

Proposed Natural Resources Plan:

Submitter:

Maxwell Aston

Submitter Number:

S9

FORM 5: SUBMISSION FORM – PROPOSED NATURAL RESOURCES PLAN FOR THE WELLINGTON REGION

This is a submission on the Proposed Natural Resources Plan for the Wellington Region pursuant to Clause 6 of Schedule 1, Resource Management Act 1991

VERTEBRATE TOXIC AGENTS. 59 #1518122

NAME/ORGANISATION

NICK WELLS ASTON

NUMBER STREET NAME

21 WIKARU ROAD

SUBURB/TOWN

POSTCODE

POINT HOWARD

5013

PHONE

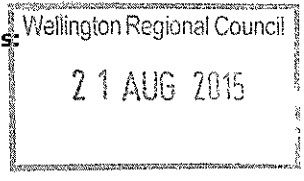
EMAIL

5683296

marton@clearnet.nz

The Wellington Regional Council has a preference for providing information about the Proposed Natural Resources Plan via email. We will send you updates on the process, information and provide you with details of any meetings and the hearing. Please tick here if you do not agree to receive communication via email

The specific provision(s) of the Proposed Natural Resources Plan that my submission relates to is: Please specify the provision/section number:



My submission on this provision is:

- I support the provision
I oppose the provision
I wish to have the specific provision amended

Reasons for my submission: DOMESTIC CATS. HAVE BEEN PROVED TO BE THE SOURCE OF THEIR PARASITE TOXOPLASMOSIS CONDII WHICH CAN CAUSE SCHIZOPHRENIA, THE DESTRUCTION OF ENDEMIC WILDLIFE AND VECTORS DOLPHINS.

I seek the following decision from WRC (give precise details): STOP THE REHOMING OF STRAY AND UNWANTED ANIMALS
(2) THE INTRODUCTION OF LICENSING, MICROCHIPPING and REGISTRATION OF ALL DOMESTIC CATS. AND NEUTERING OF ALL NOT NEEDED FOR BREEDING.

Please continue on separate sheet(s) in similar format or download a submission form from www.gw.govt.nz/regional-plan-review

Attendance and wish to be heard at hearing(s)

- We do wish to be heard in support of my/our submission at hearings
We do not wish to be heard in support of my/our submission.
If others make a similar submission, I will consider presenting a joint case with them at a hearing.

Trade competition

[Cross out this shaded section if you could not gain an advantage in trade competition through this submission]
I/we could not gain an advantage in trade competition through this submission
I/we could gain an advantage in trade competition through this submission
I/we am/am not directly affected by an effect of the subject matter of my submission that:
(a) adversely affects the environment; and
(b) does not relate to trade competition or the effects of trade competition.

Publication of details

The Wellington Regional Council is legally required to publicly notify a summary of submissions including your name and address. Your name and address will be there to enable other submitters who may wish to make a further submission to be able to serve you with a copy of it.

Signature: [Handwritten Signature]

Date: 18-8-2015

Person making submission or person authorised to sign on behalf of person making submission. NB. Not required if making an electronic submission

Post your submission to:

Freepost 3156
Wellington Regional Council
PO Box 11646
Wellington 6142



Proposed Natural Resources Plan for the Wellington Region

Pursuant to Clause 5 of the First Schedule of the Resource Management Act 1991, Wellington Regional Council gives public notice that it has prepared a Proposed Natural Resources Plan for the Wellington Region.

The purpose of the Proposed Natural Resources Plan for the Wellington Region is to identify outcomes for the management of natural and physical resources and to put in place processes and methods (including rules) to achieve the purpose of the Resource Management Act 1991. The Proposed Natural Resources Plan for the Wellington Region is a combined Regional and Coastal Plan and once operative will replace the existing Regional Plans (Regional Coastal Plan, Regional Air Quality Management Plan, Regional Freshwater Plan, Regional Plan for Discharges to Land and Regional Soil Plan).

All rules within the Proposed Natural Resources Plan for the Wellington Region have immediate legal effect.

A copy of the Proposed Natural Resources Plan for the Wellington Region and the Section 32 Reports are available for public inspection during normal working hours at:

- The offices of the Wellington Regional Council at:
 - Shed 39, 2 Fryatt Quay, Pipitea, Wellington 6011
 - 34 Chapel Street, Masterton 5810
- The head offices of the District/City Councils in the Wellington Region
- All public libraries in the Wellington Region
- The Wellington Regional Council website <http://www.gw.govt.nz/Regional-plan-review/>

A copy of the Proposed Natural Resources Plan for the Wellington Region and the Section 32 Reports can be downloaded from the Wellington Regional Council website or a USB can be obtained free of charge by contacting the Hearings Officer on 04 384 5708 / 0800 496 734 or by emailing Regionalplan@gw.govt.nz. Paper copies of the Proposed Natural Resources Plan for the Wellington Region and the Section 32 Reports are available for purchase from the offices of the Wellington Regional Council at the above addresses.

Please contact the Hearings Officer on 04 384 5708 / 0800 496 734 or Regionalplan@gw.govt.nz if you have any questions about the Proposed Natural Resources Plan for the Wellington Region.

SUBMISSIONS

The following persons can make a submission on the Proposed Natural Resources Plan for the Wellington Region:

- The local authority in its own area may make a submission; and
- Any other person may make a submission, but if the person could gain an advantage in trade competition through the submission, then the person may do so only if the person is directly affected by an effect of the proposal that -
 - adversely affects the environment; and
 - does not relate to trade competition or the effects of trade competition.

You may make a submission by sending a written or electronic

submission to the Wellington Regional Council at:
Email submissions to: Regionalplan@gw.govt.nz or post to:
Freepost 3156
The Proposed Natural Resources Plan
The Wellington Regional Council
PO Box 11646, Manners St
Wellington 6142

The submission must be on the official form 5 and must state whether or not you wish to be heard on your submission. Copies of this form are available from:

- Offices of the Wellington Regional Council
- The Wellington Regional Council website <http://www.gw.govt.nz/Regional-plan-review/>
- Calling 0800 496 734 or by emailing Regionalplan@gw.govt.nz.

THE CLOSING DATE FOR SUBMISSIONS IS 5PM FRIDAY 25 SEPTEMBER

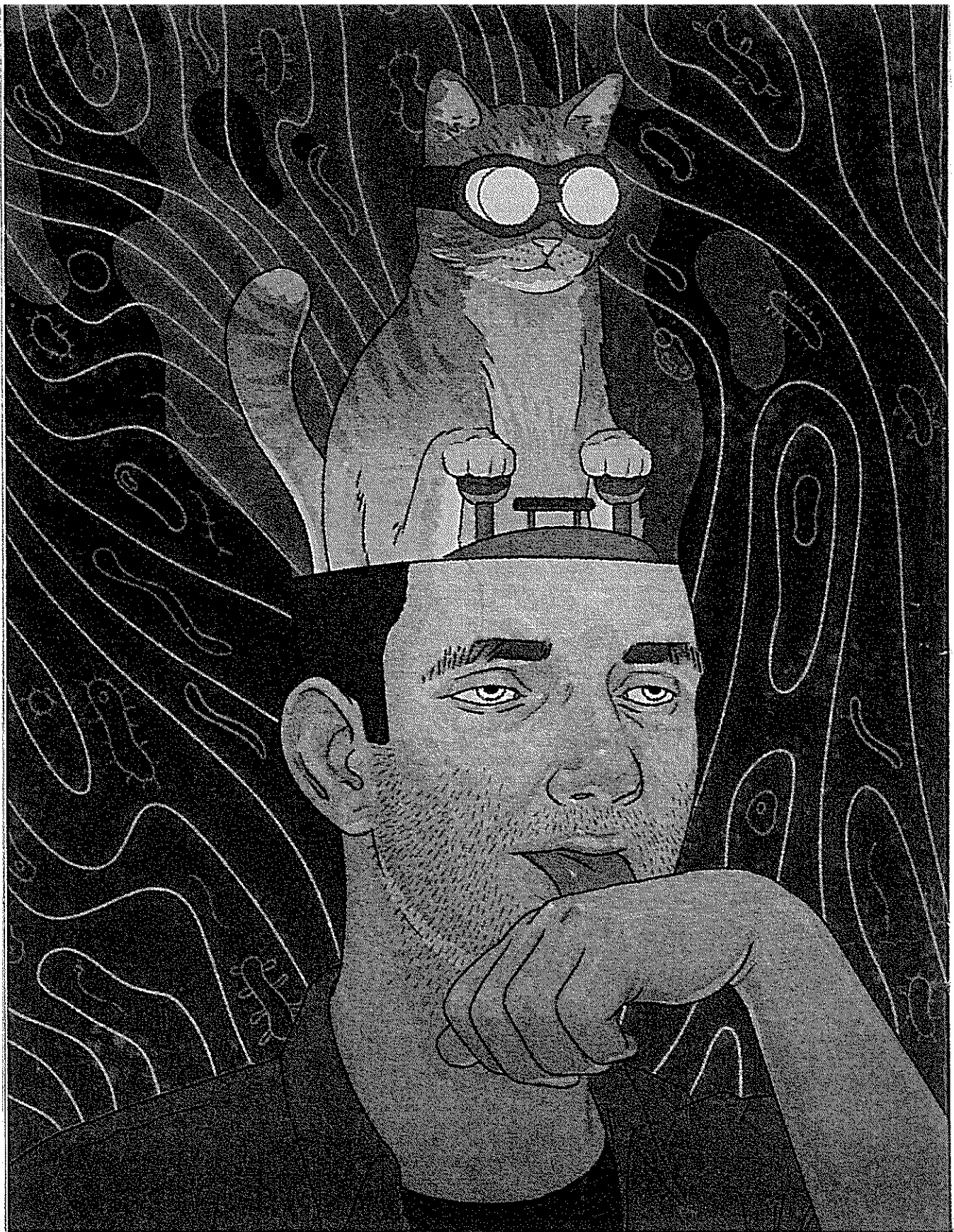
The process for public participation in consideration of the Proposed Natural Resources Plan for the Wellington Region is as follows:

- After the closing of submissions, the Wellington Regional Council must prepare a summary of decisions requested by submitters and give public notice of the availability of this summary and where the summary of submissions can be inspected; and
- There must be an opportunity for the following persons to make a further submission in support of, or in opposition to, the submissions already made:
 - Any person representing a relevant aspect of the public interest;
 - Any person who has an interest in the proposal greater than the general public has;
 - The local authority itself; and
- If a person making a submission asks to be heard in support of his or her submission, a hearing must be held; and
- The Wellington Regional Council must give its decision on the provisions and matters raised in the submissions (including its reasons for accepting or rejecting submissions) and give public notice of that decision within 2 years of notifying the Proposed Natural Resources Plan for the Wellington Region and serve it on every person who made a submission at the same time; and
- Any person who has made a submission has the right to appeal against the decision on the Proposed Natural Resources Plan for the Wellington Region to the Environment Court if:
 - In relation to a provision or matter that is the subject of the appeal, the person referred to the provision or matter in the person's submission on the proposal, and
 - The appeal does not seek the withdrawal of the proposal as a whole.

Greg Campbell
CHIEF EXECUTIVE

31 July 2015

The address for service of the Wellington Regional Council is the same as the address for submissions as set out above.



ASTON
AU RD.
HOWARD
BURNÉ.

M. G. ASTON
21 NIKAU RD.,
PT. HOWARD
EASTBOURNE.

INVASION OF THE MIND SNATCHERS

The idea that a feline parasite might hijack our brains sounds like a B-list horror movie. It isn't, says Colin Barras

IMAGINE there were a parasite living in your brain – an alien interloper with the power to alter your neurochemistry, manipulate your behaviour and change the way others see you. It might even rob you of your sanity. You are not the only person affected. The creature has taken up residence in the brains of billions of people, and many more are at risk.

This is not fiction. This mind-snatcher actually exists.

We already know that some parasites mess with their host's mind. The lancet liver fluke, for example, induces suicidal behaviour in any ant it infects, making it climb to the top of a blade of grass and hold on tightly with its jaws until it is eaten by a passing cow. Thus, the fluke gets back inside an animal in which it can reproduce, completing its life cycle. It is not the only parasite capable of such mind control, but generally their targets are insects and other small-brained invertebrates. Influence over a mammal with the brain size of a human was beyond their capabilities – or so we thought. That assumption is being challenged – at least for one parasite.

You may have heard of it. The microbe in question is *Toxoplasma gondii*, a single-celled protozoan that infects many birds and mammals but reproduces sexually in just one group: cats. Humans generally acquire it by eating undercooked meat and unwashed fruit

and vegetables, or from cleaning litter trays of cats that have recently been infected. Pregnant women and people with immune disorders such as HIV are advised to avoid these risks because *Toxoplasma* can occasionally be fatal to a fetus or to someone with a compromised immune system. But, for most of us, a mild flu-like illness is the worst we might expect. The symptoms of toxoplasmosis can be so innocuous, in fact, that most people don't even seek treatment. Soon, usually without us ever knowing we have the parasite, it enters a latent phase: it forms cysts, mostly in the brain, and hunkers down inside them, sitting dormant for decades, apparently doing nothing.

Suicidal combination

Worldwide, at least 2 billion of us carry the parasite – some estimates put it at twice that. The only hint of its presence comes in the form of *Toxoplasma* antibodies in the blood. Or so we thought. But *Toxoplasma* does have form as a mind-snatcher in other animals. We know that it boosts its chances of ending up inside a feline gut by messing with the minds of mice and rats. In the mid-1990s, for instance, researchers including Joanne Webster, now at Imperial College London, UK, discovered that toxoplasmosis makes rodents more active and less fearful: a suicidal

combination that increases their likelihood of being caught by cats. The consensus was that the parasite could not pull off a similar trick in humans. But one man suspected otherwise.

Evolutionary biologist Jaroslav Flegr at the Charles University in Prague, Czech Republic, decided to investigate its effect on human behaviour. His findings surprised many people. In 1994, Flegr and colleagues reported that men infected with the protozoan were more likely than uninfected men to disregard rules, or to be excessively suspicious or jealous. A few years later, he used a computer-based test to show that infected men and women have significantly delayed reactions compared with uninfected individuals. The work attracted little attention at the time.

Then, in 2002, Flegr tested people responsible for traffic accidents in Prague for infection. The results confirmed his hunch: car drivers and pedestrians injured on the city's roads were more than twice as likely to be infected as a comparable group of people living in the same area. As in rats, the parasite appeared to be linked with reckless behaviour. The finding, which has since been replicated by other groups, has encouraged others to question whether *Toxoplasma* is more harmful to humans than we imagined.

Another factor contributing to the shift in attitudes is Webster's discovery of the way >

"In humans, as in rats, the parasite appears to be linked with reckless behaviour"

in which the parasite exerts its mind control over rats. In 2000, she reported that toxoplasmosis doesn't simply make rats less fearful, it actually alters their sense of attraction, so that they find the smell of cat's urine alluring. Infected rats retain their aversion to the urine of other animals, leading Webster and her colleagues to dub the effect "fatal feline attraction". It no longer seemed likely that the personality changes seen in rodents – and people – with toxoplasmosis were merely a standard sickness response. Mammals have a naturally evolved suite of sickness behaviours, such as withdrawal and fatigue. But Webster's discovery of the powerful and precise way in which the parasite controls the mammalian brain suggested something else was going on.

What might that something be? A study in 2009 provides one possible answer. Glenn McConkey at the University of Leeds, UK, and his colleagues were analysing the *Toxoplasma* genome when they found something unexpected. The parasite carries two genes for tyrosine hydroxylase, an enzyme that helps produce a precursor of dopamine. There is no obvious reason why the parasite itself would need lots of dopamine, but in the mammalian brain dopamine acts as a neurotransmitter, playing a role in motivation, cognition, pleasure and fear. Could *Toxoplasma* be meddling with the brain chemistry of its hosts to change their behaviour?

It certainly might be. As early as the mid-1980s, researchers were reporting elevated

dopamine levels in rodents with toxoplasmosis. And a few years before McConkey's discovery, Webster and her colleagues found that haloperidol, a drug that inhibits dopamine production, prevents infected rats from displaying fatal feline attraction. But what about humans?

Psychotic connection

It is not really known whether people infected with the parasite have elevated dopamine levels. Intriguingly, though, haloperidol is prescribed to treat schizophrenia, a mental condition thought to be caused in part by an overactive dopamine system. We already know of a correlation between toxoplasmosis and schizophrenia. And in 2008, researchers reported that people with *Toxoplasma* antibodies had an increased likelihood of developing schizophrenia, adding weight to the idea that the parasite might actually trigger the psychotic condition.

Other teams have not yet managed to replicate the finding, but evolutionary biologist Paul Ewald at the University of Louisville, Kentucky, believes it is only a matter of time before the link is accepted.

"A strict genetic argument for schizophrenia just can't explain all of the evidence," he says. In other words, it can't just be down to our genes. He believes that about a third of all schizophrenia is triggered by toxoplasmosis.

For now, McConkey admits that we still need more evidence to show that *Toxoplasma* exerts



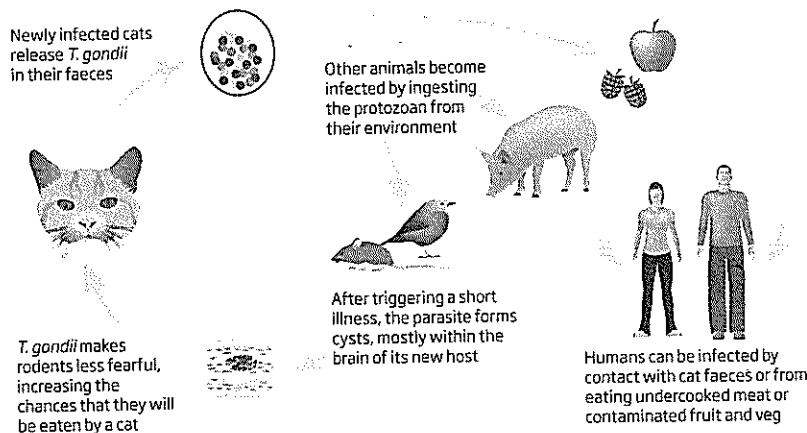
BRANDERMAN/GETTY

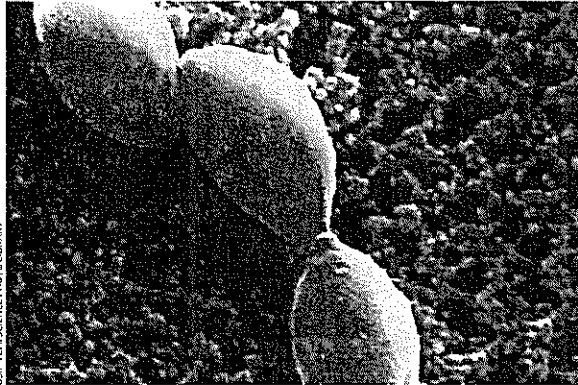
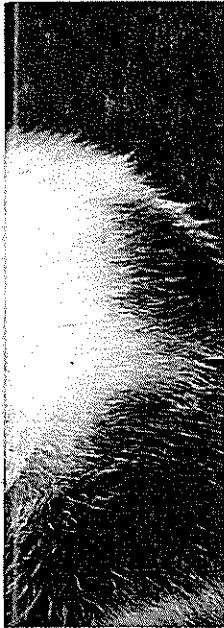
its control over the minds of mammals using dopamine. To be sure, we would need to block the activity of the two genes involved in dopamine production and see whether this affects its ability to manipulate behaviour. The first steps towards doing that have now been taken – with disappointing results. Researchers found that knocking out one of the protozoan's dopamine genes made no difference to the levels associated with toxoplasmosis in rodents. "I have some reservations about that study and the methods they used," says McConkey. However, he adds, it reminds us we should be careful about jumping to conclusions before we have all of the evidence.

But there may be another explanation for *Toxoplasma*-induced mind control. Over the past five years, Ajai Vyas at Nanyang Technological University in Singapore has amassed evidence that *Toxoplasma* doesn't just go to a rat's brain: it also clusters in the testes, from where it can pass to females during copulation, ending up in around 60 per cent of their offspring. In other words, toxoplasmosis is a sexually transmitted disease. Vyas's findings suggest we have missed something important. *Toxoplasma* has two goals, he says. It is keen to get back into a cat, but more immediately, it's driven to spread to as many rodents as possible – so it can ultimately reach many more cats.

The cat's got more than the cream!

The parasite *Toxoplasma gondii* infects most mammals but can only reproduce sexually in cats, so it manipulates the behaviour of other hosts to complete its life cycle





Fatal attraction: rats in thrall to the *Toxoplasma* parasite (above) find cat pee attractive

The parasite can achieve both goals by manipulating testosterone levels, says Vyas. Then, not only will infected rats devote more of their time and resources to breeding, they will also throw caution to the wind while they do so, boosting their chances of being caught by a cat. His findings support this idea. For instance, male rats with toxoplasmosis are judged by females to be particularly attractive. And the odour of cat urine induces sexual arousal in rats with toxoplasmosis. "Ajai's work is quite intriguing," says McConkey. "It does raise the possibility that there's a lot more going on than we currently understand."

Curiously, some parallel effects have now been reported in humans. Flegr has found evidence that men with toxoplasmosis have unusually high levels of testosterone, and tend to be viewed as particularly masculine and dominant by women. So does *Toxoplasma* pull most strongly on human brains or human groins? "This is speculation, but I don't think there are multiple controlling strategies," says Vyas. "I think it's the same strategy with multiple nodes. My goal is to find the circuit that connects it all up."

It is debatable whether *Toxoplasma* deliberately manipulates human behaviour, as some other parasites seem to (see "Micromanagers", above right). Unlike rodents, we are not eaten by cats, so any mind-

bending effects of the protozoan could be unintended. On the other hand, our distant ancestors certainly were prey to big cats, as are other apes today. What's more, in 2011 Flegr reported that infected people experience "fatal feline attraction", too. "There is no reason to think that *Toxoplasma* is better adapted to mice than to apes," he says.

So how can we stop this mind-controlling parasite? For now, the answer is we can't. The main problem is that the parasite's fatty cysts are almost impregnable to drugs. There is one way in, however. It's unclear how, but the cysts will "swallow" molecules called transductive peptides, and in 2012, researchers led by Rima McLeod at the University of Chicago, managed to attach an active drug to these molecules and get the killer agent inside *Toxoplasma* cysts. It was an exciting discovery but funding for such work is hard to come by, says team member Bo Shiun Lai, now at the University of Cambridge. "I am hopeful that our approach might lead to an effective commercial therapy against toxoplasmosis, but this will realistically not happen any time soon."

In the meantime, how worried should we be? Flegr believes the link between toxoplasmosis and traffic accidents, schizophrenia and possibly other mental illnesses, too, means it must have a huge economic impact. Exactly how much of an impact is unclear, but Ewald points out that the total bill for treating schizophrenia in the US is \$63 billion per year. If toxoplasmosis really is responsible for one-third of all cases

"Does *toxoplasma* pull most strongly on human brains or human groins?"

MICROMANAGERS

It's hard to assess the extent to which parasites and pathogens affect our behaviour because it would not be ethical to deliberately infect people and observe them. But Chris Reiber at Binghamton University in New York and Janice Moore at Colorado State University in Fort Collins have come up with a neat and ethically acceptable workaround - study what happens when people are exposed to pathogens through vaccination.

They have found that people were far more sociable in the 48 hours following their annual flu vaccination than in the 48 hours preceding it. "This is highly suggestive that the virus is manipulating human behaviour for its own ends; that is, to spread itself to other potential hosts," says Reiber. Another possibility, however, is that humans subconsciously become more sociable in anticipation of needing help and support ahead of disease.

The guinea worm is another example of a parasite that may be manipulating human behaviour for its own ends, says Reiber. The nematode's life cycle involves humans and water fleas. People ingest them in contaminated water and, a year later, the larvae emerge below their skin causing a burning sensation as they do. This encourages the infected individual to bathe, allowing the larvae to return to the rivers where it can infect a water flea.

of schizophrenia, it could easily cost the US \$20 billion each year. "Of course, this sort of estimate doesn't take into account the non-economic, quality-of-life costs, which I consider to be even more important," he adds.

Toxoplasma also presents us with an opportunity, says Shelley Adamo at Dalhousie University in Halifax, Nova Scotia. Parasites like *Toxoplasma* are "evolution's neurobiologists", she says. Careful study of the mechanisms they have evolved to manipulate behaviour might offer neuroscientists some handy tips on how to treat diseases and addictions. A parasite that makes its host less fearful could really come in handy. After all, excessive fear is a characteristic of many conditions - from phobias and social anxiety to post-traumatic stress. Perhaps one day we will be able to manipulate the manipulators.

Colin Barras is a science writer based near Ann Arbor in Michigan