the University of Cape Town conducting research as part of the Khayelitsha Rodent Study.

The Rat Trap: Contestation over rodent control in Cape Town

Abstract

This paper discusses policy contestation in Cape Town over an expanded public works program (EPWP) in which previously unemployed people were hired to help poor households in Khayelitsha (a low-income suburb) deal with rodent infestation in a 'poison free' manner. EPWP workers, managed by Environmental Health (EH), a government operation in Khayelitsha, set cage traps for rats inside people's homes. This project was halted after the South African National Council for Societies for the Prevention of Cruelty to Animals (NSPCA) objected because the rats were subsequently drowned. We show that rival understandings of the morality (or humaneness) of rodent control shaped the policy contestation. EH officials held that cage-trapping and drowning rats was preferable to poisoning them primarily because rat poison was dangerous to children, domestic animals and other wildlife. In so doing, they adopted a broader, and more ecological, notion of welfare that extended beyond the NSPCA's focus on whether the rat was killed in a cruel and legal manner. The clash in perspectives nevertheless had some common ground: both 'sides' believed that drowning was cruel. For EH, it was the least worst option and officials continued to seek alternative, poison-free and more humane methods of disposing of rats (though these proved impractical). We draw on a representative survey of Site C in Khayelitsha to show that EH's approach had significant support amongst local people. Most agreed that workers should be allowed to trap and drown rats and those who said they were concerned about rat poison killing other animals like cats and owls were more likely to do so. Those who believed that drowning was painful for the rat were less likely to agree with cage-trapping and drowning.

1. Introduction

In 2014/15, Khayelitsha Environmental Health (EH), a City of Cape Town government operation, ran an expanded public works programme (EPWP) to help poor people deal with rodent infestation in a 'poison free' manner. EPWP workers set cage traps inside people's homes in Khayelitsha (a low-income African suburb of Cape Town – see Figure 1) and the captured rats were

subsequently drowned. The initiative proved popular but was brought to a halt after the National Council for Societies for the Prevention of Cruelty to Animals (NSPCA) issued a warning to stop the drowning of animals. NSPCA is the legislated authority in terms of the SPCA Act (no 169 of 1993) for the enforcement of the Animals Protection Act (no 71 of 1962). Faced with the threat of legal action, the EPWP reverted to using poisoned bait instead.

This story is of interest to the social and policy sciences for five reasons. First, it illustrates how rival understandings of the morality (or humaneness) of rodent control shaped the policy contestation. People in EH believed that cage-trapping and drowning rats was preferable to poisoning them primarily because rat poison was dangerous to children, domestic animals and other wildlife such as owls. In so doing, they adopted a broader, and more ecological, notion of welfare that extended beyond the rat itself. The NSPCA, by contrast, took a principled stance (consistent with an animal rights approach) against drowning on the grounds that it was cruel. The NSPCA accepted that death through poisoning was also cruel but that it was unacceptable to replace one cruel method with another.

Second, the story illustrates how the legal framework for animal protection can differ according to whether the animal is regarded as 'vermin'/'pest' or not. According to South African animal protection legislation, animals cannot be poisoned, harmed by traps or deliberately exposed to danger – unless they are considered 'vermin' (as is the case with rats). Legislation pertaining to human health requires restaurants and public facilities to act swiftly against rodent infestation – and this typically entails the use of rodenticides. Thus, while animal ethics in research requires laboratory rats to be euthanized humanely (as would also be the case also with pet rats managed by veterinarians), wild rats can be regarded as vermin/pests and thus can legally be killed by traps and poison. The NSPCA accepted that poisoning rats was legal, but argued that drowning a caged rat violated the Animals Protection Act (no.71 of 1962) because the Act did not specifically allow this in the case of rodents.

Third, the story provides an example of how both values and strategic considerations shape policy conflict. The NSPCA could at any time have chosen to challenge the clauses in the animal protection legislation that made it legal to use poison against vermin/pests. Its own promotional materials emphasise that *all* animals should be treated humanely, including animals considered to be vermin. Yet by drawing a clear distinction between the *cruel but legal* poisoning of rats and the *cruel but illegal* drowning of rats, the NSPCA in practice opted to take the existing legal framework as given and not as something to be contested. This principled stance enabled the NSPCA to avoid engaging with EH's consequentialist moral-ecology (that drowning is preferable because it

minimises harm within the environment). Rather than engage with EH's 'least worst' reasoning, the NSPCA stuck to a simple message: drowning is cruel and illegal. The NSPCA is a non-profit organisation that relies on public donations. Many if not most of its donors and supporters probably use rat poison at home as the poisoning of rodents is widespread and in that sense socially acceptable. There are clear strategic advantages for the NSPCA to take a stance against the drowning of rodents whilst doing nothing to challenge the legal status quo with regard to the poisoning of rodents.

Fourth, the story shows that despite the clash in values and perspectives between the NSPCA and EH, there was nevertheless some common ground: both accepted that drowning was cruel. EH's position acknowledged that drowning was the least worst option, yet City officials were reluctant to make this argument in public, preferring to talk in vague terms about the captured rats being 'removed' and 'disposed of' by EPWP workers (quoted in Peterson, 2015). This suggests that they were uncomfortable with the drowning of rats and understood that members of the public might be similarly uncomfortable, if not horrified. We show that EH was open to finding alternative strategies that were both poison free and more humane. Specifically, serious consideration was given to a scheme to continue cage trapping, but instead of drowning the rats, transporting them to a raptor rehabilitation centre where the rats would be euthanized with CO_2 before being fed to the raptors. This proposal, however, proved impractical and fraught with animal welfare problems of its own.

Fifth, the case study draws on a representative survey of Site C, Khayelitsha to show that most people were concerned about rat poison killing other animals and believed that workers should be allowed to trap and drown rats. The NSPCA (with the law on its side) thus effectively trumped local concerns and values.

2. Theoretical framework and methods

The interdisciplinary policy sciences provides a useful framework for our discussion. In his famous approach, Lasswell (1956) distinguishes between various elements of government decision-making processes including: intelligence (gathering information); promotion (attempts to persuade others of a particular interpretation); prescription (stabilisation of norms, including their codification in legislation) and invocation (initial testing of a particular policy). Not all elements are present in all decision-making processes and they do not necessarily follow a fixed order (Auer, 2015). In our case study, EH piloted a novel, poison-free rodent control program (invocation and promotion) which failed at the prescription stage because the underlying notion of humane treatment was contested by the NSPCA on the grounds that it violated the law.

Clark and Wallace (2015) expand Lasswell's approach in recommending an inter-disciplinary approach to understand the values and strategic interests of the various players. They also recommend that analysts of policy processes clarify their own standpoint or positionality. In this regard, our interest in the contestation was an academic one (we were intrigued by the apparent clash between the NSPCA's animal rights perspective and EH's moral-ecology). However, during the research process, which started off as interview based, we found ourselves being asked to help EH officials think about the advisability of various options. This meant that much of the information we gleaned about the experience of the EPWP, the motivations of government officials (and their internal debates) as well as the proposal to feed captured rats to raptors, was obtained through participant observation and discussions. We doubt that this had any significant impact on policy outcomes, but rather helped us gather the necessary information/intelligence to understand the conflict and evolving policy suggestions.

In addition to the qualitative research approach outlined above, we also collected data in 2017 from a representative sample of people living in Site C (aka Ikwezi Park), Khayelitsha (CSSR & iCWild, 2018). According to the 2011 South African national census, Site C is home to 52,184 people (13.3% of people in Khayelitsha). It comprises a mix of formal and informal housing (marked in brown and green respectively in Figure 2). Using the 'Small Areas' demarcated by the 2011 census as the primary sampling unit, we drew a stratified two-stage random sample[1]. The Small Areas were stratified according to whether they covered formal housing areas (i.e. had a cadastral layer) or were informal shack settlements (without such a layer). See Figure 2 (Small Areas in outline).

The secondary sampling unit was the dwellings within the randomly selected Small Areas: each Small Area has roughly the same number of dwellings (an average of 210 and 232 in formal and informal Small Areas) and approximately 15 to 20 respondents. The sample rule aimed for a 12.5% sample from each Small Area. As of December 2017, we had interviewed 157 people, an average of 10%. The sampling design allows us to draw conclusions about people living in Site C on a range of issues, including experience of rodent infestation, rubbish management, socio-economic status, attitudes to rodent control etc. It is, to the best of our knowledge, the first representative survey of rodent infestation and control in Cape Town. In this paper we draw on questions posed to respondents specifically about the cage-trapping and drowning project and related attitudes towards the treatment of rats and the wider risks posed by the use of rat poison.

[1] The sample was designed, drawn and managed by Jed Stephens. The interviews were conducted by Thobani Ncapai and Fezeka Lephaila.

3. Rats, poison and policy contestation in Cape Town

The brown rat (*Rattus norvegicus* – see Khayelitsha photo file) is common across the world, including in South Africa (Puckett et al., 2016; Bastos, et al., 2011). They are widely seen as pests because of the damage they do to infrastructure (through gnawing and burrowing) and to stored food, and because of the health risks they pose to humans through rat bites and potentially also from zoonotic diseases such as plague (*Yersinia pestis*), leptospirosis and toxoplasmosis (Begon, 2003; Bonnefoy, 2008; Taylor et al., 2008; Julius et al., 2012; Himsworth, 2013; Ithete, 2013, Archer et al., 2017). Low-income urban areas are particularly vulnerable to rodent infestation because of their typically dilapidated structures (providing harbourage for rats), high housing densities (facilitating easy colonisation of adjacent buildings) and inadequate waste management (providing food and shelter) (Himsworth, Feng et al., 2013; Jassat et al., 2013).

Rats provoke fear and health concerns because of their association with bubonic plague which caused the Black Death (Stenseth et al., 2008). The third great pandemic of bubonic plague (which started in South China in the second half of the 19th century) reached South Africa in 1900, during the South African (aka 'Anglo-Boer') war. Cape Town was the first to be infected by rodents accompanying imported forage for British horses (Swanson, 1977: 392). Fear of disease intersected with colonial racist ideology to create a 'sanitation syndrome' (Swanson, 1977) used to prompt and justify racial segregation. In Cape Town, colonial officials responded to the threat of plague by creating the first African township outside Cape Town's borders (Ndabeni) and moving thousands of African people there – even though there were fewer African deaths from plague amongst Africans than there were amongst whites and coloureds in Cape Town (Swanson, 1977: 393-4). Similarly, the first detached African township in Johannesburg was created in 1904 after African slums were burned down in a 'matter of hours' after the discovery of bubonic plague (Swanson, 1977: 388). Plague affected many towns and cities in the early half of the twentieth century, leading to emergency efforts geared at killing rats (Poleykett, 2017; Mitchell, 1930: 394).

Despite vigorous eradication strategies, rats retained a firm foothold in Cape Town. Rat populations can grow quickly (causing 'rodent outbreaks') and these appear to be predominantly linked to increased food supply notably in agricultural areas, but also cities (Singleton et al., 2010). Between 2013 and 2015, newspaper reports in Cape Town indicated that a rodent outbreak (perhaps

fuelled also by a 'moral panic') was taking place. The City allocated additional funding to rodent control in 2013 (perhaps co-incidentally) after the premier of the Western Cape reported that she had been bitten on her toe by a rat when she went out to fetch her newspaper. Her official spokesman said, 'I know the City Bowl rats are mutant freaks of nature, but if they're starting to take nibbles out of people, we're in trouble.'[2] Similar descriptions of the mutant, even supernatural character of rats were reported from poorer areas. A resident in a hostel (low-income formal housing) in Langa, Cape Town's oldest African suburb, told reporters that rats could eat through metal doors and were 'like vampires' because they come out at night with their eyes 'lit up like the headlights of a car'. According to the community leader, the 'rat problem has got worse over the years and they are not scared of us'. He complained that people have to sleep under blankets even in the summer to prevent rat bites: 'They bite us in the face, head and feet… They know what they want and where they are going… they walk with a purpose, like humans'.[3]

By 2015, newspaper reports described low-income areas including Khayelitsha as being 'under siege' by 'marauding rats' some reportedly as 'large as cats; (Stone, 2014; Bamford, 2015) and 'human-like' (Lwandle, 2013). In September 2015, 4,000 awaiting trial prisoners were moved from Cape Town's largest prison (Pollsmoor) so that it could be fumigated after an inmate died of leptospirosis, thought to have been transmitted by contact with rodents (Petersen, 2015b).

City spokesmen acknowledged that the rat problem was fuelled primarily by poor waste management (insufficient rubbish removal) but they also blamed local residents who dump food waste in the street or leave rubbish bags on the ground (Petersen, 2015a). The City subsequently improved waste removal services and launched various public education campaigns – yet the mainstay of its approach was to target problem areas with anticoagulant poison, provide educational materials and install poison bait in people's homes (Stone, 2014).

Rodenticide use is a dominant city management strategy globally because concentrated, sustained and well-targeted use of rodenticides can significantly reduce urban rat populations (Bonnefoy et al., 2008: 404; Buckle and Smith, 2015). However, there is growing doubt about its effectiveness over the medium-term as rodent populations can recover quickly (Easterbrook et al., 2005; Singleton et al., 2010; Gras et al., 2012). There are also concerns about

[2] 'Cape Town goes after rats', News24 20 March 2013: http://www.news24.com/SouthAfrica/News/Cape-Town-goes-after-rats-20130320

[3] 'Large rats terrorizing Cape Town, News24 27 March 2013: http://www.news24.com/SouthAfrica/News/Large-rats-terrorising-Cape-Town-community-20130327

the negative impact of rodenticides on wildlife through accidental poisoning of non-target animals and secondary poisoning of predators and scavengers who are exposed to rodenticides when they consume poisoned rats (Thorsen et al., 2000; Eason & Spurr, 1995; Brakes & Smith, 2005; Serieys et al., 2018). Furthermore, rodenticides do not offer a quick and painless death, and there is growing pressure to take animal welfare concerns more seriously when managing pests (e.g. Hadidian, 2015, see also Edelman, 2002 about changing attitudes to the treatment of rats).

Rodenticide use has been implicated in the increase in accidental poisoning of children in Cape Town (Balme et al., 2010; Rother, 2010) and in the accidental and secondary poisoning of pets in townships (Smallhorne, 2017). Concern has been mounting in particular about illegal or 'street pesticides' (Rother, 2010) but non-target animals and children are harmed by both legal and illegal pesticides.[4] Anticoagulant rodenticides have been shown to undermine the metabolism and immune system of bobcats living near cities in the US (Serieys et al., 2018; Fraser et al., 2018) and have been implicated in the deaths of wild caracals (a similar sized wildcat) in Cape Town.[5] Bird rehabilitation facilities in Cape Town report that rodenticide poisoning is a major cause of death of owls, buzzards and other raptors.[6]

Thus, when pressure mounted on City of Cape Town managers to do something about rodent infestation, they were also under pressure to reduce the use of rodenticides. EH had come under pressure from ecologists about the impact of their rodenticide use on birds, and there was growing concern amongst public health officials about poisoning of children through the accidental ingestion of legally and illegally used pesticides (Balme et al., 2010; Rother 2010). In 2014, the City launched an educational campaign about poisons and started taking action against street sales of illegal pesticides (Stone, 2014). It is, however, very difficult preventing the illegal sale of pesticides because as soon as the police and related environmental health officials start to 'raid' street sellers, most disappear quickly from the scene (personal observations).

The street pesticide most commonly used against rats is aldicarb, an agricultural carbamate pesticide that is highly toxic to human and non-human animals. In terms of the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies (Act 36 of 1947) it is illegal to use agricultural pesticides for purposes other than specified on the label, and illegal to sell such pesticides in containers not

[4] A study of pediatric pesticide exposures and poisonings seen at the Red Cross Children's Hospital in Cape Town between 2003 and 2008 found that 39% of the cases from Khayelitsha were caused by 'street pesticides' (Balme et. al., 2010: 930).
[5] http://www.urbancaracal.org/threats/
[6] Information obtained from *World of Birds* and *Eagle Encounters*.

regulated by the law.[7] Aldicarb, however, is widely available and sold very cheaply by street sellers and hawkers on trains. It is sold in the form of black grains somewhat resembling gunpowder contained in small plastic bags (see Khayelitsha photo file) or in sealed straws (known as 'sticks'). As of late 2017, aldicarb was selling for R2 a straw.[8] Aldicarb is highly toxic and poses serious threats to humans and animals (Arnot et al., 2011). Two grains of aldicarb is apparently sufficient to kill a cat.[9]

The cage-trapping and rat drowning EPWP has to be understood in the context of EH's wider initiative against poison. Most attention has been paid to the campaign against illegal pesticides. However, legal pesticides – including those used by the City of Cape Town to manage rats – are also potentially harmful to children and non-target wildlife. EH was thus seeking an alternative to placing poisoned bait inside people's homes and the idea of capturing and drowning the rats was born. The pilot phase of the program ran in October 2014, employing 22 EPWP workers who caught and disposed of 4,500 rats (Petersen, 2015a). Funding was subsequently secured for several more EPWPs in 2015.

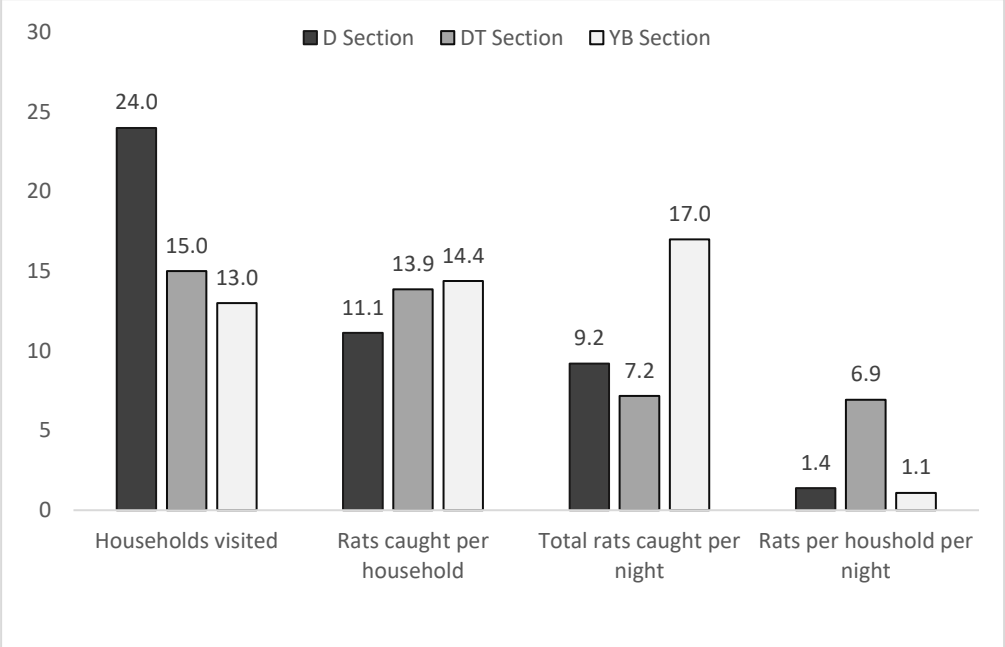
EPWPs are an important policy initiative to alleviate poverty and joblessness in South Africa (Bokolo, 2013; Satumba, 2016). South Africa has one of the highest rates of unemployment in the world (Nattrass and Seekings, 2017), particularly among poorer, less-skilled people. Local governments can apply for funding to the national government's expanded public works programme, which provides jobs lasting typically three months.[10] The cage trapping EPWP provided workers with training in the use of cages, and in public education about waste management and rodent control.

The EPWP proved very popular and its services were in great demand. According to EH officials, people liked the fact that the rats were caught (rather than poisoned where they could die in inconvenient places, such as within floor and wall cavities, causing a bad smell). They also liked the fact that the rat could be killed and disposed of without anyone having to touch it (as the entire cage was immersed in a bucket of water and then the drowned rat was tipped out into a bag and the cage trap reset).[11] EH kept records of which households were visited, over how many nights, and how many rats were caught and disposed of. This was partly an exercise in monitoring and evaluation (Lasswell's 'appraisal' function), but was also understood by local officials to be necessary in order to

[7] See discussion: http://wildlifepoisoningprevention.co.za/legislation-information/
[8] Research on trains from Cape Town to Khayelitsha (conducted for the CSSR by Thobani Ncapai.
[9] Information from a farmer in the Karoo.
[10] See http://www.eEPWP.gov.za/
[11] Information obtained from talking to managers of the EPWP in Khayelitsha.

provide the data necessary to promote the project ('invocation' function) in the hope of encouraging wider support for non-poison based methods and wider implementation of the model.

Figure 3 provides illustrative data from the month of September 2015 for three areas of Khayelitsha visited by EPWP workers. It shows that between 11 and 14 rats were caught on average per household. In D Section and YB section, an average of just over one rat was caught per household per night – but in YB section, the average was six per household. One particular household recorded 18 rats in a single night (and four more were caught a week later when the team was called back). What happened in cases like these was that people took matters into their own hands: when they heard the cage trap clicking shut, they immersed the cage in a bucket of water, tipped the dead rat in a bag to be collected by the EPWP worker in the morning, and then reset the trap themselves. Multiple killings thus reflect a serious rat problem in the house and the willingness of the householder to kill the rats and reset the trap.



Source: Data provided by EH

Figure 3: Rat trapping statistics for three parts of Khayelitsha, for the month of September 2015

Local officials in Khayelitsha – and in the City of Cape Town – were pleased with the results. The Mayoral Committee member for Public Health described the previous strategy of block baiting (with poison) as 'risky' and praised the cage traps for being 'poison free' and effective at catching adult rats, thereby hopefully helping to reduce the size of the rodent population (Petersen, 2015a). When journalists probed officials about the method to dispose of the rats, City

officials presented drowning as 'the most humane and practical way of exterminating the rats' (Bamford, 2015a). City officials were interviewed on the radio about the program, where they promoted it as job creation for poor people, in the interests of poor people. They also argued that it was in the interests of the environment and conservation because it avoided the secondary poisoning of predators and raptors.

This promotional strategy seemed to be doing well until one such radio broadcast was heard by Senior Inspector Alwyn Marais, a national senior inspector for the NSPCA Special Projects Unit. Senior inspector Marais took great exception to the project being described as 'humane' on the grounds that it was poison free.[12] He contacted the City of Cape Town to say that drowning was not 'humane' and was, in the opinion of the NSPCA, illegal (Bamford, 2015b). This brought the cage trapping to an abrupt halt once an official warning was issued by the NSPCA.

3.1 The NSPCA's approach

According to the South African Animals Protection Act (No 71 of 1962), an 'animal' means 'any equine, bovine, sheep, goat, pig, fowl, ostrich, dog, cat or other domestic animal or bird, or any wild animal, wild bird or reptile which is in captivity or under the control of any person' (Section 1 (1)).[13] The Act then goes on to specify a wide range of actions with regard to the treatment of animals deemed to be cruel, including terrifying or torturing an animal. Drowning is not specifically mentioned, although it is clear that an animal immersed in water would be stressed and terrified, and thus cruelly treated. Given that a caged rat is under the control of a person, immersing the cage in water to drown the rat could thus be seen as illegal under the Animal Protection Act.

The NSPCA emphasises in its promotional materials that it protects *all* animals, including those defined as problem animals such as jackals and rats and that they require the same level of consideration as animals in other contexts.[14] However, South Africa's Animals Protection Act does not go this far, but rather explicitly allows for some forms of cruelty against so-called 'vermin'. Notably, it is illegal to use poison 'except for the destruction of vermin or marauding

[12] Interview conducted on 21 February 2017. For an example of public discussion on the radio about this see: http://www.capetalk.co.za/articles/6050/nspca-warns-city-against-inhumane-rat-drowning-strategy.
[13] The Act is available here: https://www.gov.za/sites/www.gov.za/files/Act%2071%20of%201962.pdf
[14] https://nspca.co.za/

domestic animals or without taking reasonable precautions to prevent injury or disease being caused to animals' (Section 2(1)(d)). It is also illegal to expose animals to immediate attack by other animals – but an exception is again made in the case of vermin if the action is conducted by vermin clubs to train hunting dogs (Section 2(1)(g)). The Act does not define 'vermin' explicitly, but this section probably refers to allowing for the release of captured caracals and jackals in front of hounds as an (obviously cruel) training exercise. Trapping and killing animals is also prohibited under the Act – unless necessary to prevent the destruction of property and the spread of disease (Section 2(1)(j)). This probably refers primarily to rodent control. Unlike the sale of traps to catch wild animals, no restrictions are placed on the sale of traps for rodents (Section 2(1)(l)). In other words, many of the protections generally afforded wild animals are explicitly allowed with regard to the treatment of rodents. As far as EH was concerned, this implied that disposing of rats by drowning was within the spirit of the law. For the NSPCA, this was illegal because the Act did not specifically provide an exemption with regard to drowning rodents.

Other relevant South African legislation is similarly confusing about whether any of the protections contained in the Animals Protection Act apply to pests. The National Norms and Standards Relating to Environmental Health in Terms of the National Health Act (No 61 of 2003)[15] fails to make any determination about how creatures deemed to be vermin/pests (including birds, bats, insects, rodents) are to be treated: it simply requires public facilities, restaurants etc. to control and eliminate vermin where necessary to protect human health. The word 'animal' does not appear in the Act which instead mentions 'pests', 'vermin' and 'disease vectors'. The Act does not impose restrictions on the use of poison against vermin/pests other than to protect pest control workers and to ensure that poison does not pose dangers for human health (Section 23, subsection 3: Pest and Vector Control).

The NSPCA is expressly opposed to the use of poison because of the suffering it causes to targeted animals and because it poses threats to non-target wildlife.[16] It is well established that rodenticides cause prolonged and painful deaths from internal haemorrhaging over five to fifteen days, with the animals suffering from swelling in their joints and abdomens (Litten et al., 2004; Meerburg et al., 2008; Yeates, 2010). Death by poison is obviously a cruel death, and it is likely that

[15] http://www.nicd.ac.za/assets/files/Norms_and_standards_for_environmental_health.pdf

[16] https://nspca.co.za/rodent-control/. In a response to an earlier version of this paper, the NSPCA reiterated that it was opposed 'to the use of various classes of poison in general, due to specific concerns with regards to that it is considered cruel and inhumane towards target and non-target species via primary and secondary poisoning, including the possibility of associated detrimental effects on the environment through the process of bioconcentration, bioaccumulation and biomagnification'. [Personal communication, 15/2/18].

death by drowning is kinder because it is faster. Yet to the best of our knowledge, the NSPCA has never challenged the legislation that allows for the poisoning of animals deemed to be pests or vermin. Rather it takes the law as given. According to a statement by the NSPCA:

> 'the NSPCA and SPCA movement strives to maintain a standard approach with regards to educational tools and prosecution with regards to animal cruelty, i.e. we cannot start to categorise levels of animal cruelty and see which cases need action, instead all animals are protected under the APA [Animals Protection Act]. The NSPCA and SPCA movement is aware of the inconsistencies within the APA with regards to the control of vermin via poison, but we still strive to prevent animal cruelty in sections of the APA that legally prohibits certain acts such as drowning'. [Personal communication, 15/2/18]

Drowning may be a preferable death to poisoning, but it is clear that drowning is also a cruel death. Drowning is not considered to be a form of euthanasia because it causes death in minutes rather than seconds (Ludders et al., 1999). In this regard, the NSPCA's position on the matter is consistent with growing international concerns about the ethics of managing pests and other wildlife (e.g. Bluett, 2000; Edelman, 2002; Ohl & van der Staay, 2012). Yet drowning is also argued in other contexts to be the only practical means of controlling certain 'nuisance' wildlife like beavers and muskrats – and better for the target animal than the available alternatives, notably leg-hold or body gripping devises. While it would hypothetically be better to capture these animals in cages and then euthanize them, this option has been strongly argued by field practitioners to be impractical (e.g. Bluett, 2002).

There is a double-standard globally with regard to the treatment of 'nuisance' or 'pest' animals. When a rat is a pet or a laboratory animal it is managed humanely (euthanized under as stress-free circumstances as possible), yet when it is seen as a 'pest', the global practice is to allow pest controllers to poison them, that is treat them cruelly (Meerburg et al., 2008; Yeats, 2009). This double-standard is partly because of the complicated history of the relationship between humans and rats (as feared pests, loved pets and neutral laboratory animals (Edelman, 2002)) and partly because it is difficult to replicate the conditions for humane clinical euthanasia for free-ranging 'wild' animals.

Debates about how to kill animals deemed to be pests in the wild quickly become mired in considerations about the 'least worst' practical alternative – such as whether it is better for a beaver to be drowned or captured in a gin trap where it could die of shock and injuries over an extended period of time. The NSPCA's actions to halt the EPWP on the grounds that drowning rats was

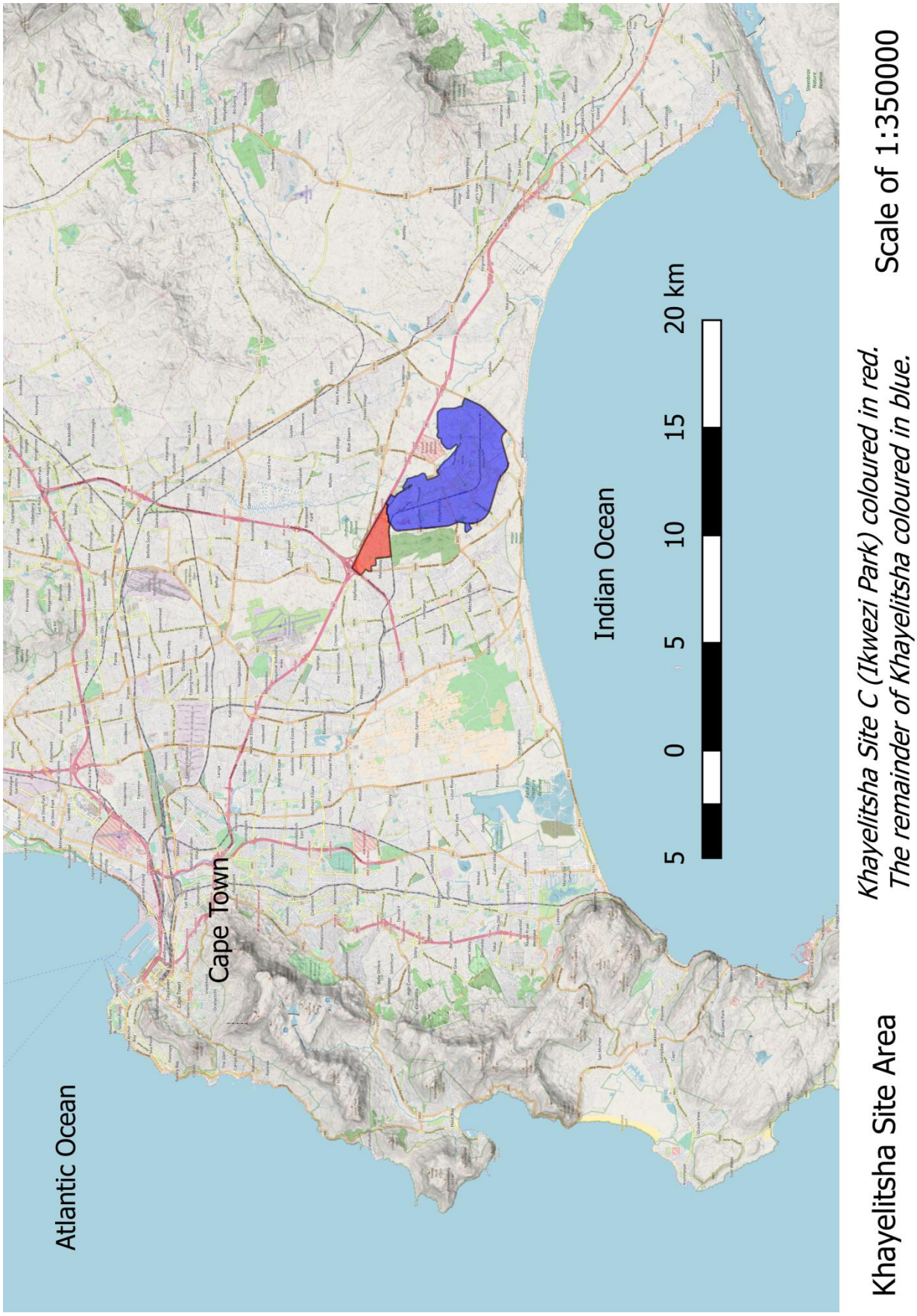


Figure 1: Khayelitsha [Map produced by Jed Stephens]

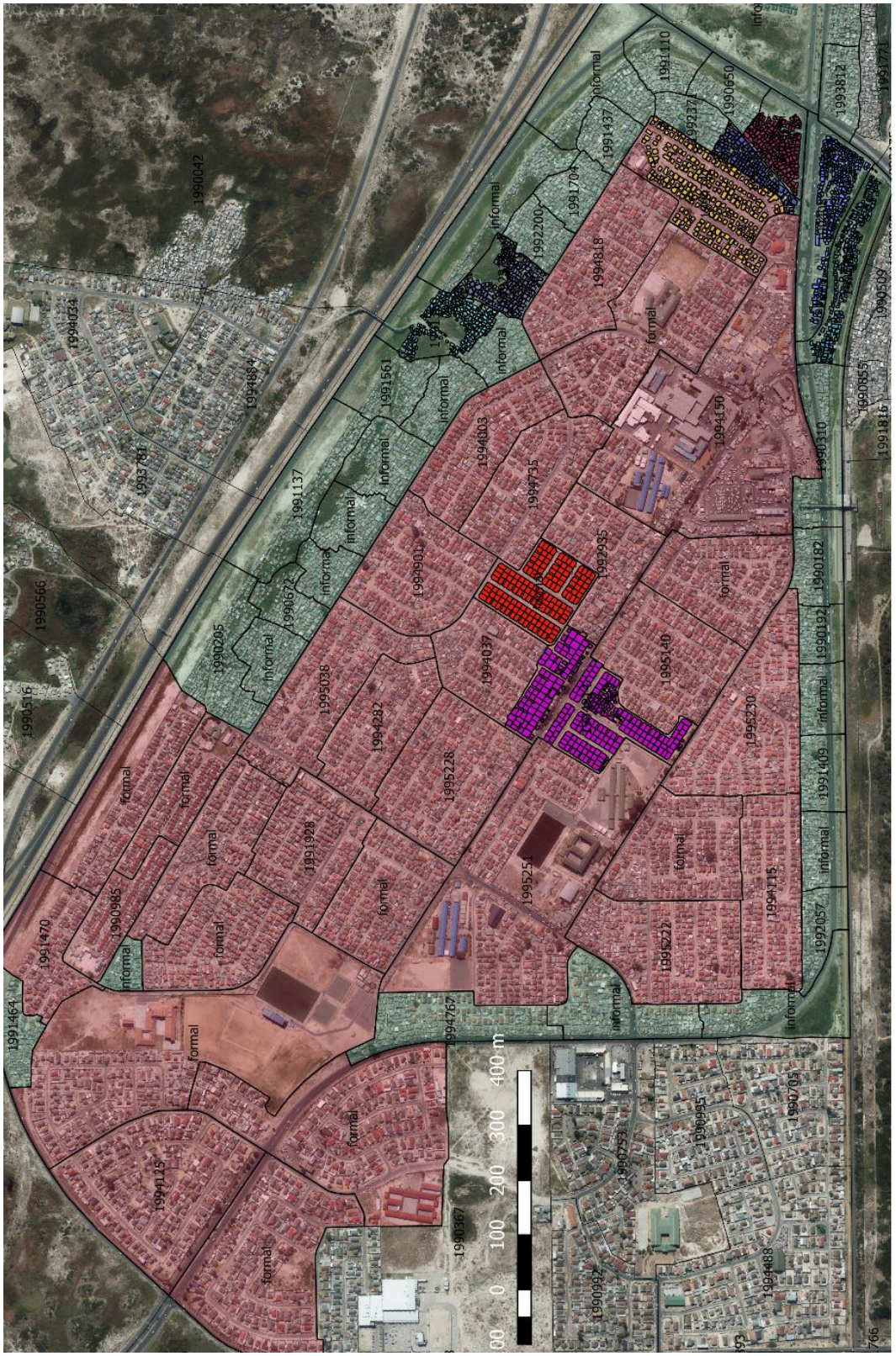


Figure 2: Site C sample area (census Small Areas marked, households outlined in sampled small areas). Red areas are Small Areas with formal, housing, green are informal. Houses outlined in colour are in the randomly selected Small Areas – respondents were randomly selected from within these Small Areas. *[Map produced by Jed Stephens]*

Poisoned wheat grains

Aldicarb

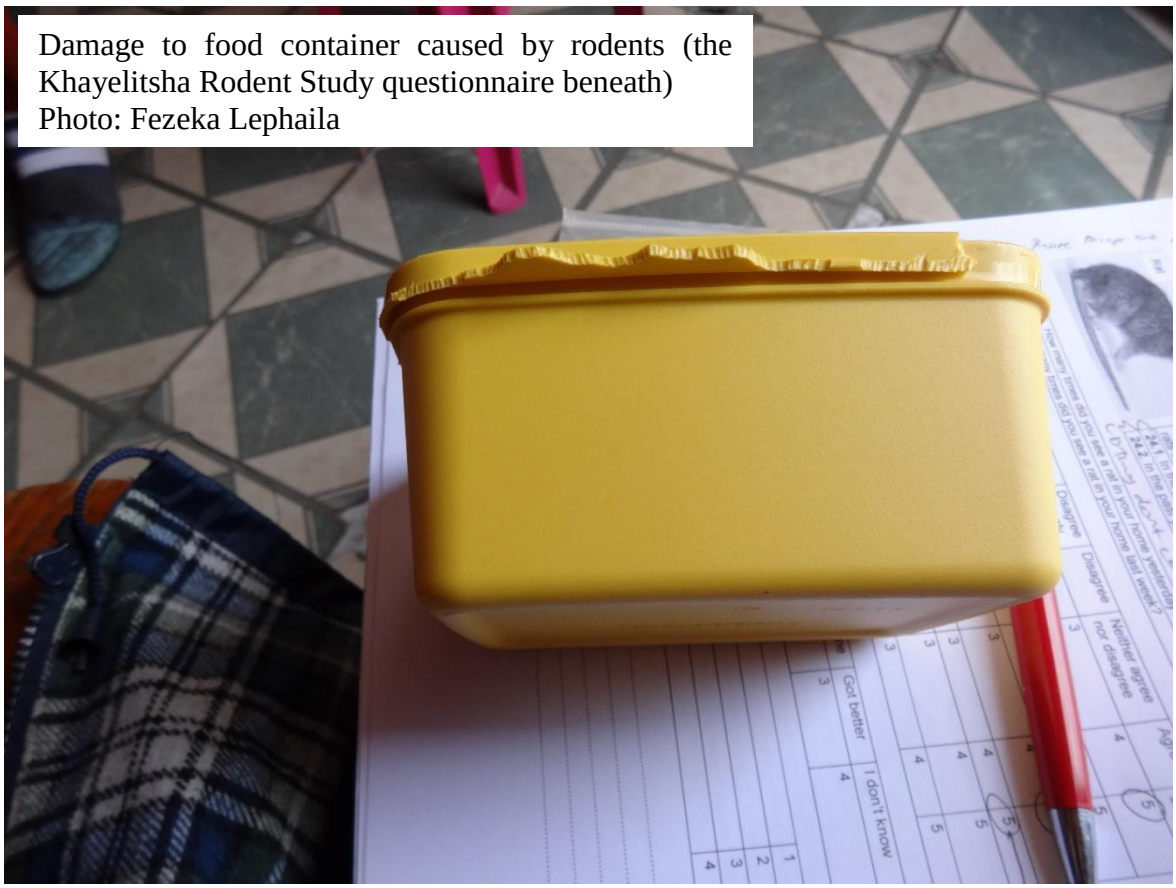
Poisons on sale in Khayelitsha
Photo: Nicoli Nattrass

Child with a brown rat, Site C
Photo: Fezeka Lephaila

The river in 'Island', Site C
Photo: Jed Stephens

Children playing in good rodent habitat, Site C
Photo: Fezeka Lephaila

Women displaying rodent damage, Site C
Photo: Fezeka Lephaila



Damage to food container caused by rodents (the Khayelitsha Rodent Study questionnaire beneath)
Photo: Fezeka Lephaila

inhumane (a principled position) is ethically complicated by the fact that no consideration was given to the fact that the context was a similarly second best world. Stopping the EPWP from drowning rats did not stop rats being treated cruelly as cage trapping was simply replaced by poisoning.

Senior Inspector Marais acknowledged that if he was a rat, faced with the choice of being drowned or poisoned to death, he would choose to be drowned because it would probably be faster and entail less suffering. Yet he justified the NSPCA's actions on the grounds that the organisation worked within a legal framework that allowed for poisoning of rats and that it was unacceptable ever to consider drowning to be 'humane'. He objected to calling a cruel procedure as 'humane' simply because it was better than the alternative and/or because it was better for other animals (pets, wildlife). The NSPCA reiterated this position, arguing that poisoning rodents:

> 'cannot be replaced by yet another cruel and inhumane method of control, i.e. drowning. While the NSPCA acknowledges that under certain circumstances, pest and/or problem animal control and/or extermination may be required, the NSPCA only supports the use of humane methods. The NSPCA does not support methods of pest/problem animal management that cause suffering, pain, or distress to any animal'. [Personal communication, 9/2/18].

This principled position is best understood in the context of the NSPCA's general mandate to promote kind and empathetic treatment of all animals. In this regard, Senior Inspector Marais worried that when City spokesmen described the EPWP as 'humane', people might think that drowning was a good death – and acceptable way of killing animals – and that they might then go on to use it on other animals (unwanted kittens, for example). His fear was that any sort of nuanced position, where a cruel death is weighed up against an even worse death, would weaken the NSPCA's strategic objective: to promote the social value that animals never deserve a cruel death.

3.2 The view from Khayelitsha, Site C

Khayelitsha EH officials were not impressed with the NSPCA's principled position, seeing it as a cop out and a refusal to deal with the realities of resource-constrained real life. We were told that EH had offered to transport the captured rats to SPCA facilities where they could be euthanized humanely but that the NSPCA had declined on the grounds that they did not have the capacity to

manage such large numbers.[17] The NSPCA was thus, in their view, thus acting unfairly and unreasonably and was complicit in an outcome (the resumption of rodent poisoning) that was worse for animals and people. EH officials lived in a world of constrained optimisation, where multiple objectives – notably job creation, reducing poison use in Khayelitsha, combatting rodent infestation and protecting wildlife including in the nearby Wolfgat nature reserve and the Kuils River wetland – had to be met within tight budget constraints. They were also convinced that their cage-trapping project enjoyed support in Khayelitsha and that the NSPCA was imposing bourgeois values on a poor community with a serious rodent problem.

There is some evidence for this. Rats are clearly a problem in the area. Our representative survey of Site C, Khayelitsha found that 84.7% of respondents reported seeing evidence of rodents such as damage to food or possessions, getting into the rubbish or biting people in the household. Over a third (38.2%) reported seeing rats in their house in the previous week and 40.8% said that rats were a big problem for the household. Over half (55.4%) estimated that the rat problem had become worse over the previous year.

Only a third (34.4%) of respondents had heard of the NSPCA and most (95.5%) were unaware that the NSPCA believed that drowning was cruel and had stopped the cage trapping project. Three-quarters (75.8%) agreed with the proposition that council workers should be allowed to set cage traps and drown the rats. Most were unconcerned about cruel treatment of rats: when asked if they cared if rats were 'killed in a cruel way', two-thirds (67.3%) agreed with the statement, 'No, I really do not care how rats are killed' and a fifth (19.9%) agreed with the statement, 'No, and actually I am happy if the rats suffer'. Only 9.6% agreed with the statement 'Yes, I care and would prefer the rats not to suffer' and 1.9% said they did not know how they felt about the issue.

The regression reported in Table 1 (a probit regression taking into account the two-stage stratified complex survey design and reporting average marginal effects[18]) shows that the average change in probability of a respondent agreeing that the cage trapping and drowning project should be allowed was significantly and substantially affected by attitudes. Controlling for the other variables in the model, believing that drowning was painful for the rat reduced the average

[17] Senior Inspector Marais responded to this point as follows: 'I don't recall this ever being offered by them. Besides the fact that the SPCA is a NGO and NPO [Non-profit organisation] that operates from public donations. How are we to be responsible financially for the euthanasia of all these animals when the City does have its own Veterinarian?' [Personal communication, 9/2/18].

[18] Following Williams (2012) we calculate average marginal effects rather than marginal effects at the mean.

marginal probability of agreeing that council workers should be allowed to catch and drown rats by just over a third (that is, by 0.382 probability units or 38.2 percentage points). Being concerned about unintended or secondary poisoning of other animals increased by over a quarter (by 26.9 percentage points) the average marginal probability of agreeing.

Table 1: Predicting the probability of agreeing with the cage trapping and drowning of rats

Regressors	dF/dx
1=Yes, drowning is painful for the rat, 0= Neutral or does not think it is painful	-0.383*** (0.084) p=0.003
1=Worries about rat poison killing other animals like owls and cats, 0= Neutral or does not worry	0.271*** (0.068) p=0.005
Index of rodent infestation (0 to 4 different kinds of evidence of rodent infestation)	0.057* (0.030) p=0.096
Asset index (scaled average price index)	-0.195* (0.084) p=0.053
1=Lives in a formal house, 0=Lives in an informal (shack)	0.058 (0.055) p=0.331
1=Female, 0=Male	-0.029 (0.063) p=0.658
1=Matric (school leaving certificate), 0 = all other educational outcomes	-0.096 (0.076) p=0.246
Age	-0.001 (0.001) p=0.215
Observations (n)	136
Wald Test	F(7,7) = 5.95 Prob >F = 0.016
Goodness of Fit Test	F(6,2) =944.46 Prob>F = 0.001

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Other statistically significant variables were the asset index (constructed by summing the number of recorded household items weighted by their average prices and scaling this index to 1 using the weighted value of the wealthiest respondent) and the index of rodent presence – though both of these had a

relatively small effect on the outcome. Controlling for the other variables in the model, the respondent from the richest household[19] had a 19.5 percentage point lower average marginal probability of agreeing that council workers should be allowed to trap and drown rats. For each decile increase in the scaled asset price index the marginal average probability of agreeing fell by 1.95 percentage points.[20] For every additional kind of evidence of rodent infestation, the marginal average probability of agreeing increased by 6.2 percentage points.

The regression also controlled for individual characteristics (age, gender and education). The signs of these coefficients suggest that older, female and high-school graduates were less likely to agree to the cage trapping and drowning of rats, but none was statistically significant. In short, the key drivers of a respondent agreeing with cage trapping and drowning were primarily attitudinal. Those who believed that drowning was painful for the rat were, controlling for the other variables, less likely to support cage trapping and drowning. This indicates support for the NSPCA approach – however, such views were in the minority. The vast majority who worried about the secondary poisoning of other animals by rodenticides favoured the cage trapping and drowning, and this can be seen as evidence for strong support for EH poison-free cage trapping and drowning project.

3.3 Alternative poison-free strategies

Some EH officials wanted to meet the NSPCA in court to argue that because rats were pests, drowning them was in the spirit of South African legislation even though it was not explicitly allowed for in the Animals Protection Act. Yet there were also concerns about legal costs and adverse publicity. Furthermore, many officials acknowledged that drowning was a cruel fate and were very open to finding more humane, poison-free, methods of killing them.

Similar sentiments were evident among respondents in our survey of Site C, Khayelitsha. When asked whether alternative less cruel alternatives should be found to drowning the rats, a quarter (26.7%) were in favour and two-thirds (65.8%) said they were in favour as long as the alternatives were ‘effective.’ Our survey thus indicates that there was a strong preference in Khayelitsha for both the cage trapping project, *and* for finding more humane ways of killing rats (with the important proviso that such methods be effective).

[19] The wealthiest household in the sample had assets valued at approximately R68,500.

[20] The marginal average probability of the median and mean respondent would be 5.79 and 6.67 percentage points less likely to agree with council workers trapping and drowning rats.

Evidence from the survey supports EH's concerns about the ubiquitous use of rat poison. Half the sample (49.7%) reported that their household had purchased rat poison in the past year, and by far the most popular poison was Aldicarb. Over a third (37.5%) of the sample reported that their household had purchased this illegal poison in the past year. Most (65.5%) of these respondents had purchased it from a hawker on the train, and the remainder (34.5%) had purchased it from a street seller. The poison was prepared for rats by either mixing it with cooked food (60.0%) or with mielie pap (maize porridge) (40.0%). The potential for accidental poisoning of children and animals is clear.

Most respondents agreed that it was 'a good thing' to have spaces like the Khayelitsha Wetlands Park (88.5%) and Wolfgat Reserve (79.6%). As discussed earlier, respondents were asked if they were concerned that if people use poison to kill rodents that other animals like cats and owls could be killed. Most (81.9%) said they worried about this (and a further 8.4% said they worried 'but not much'). This suggests that the conservation concerns that also shaped EH's thinking about poison had some resonance within the local population.

When EH at Khayelitsha was approached by a local raptor rehabilitation centre with a novel proposal that appeared, at least on paper, to offer a humane, poison-free and pro-conservation solution, it generated some excitement. In essence, the rehabilitation centre ('*Eagle Encounters*') located about 20 kilometres away on the road to Stellenbosch proposed to euthanize the captured rats with CO_2 and feed them to the raptors.[21] *Eagle Encounters* typically relies on reject chicks donated by the poultry industry. These chicks are killed by CO_2 in pressurised steel containers and then frozen before being fed to raptors. When Hank Chalmers (the co-owner and founder of *Eagle Encounters*) heard about the cage trapping project being stopped because of concerns about how the rats were killed, he wondered whether it would be possible to euthanize the rats and use them as an alternative food source. The Head of EH was particularly taken by this proposal, seeing it as a means of maintaining the poison-free approach, satisfying concerns about the humane treatment of rats, and as achieving additional conservation objectives (helping to rehabilitate raptors).

Unfortunately this plan, while attractive at first blush, proved impractical and with animal welfare concerns of its own.[22] Notably, rats would spend much longer in the cage traps, have to endure the stress of being loaded onto a vehicle

[21] Information about the *Eagle Encounters* plan was obtained from Hank Chalmers (discussions on 27 July and 29 August 2017) and from EH officials. Information about Eagle *Encounters* is available here: http://www.eagle-encounters.co.za/

[22] This information was gleaned through interactions with people in EH, and from a discussion session led by Jed Stephens and Jorich Loubser about the costs and benefits of the *Eagle Encounters* plan.

and transported to *Eagle Encounters* where they would be unloaded into metal containers for observation (to attempt to weed out any rats that appeared ill or poisoned)[23] and then euthanized. Aside from worries that rats could get injured (or attack each other) when transferred to the larger container, were concerns about whether CO_2 was humane or not. Studies showing that rats are aversive to CO_2 gas, and that it causes pain, resulted in North American protocols recommending that it be accompanied by other inert gasses and delivered only in rising concentrations (Hawkins et al., 2016). There was thus a real possibility that if this project were to be implemented, the NSPCA would object to it as well.

Other objections concerned the implications for the EPWP workers. EPWP managers pointed out that urine and faeces from stressed rats would contaminate the cages and any vehicle that transported them. They also worried about how much time would be wasted collecting and transporting the rats, tying up cages and vehicles that could be being redeployed to catch more rodents. Some warned that this would not be as popular as the drowning method because only one rodent could be caught per trap night. For these mid-level managers, the whole idea was a folly, a vanity project even.

Eagle Encounters had initially offered to collect the rats, but had assumed the rats would be brought to a central location in Khayelitsha for collection. The EPWP team leaders were, however, reluctant to do so, and besides, there was no obvious and suitable place where caged rats could be stored temporarily before being loaded and transported. Contestation over who would be responsible for transporting the rats resulted in the idea eventually being abandoned. Uncertainty over whether one required a permit to transport live rats acted as another nail in the coffin.

In the end, Khayelitsh EH continued the EPWP rodent control service but instead of using cage traps, workers presented households with a choice between poison and snap traps. Snap traps vary in size. Small snap traps (aimed at mice) are often not strong enough to kill rats, but can injure or maim them. The rodent control EPWP offered households the use of larger, more powerful plastic snap traps which killed rats instantly. The downside of this method of rodent control for householders was that these traps could potentially injure children and household pets and that they would have to deal with the violent, bloody aftermath (headless rats, rats cut in half, blood splatter etc.). According to EPWP managers, workers and householders preferred dealing with drowned rats than

[23] Hank Chalmers accepted that some poisoned rats would get through such a simple screening process but he argued that rehabilitated raptors needed to get used to eating the odd mildly poisoned rat because they were going to encounter many more in the wild.

with rats mutilated by traps because they did not want to touch their broken and bloodied bodies. This aversion to touching rodents killed in traps could partly account for the fact that even when provided with snap traps (as part of a study of the acceptability of snap traps), a third of households continued to use poison (Roomany et al., 2012).

4. Conclusion

The story of policy contestation over the Khayelitsha cage-trapping and drowning project is one of conflicting values, approaches and strategies. Yet it is important to note that it took place against a back-drop of wider poverty and inequality in Cape Town. The back-story is that poor sanitation and inadequate housing are well understood drivers of rodent infestation. In Johannesburg, poor sanitation and protein in pet food (often stolen by rats) has been implicated in the rise in the size of rats (one weighing in at 661 grams was recorded in Johannesburg in February 2018 (Collins, 2018). Yet city managers in Cape Town and elsewhere in South Africa (as is common-place globally) resort to poison-based strategies as a short-term solution to a much more intractable political-economic problem (allocating more resources to waste management in poor areas, redistributing income and opportunities to poor people, etc.).

Allocating more resources to improving housing and waste management in low-income areas like Khayelitsha would go a long way towards removing the food supplies and harbourage favourable to rodent population growth. Both 'sides' of the conflict recognise this. The head of EH was concerned about poison being used as Cape Town's 'first option' rather than as a last resort (interviewed 6/9/17) and Senior Inspector Alwyn Marais was firmly of the view that:

> 'You cannot advocate cruel treatment of animals to correct the problems created by humans. Those animals are innocent in this. Humans are trying to find an easy way out to fix their mistakes, and that often results in ideas that are cruel to animals'. [Personal communication, 9/2/18].

The fact that EH seriously considered the proposal to transport rats to Eagle Encounters demonstrates a willingness to find better, poison-free alternatives to drowning and poisoning. And although the NSPCA effectively trumped local values and concerns by bringing the cage-trapping and drowning project to a halt, the NSPCA recognised that the outcome was less than optimal. In reaction to an earlier draft of this paper, the NSPCA informed us that:

> 'The Cape of Good Hope SPCA is working towards a practical solution in finding methods to euthanize large numbers of captured rodents in an

attempt to ensure animal welfare is maintained, thus assisting the community members of Khayelitsha'. [Personal communication, 15/2/18].

To conclude on an up-beat note, perhaps the conflict will indeed result in new, more humane technologies of rodent control. Even so, addressing the social and economic inequalities that make the rodent problem so much more acute in low-income areas has to be part of a longer-run, sustainable solution.

References

Archer C., Appleton C., Mukaratirwa, S. et al. (2017) Endo-parasites of public-health importance recovered from rodents in the Durban metropolitan area, South Africa. Southern African Journal of Infectious Diseases, 1-10.

Arnot, L., Veale, D., Stey, J. and J. Myburgh. (2011). Treatment rationale for dogs poisoned with aldicarb (carbamate pesticide). Journal of the South African Veterinary Association, 82(4): 232-238.

Auer, M. (2017). Rescuing the decision process. Policy Sciences, 50: 519–526.

Balme K, Roberts J., Glasstone M et al. (2010) Pesticide poisonings at a tertiary children's hospital in South Africa: an increasing problem. Clinical toxicology 48(9): 928-934.

Bamford, H. (2015a). Cape battling rat epidemic, Cape Argus, 24 September.

Bamford, H. (2015b). Cape warned to stop drowning rats. *Independent Online*. 28 October. Available: http://www.iol.co.za/news/south-africa/western-cape/cape-warned-to-stop-drowning-rats-1936895 .

Bastos, A., Nair, D., Taylor, P. et al. (2011). Genetic monitoring detects an overlooked cryptic species and reveals the diversity and distribution of three invasive Rattus congeners in South Africa. BMC genetics, 12(1): 26.

Begon M. (2003). Disease: health effects on humans, population effects on rodents. In: Singleton G., Hinds L., Krebs C. & Spratt D eds. Rats, Mice and people: Rodent Biology and Management. Australian Centre for International Agricultural Research: 13-19.

Bluett, R., (2001). Drowning is not euthanasia. Wildlife Society Bulletin, 29(2): 666-70.

Bokolo, S. (2013). Integrating Employment Creation and Skills Development : The Case of Expanded Public Works Programmes in South Africa, AfricaPortal, 1 August. https://www.africaportal.org/publications/integrating-employment-creation-and-skills-development-the-case-of-expanded-public-works-programmes-in-south-africa/

Bonnefoy X., Kampen H., Sweeney K. (2008). Public health significance of urban pests. World Health Organization, Copenhagen. Available: http://www.sanidadambiental.com/wp-content/uploads/2009/12/Urban-pest-OMS.pdf

Brakes, C. & Smith, R. (2005). Exposure of non-target small mammals to rodenticides: short-term effects, recovery and implications for secondary poisoning. Journal of Applied Ecology 42(1): 118-128

Buckle A., Smith R. (2015) Rodent pests and their control, 2nd edn. CABI, Wallingford.

Clark, S. & Wallace, R. (2015). Integration and interdisciplinarity: Concepts, frameworks, and education. Policy Sciences, 48(2), 233–255.

Collins, F. 2018. Horror tails of Ratzilla breeding up a storm in Jozi gutters. Sunday Times 18/2/18.

CSSR & iCWild. (2018). *Khayelitsha Rodent Survey Site C V0.6* [Dataset], Centre for Social Science Research and the Institute for Communities and Wildlife, University of Cape Town.

Eason, C. & Spurr, E. (1995). Review of the toxicity and impacts of brodifacoum on non-target wildlife in New Zealand. New Zealand journal of zoology 22(4): 371-9.

Edelman, B. (2002). 'Rats are people, too!': Rat-human relations re-rated. Anthropology today, *18*(3), 3-8.

Easterbrook, J., Shields, T., Klein, S. et al. (2005). Norway rat population in Baltimore, Maryland, 2004. Vector-Borne & Zoonotic Diseases, 5(3): 296-9.

Fraser, D., Mouton, A., Serileys, L. et al., (2018). Genome-wide expression reveals multiple systemic effects associated with detection of anticoagulant poisons in bobcats (Lynx rufus). Forthcoming in Molecular Ecology.

Gras, L., Patergnani, M. & Farina, M. (2012). Poison-based commensal rodent control strategies in urban ecosystems: some evidence against sewer-baiting. EcoHealth, 9(1): 75-9.

Hawkins, P., Prescott, M., Carbone, L., Dennison, N., Johnson, C., Makowska, I.J., Marquardt, N., Readman, G., Weary, D. & Golledge, H. (2016). A good death? Report of the second Newcastle meeting on laboratory animal euthanasia. Animals, 6(9), p.50.

Hadidian, J. (2015). Wildlife in US Cities: Managing Unwanted Animals. Animals 5(4): 1092-1113.

Himsworth, C., Parsons, K., Jardine, C. et al. (2013). Rats, cities, people, and pathogens: a systematic review and narrative synthesis of literature regarding the ecology of rat-associated zoonoses in urban centers. Vector-Borne and Zoonotic Diseases 13(6): 349-359.

Himsworth, C., Feng, A., Parsons, K. et al. (2013). Using experiential knowledge to understand urban rat ecology: A survey of Canadian pest control professionals. Urban Ecosystems, 16(2):341-50.

Ithete, N., (2013). Investigation of small mammal-borne viruses with zoonotic potential in South Africa (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Jassat, W., Naicker, N., Naidoo, S. & Mathee, A. (2013). Rodent control in urban communities in Johannesburg, South Africa: From research to action. International journal of environmental health research, 23(6):474-83.

Julius, R., Bastos, A., Brettschneider, H. et al. (2012). Dynamics of Rodent-Borne Zoonotic Diseases and Their Reservoir Hosts: Invasive Rattus in South Africa. In Proceedings of the 25th Vertebrate Pest Conference, University of California.

Lasswell, H. D. (1956). The decision process: Seven categories of functional analysis. College Park, MD: University of Maryland.

Littin, K., Mellor, D,, Warburton, B, et al. (2004). Animal welfare and ethical issues relevant to the humane control of vertebrate pests. New Zealand Veterinary Journal 52(1): 1-10.

Ludders, J., Schmidt, R., Dein, F. et al. (1999). Drowning is not euthanasia. Wildlife Society Bulletin, 27(3): 666-670.

Meerburg, B., Brom, F. & Kijlstra, A. (2008). The ethics of rodent control. Pest management science 64 (12): 1205-11.

Mitchell, J. (1930) Epizootic among Veld Rodents in De Aar and Neighbouring Districts of the Northern Cape Province. Epidemiology and Infection 29(4): 394–414.

Nattrass, N. & Seekings, J. (2017) Employment and labour productivity in high unemployment countries. Development Policy Review. Published ahead of print: doi: 10.1111/dpr.12313.

Ohl, F & Van der Staay, F. (2012). Animal welfare: At the interface between science and society. The Veterinary Journal 192(1): 13-19.

Petersen, T. (2015a). City of Cape Town launches new rat attack, News24, 15 Sept.

Petersen, T. (2015b). 4,000 awaiting trial prisoners to be moved from Pollsmoor, News24, 18 September.

Poleykett, B. 2017. Building Out the Rat: Animal Intimacies and Prophylactic Settlement in 1920s South Africa. Engagement, 7 February. https://aesengagement.wordpress.com/2017/02/07/building-out-the-rat-animal-intimacies-and-prophylactic-ssettlement-in-1920s-south-africa/

Puckett, E., Park, J., Combs, M. et al. (2016). Global population divergence and admixture of the brown rat (Rattus norvegicus). In Proceedings of the Royal Society, 283(1841): 20161762.

Roomaney, R., Ehrlich, R. & Rother, H.. (2012). The acceptability of rat trap use over pesticides for rodent control in two poor urban communities in SA. Environmental Health 11(1): 32.

Rother, H. (2010). Falling through the regulatory cracks: street selling of pesticides and poisoning among urban youth in South Africa. International journal of occupational and environmental health 16(2): 183-194.

Satumba, T., (2016). Evaluating the impact of social grants and the Expanded Public Works Programme (EEPWP) on poverty reduction in South Africa (Doctoral dissertation, University of the Western Cape).

Serieys L. et al. (2018). Urbanization and anticoagulant poisons promote immune dysfunction in bobcats. Proceeding of the Royal Society, 285: 20172533. http://dx.doi.org/10.1098/rspb.2017.2533

Singleton, G. Belmain, S., Brown, P. and Hardy, B. (eds). (2010). Rodent Outbreaks: Ecology and Impacts. International Rice Institute, Manila.

Smallhorne, M. (2017). The Scourge of poisoned pets. Fin24, December 30: https://www.fin24.com/Opinion/the-scourge-of-poisoned-pets-20171230-2

Stone, M. (2014). Cape Town wages war on rodents. Independent on Line, 25 March 2014. https://www.iol.co.za/news/south-africa/western-cape/cape-town-wages-war-on-rodents-1665861

Stenseth, N., Atshabar B., Begon M., Belmain S., Bertherat E. et al. (2008) Plague: Past, present, and future. PLoS Med 5(1): e3. doi:10.1371/journal. pmed.0050003

Swanson, M. (1977). The Sanitation Syndrome: Bubonic Plague and Urban Native Policy in the Cape Colony, 1900-1909, *The Journal of African History* 18, 3: 387-410.

Taylor, P., Arntzen, L., Hayter et al. (2008). Understanding and managing sanitary risks due to rodent zoonoses in an African city. Integrative Zoology, 3(1): 38-50.

Taylor A., Downs S., Monadjem E. et al. (2012). Experimental treatment-control studies of ecologically based rodent management in Africa: balancing conservation and pest management. Wildlife Research, 39: 51-61.

Thorsen, M., Shorten, R., Lucking, R. et al. (2000). Norway rats (Rattus norvegicus) on Fregate Island, Seychelles: the invasion; subsequent eradication attempts and implications for the island's fauna. Biological Conservation, 96(2):133-8.

Williams, R. 2012. Using the Margins Command to Estimate and Interpret Adjusted Predictions and Marginal Effects. Stata Journal 12 (2): 308–331

Yeates, J. (2010). What can pest management learn from laboratory animal ethics? Pest management science 66(3): 231-7.