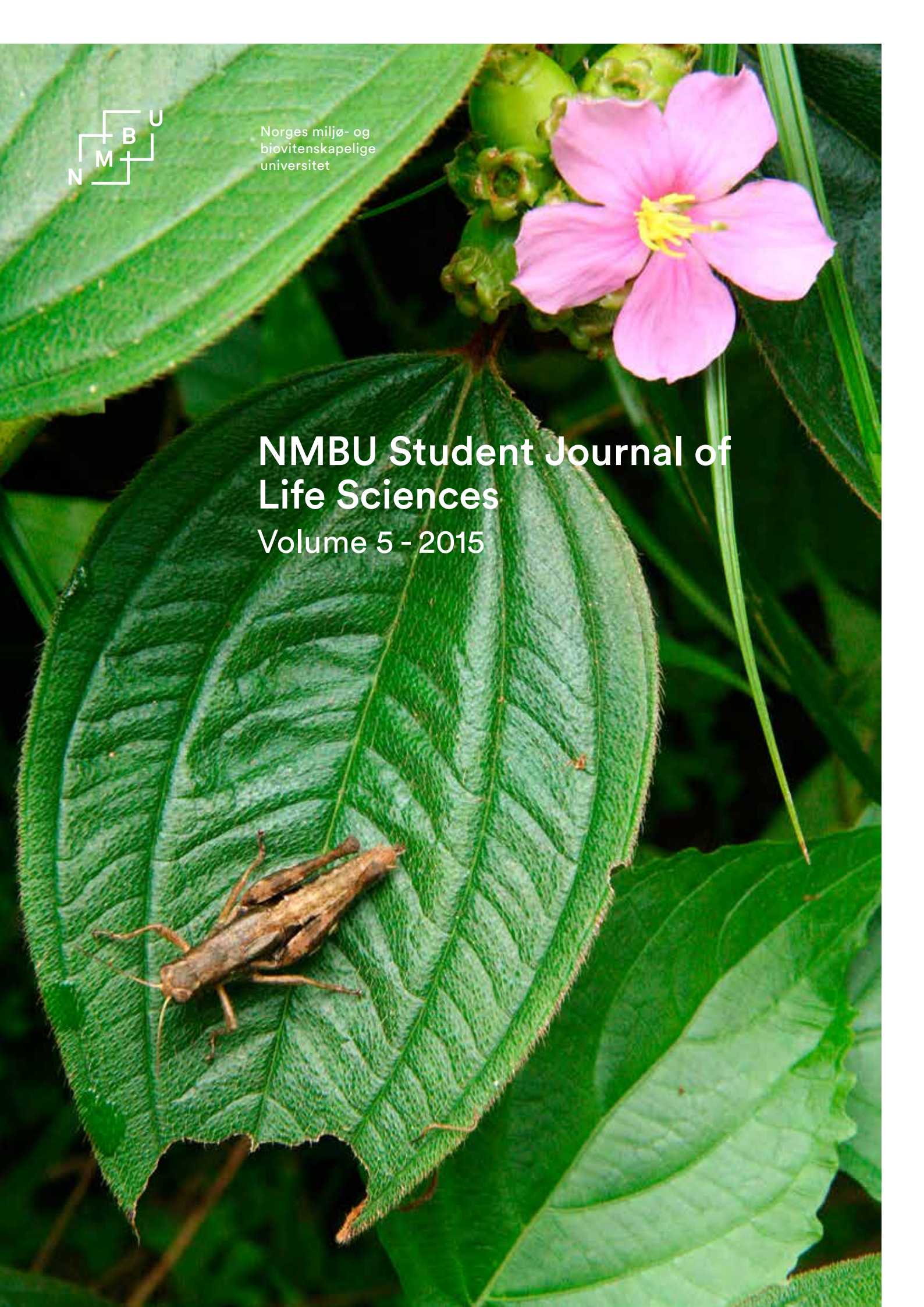




Norges miljø- og
biovitenskapelige
universitet

NMBU Student Journal of Life Sciences

Volume 5 - 2015



Published by Norwegian University of Life Sciences.

NMBU Student Journal of Life Sciences, Universitetsbiblioteket
Norges miljø- og biovitenskapelige universitet (NMBU)
P.O. Box 5003
NO-1432 Ås
Norway

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The opinions expressed herein are solely those of the individual authors.
The *NMBU Student Journal of Life Sciences* is published annually by Norwegian University of Life Sciences. Our mandate is to showcase exemplary writing by students at the Norwegian University of Life Sciences.

Submissions are accepted every autumn for publication the following spring. All submissions are peer reviewed. For questions and enquiries, please contact nmbujournal@gmail.com.

NMBU Student Journal of Life Sciences
Volume 5 - 2015

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Online ISSN: 2387-5755

Print ISSN: 2387-5747

Cover Photo: Hanna Kavli Lodberg-Holm

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Editor’s Note

NMBU’s Student Journal of Life Sciences is both unique and characteristic of academic journals. All submitted papers are peer reviewed, following rigid protocol. This exposes students to the demands of professional scholarship and expectations of NMBU writing. Our Review Board provides comprehensive feedback to submitted papers. Selected authors must tailor their papers before the Editorial Board makes a final decision. The authors are then assigned an editor from the Board to improve the final version of the paper. Consequently, the papers in this volume have been evaluated several times to ensure quality and credibility.

Like all scholarly journals, each article relates to a particular academic discipline. However, the *NMBU Student Journal* integrates several disciplines, similar to top-tier journals for the general reader. This volume manifests the interdisciplinary nature of life sciences at NMBU by representing eight study fields: environmental microbiology, general ecology, bioinformatics and quantitative genetics, veterinary medicine, environment and development studies, international relations, ecosystem management, and plant science.

Volume 5 presents nine articles that showcase NMBU’s academic diversity. Natalie Lim (PhD) reviews how parasitic fungi create Zombie forests. Henriette Wathne Gelink (MSc) links the Norwegian wolf-debate to the African Wild Dog-debate by examining how negative attitudes prevent effective conservation. This volume is the first to present a paper by the newest addition to NMBU’s bouquet of study: veterinary candidates Irina S. Flaatten, Inger Helene Meyer, Randi Vaage Thon and Selina S. Hellestveit review how hantavirus infect humans and the diseases the virus causes. Siri Hafstad Eggset (MSc) assess the climate resilient Green Economy in Ethiopia. Aaron James Willey (MSc) evaluates U.S. nuclear policy in light of neorealism and constructivism. Tina Križman (MSc) investigates the propaganda by supporters of Tar Sands production in Canada. Saroj Upadhyay (MSc) analyses the conservation benefits and costs in Chitwan National Park, Nepal. Neil Davey (BSc) assesses the implementation of the U.N. Global compact in Colombian workplaces. Finally, Katharina Lühmann (BSc) suggests that the variations of mercury levels in the eastern Beaufort Sea beluga population is caused by individual feeding behaviour.

In addition, this volume offers shorter opinion-based contributions to current debates through four *Letters*: Henrik Hæhre Ingebrigtsen (MSc) argues that insects are the food of the future. Joshua Larabee (BSc) presents his views on the legalization of prostitution. Tim Martin Knutsen (PhD) compares organic and conventional produced milk in light of heart health benefits. Tove Heiskel (MSc) looks at social resistance towards gold mining in Peru.

Volume 5 is a product of many, and on behalf of the Editorial Board I would like to thank Åslaug Borgan for her flexibility and reliance in assisting us with design and printing, and to the University library for support and goodwill. Thanks to NMBU’s Dean of Academic Affairs, Ole-Jørgen Torp; the Library Director, Geir Arne Rosvoll; and Rector Mari Sundli Tveit, for recognising the importance of our work. In addition, thanks to Connor Cavanagh for offering advice and comments in the selection process, Paul Beaumont for life-saving inputs at the most intense stage of editing, and a special thanks to our Faculty Advisor, William Warner for always having the utmost confidence in and respect for his students.

Most importantly, The *NMBU Student Journal* depends on voluntary engagement and I would like to thank all the students involved: thanks to the Editorial Board for their high-quality work and commitment throughout the whole process, and to the Review Board for delivering thorough critiques and recommendations during article selection. Volume 5 would not be possible without your efforts. Finally, the *NMBU Student Journal* would like to thank the 41 authors who submitted all together 49 papers. A new record and a clear message: NMBU’s students are hard-working and skilled; academic integrity is visible on all study levels. Volume 5 is thus a product of constructive, critical and creative students.

Editor-In-Chief

Eva Petershagen Åsbø



Photo: Akari O. Izumi Kvamme

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Photo: Hanna Kavli Lodberg-Holm

Parasitic fungi: The making of forest zombies

Natalie Lim

PhD Candidate in Environmental Microbiology

Abstract: Parasites are widely feared due to their reputation generated by modern media. Many common depictions involve *Alien*¹ movie-like monsters bursting out of chest cavities, and other such gruesome images. In reality, truth can be stranger than fiction, especially in the case of fungi that parasitise insects from within. Not only do these fungi show evidence of mind-control by manipulating the actions of the insect host, the style of emergence from the insect carcass can easily vie with the most fantastical creations of Hollywood scriptwriters. In this paper, insect-parasitising fungi of the phylum Ascomycota is reviewed, including its classification, mode of action, use as biocontrol agents, and its unusual aspect as a highly-prized traditional herb in the Far East.

A parasite is an individual that lives off another organism (the host), causing a detrimental effect to the host's fitness and health, often leading to an eventual death. There are two kinds of parasites: those that live on the surface of the host, ectoparasites; and those that live internally, endoparasites (Gullan & Cranston, 2010). Within the fungal kingdom, many parasites are endoparasites, living and growing within the host and often only emerging on the surface to produce reproductive structures.

In particular, many parasitic fungi come from the fungal phylum Ascomycota (Berbee, 2001). The insect-parasitising ability of fungi from and related to the *Cordyceps* clade in this phylum is discussed, taking special note of its ability to create zombies (host behaviour manipulation). The use of Ascomycetes as biocontrol agents is reviewed and an interesting alternative use for these fungi is mentioned as well.

Entomopathogenic Ascomycetes

In the phylum Ascomycota, fungi have repeatedly evolved and lost the ability to parasitise other organisms. For example, members of the subphylum Pezizomycotina was found to have independently evolved obligate plant pathogens on three separate occasions (Berbee, 2001). Despite the entomopathogenic fungi (fungi that attack insects) group having an exceedingly large host insect range, they are mostly found in the same few clades (Berbee, 2001; Deacon, 2006). Remarkably, a great number of closely related fungi parasitise the same few host species, giving rise to the hypothesis that fungi evolve to parasitise their hosts, eventually differentiating to produce various strains and species (Berbee, 2001; Nikoh & Fukatsu, 2000).

Of note, parasites do not often simply reside passively within their host organism. There are incidences of parasites altering the behaviour and physiology of the host organism (Poulin, 1995). While in many cases it may be disregarded as a pathological side-effect of the parasitism, it is not always so easily explained, such as the later discussed “zombie ant death-grip” (D. Hughes

¹ Referring here to the 1979 motion picture *Alien*: Carrol, G., Giler, D., Hill, W. (Producers), & Scott, R. (Director). (1979). *Alien*. [Motion Picture]. UK & USA: 20th Century Fox.

et al., 2011). This has led to the belief that host behaviour may be caused by one of the following reasons (Poulin, 1995): 1) The host is trying to remove the parasite; 2) The host is trying to compromise the efforts of the parasite; or 3) The parasite is trying to improve transmission rates. There is ongoing debate, with signs emerging that all of these reasons may be valid, depending on the relationship between parasite and host (Deacon, 2006; Gullan & Cranston, 2010; Poulin, 1995). Regardless, the present consensus is that a parasite affects the host in some way, and by its most basic definition, a parasite will normally compromise host fitness and health sufficiently to cause an eventual death (Gullan & Cranston, 2010).

The parasitic mechanism of entomopathogenic fungi

Entomopathogenic fungi are often obligate parasites, which means that they are unable to germinate alone in soil or on leaf litter and require an insect host. (Walstad, Anderson, & Stambaugh, 1970). As such, the life cycle of an entomopathogenic fungus is normally only able to commence once it has parasitised an insect. This starts with the adherence of spores to the insect cuticle, leading to the germination of spores if the environmental conditions are correct (Bidochka & Khachatourians, 1990; Deacon, 2006). The germ-tube then penetrates the insect with the help of cuticle-degrading enzymes, without which, the fungus is unable to digest the cuticle and penetrate the host (Bidochka & Khachatourians, 1990; Deacon, 2006).

Once the fungus has penetrated and entered the haemocoel, it is able to proliferate within the insect by utilising the nutrients in the insect haemolymph (Bidochka & Khachatourians, 1990). At this stage, the parasite must either avoid or suppress the immune system of the host (Deacon, 2006). If the fungus is unable to inhibit the host immune system, it will be destroyed and rejected before parasitism can properly take place. For example, some fungi avoid the host immune system by producing chemicals that suppress nodule formation (Huxham, Lackie, & McCorkindale, 1989). Since nodules are important in removing and guarding against particulates in the insect, the suppression ensures successful parasitisation (Huxham et al., 1989).

The growth of the parasite within the insect eventually leads to the death of the host.

Although the exact mechanism is still debated, both the depletion of haemolymph sugar levels and mycotoxin production have been implicated in host death (Grove & Pople, 1980; Miranpuri & Khachatourians, 1991). Neurotropic mycotoxins are readily secreted by entomopathogenic fungi, paralysing their hosts for extended periods of time (Cayrol, Djian, & Pijarowski, 1989). The accumulation of these mycotoxins over time leads to host death.

Once the host is dead, the fungus begins the process of saprotrophic nutrition (the consumption of dead organic matter) eventually colonising all parts of the dead insect (Deacon, 2006). Once properly established within the cadaver, some fungal species will begin to generate sporulating structures, emerging from the cuticle of the dead insect to release the spores in the hope of infecting new hosts. It is worth mentioning that unlike their counterparts, many *Cordyceps* clade parasites reproduce only after the death of the host, and not when the host is still alive (Andersen et al., 2009).

The *Cordyceps* clade

The *Cordyceps* clade is a large phylogenetically-related group of fungi within the phylum Ascomycota, many of which are entomopathogenic fungi (Sung et al., 2007). Like all other fungi, it is difficult to identify and study the complete lifecycle of *Cordyceps* clade members because of the vastly different asexual (anamorph) and sexual (teleomorph) states (Buenz, Bauer, Osmundson, & Motley, 2005). In itself, members of the *Cordyceps* clade are closely-related teleomorphs that have been linked with various anamorphic states, although some of these may have been morphological variants that were mistakenly named new species (Buenz et al., 2005). For example, until recently, 22 names in 13 anamorph genera had been associated with a single teleomorph *Cordyceps* species (Buenz et al., 2005). Even more confusingly, most members of the *Cordyceps* clade used to belong to a single genus, but in 2007 there was a major reclassification effort, resulting in much renaming and regrouping (Sung et al., 2007). For example, the prized traditional medicine *Cordyceps sinensis* is now *Ophiocordyceps sinensis*.

Host behaviour manipulation, aka “zombie ants”

Since a parasitic fungus spends much time

growing within its host, successful reproduction and dispersal of the parasite may depend on its ability to influence the behaviour of the host. An interesting aspect of entomopathogenic fungi is their ability to manipulate host behaviour in order to achieve their own goals. Parasites have long been known to be able to create minor alterations in host behaviour or even entirely new behaviours that are not normally seen, to the extent of being termed “mind-control”: Worm-infested crickets seek out water and “drown” themselves, and spiders spin a web for their wasp parasites before dying (Andersen et al., 2009; D. Hughes et al., 2011).

A well-known example of behaviour modification by entomopathogenic fungi of the *Cordyceps* clade is the creation of “zombie ants” by the fungus *Ophiocordyceps unilateralis* (Andersen et al., 2009; D. Hughes et al., 2011; D. P. Hughes, Wappler, & Labandeira, 2011). The “zombie ants” are termed as such because while they are principally still ants on the outside, they appear to be carrying out fungal actions with no benefit to themselves (D. Hughes et al., 2011). An obligate parasite, *O. unilateralis* creates behaviours in the host ants that do not appear to have any apparent purpose other than to help the parasite achieve optimal growth and sporulation conditions (D. Hughes et al., 2011).

The parasitising fungus causes their ant hosts to use their mandibles to attach themselves to a major leaf vein on the underside of a leaf before dying (Andersen et al., 2009; D. Hughes et al., 2011; D. P. Hughes et al., 2011). This mandibular “death-grip” is believed to be caused by severe atrophy in the mandible muscles after clamping down on the leaf vein, resulting in the ant unable to open its jaws (D. Hughes et al., 2011). It is still unknown how the fungus causes the ant to bite onto the leaf, but all evidence so far is only able to support the theory of a fungal cause, and sheds no light on the precise mechanism of action (D. Hughes et al., 2011).

Of particular interest to entomologists, the place at which the ant performs its death-grip is extremely specific. The death-grip is always on the underside of a leaf and mostly on the main vein, and is always close to the ground (Andersen et al., 2009). While many of these traits appear inexplicable, they may be selected because the location is optimal for fungus growth (D.

Hughes et al., 2011; D. P. Hughes et al., 2011). At approximately 25 cm from the ground, the “death-grip kill-zone” has a comparatively high relative humidity and a significantly lower temperature, unlike the ant hive in the canopy more than 20 m above the ground (Andersen et al., 2009; D. Hughes et al., 2011; D. P. Hughes et al., 2011). This means that the zone in which the death-grip takes place is a moist and cool environment, ideal for fungal germination and growth. Moreover, the forest floor is well shaded from the sun and harmful UV rays, ensuring a higher survivability rate of spores.

With such perfect conditions for fungal germination and growth, it is difficult to believe that this constant distance to the ground where the ant “chooses to die” is a coincidence and not some kind of logical choice. There have been varieties of theories as to why the ant appears to choose to stay within this specific distance, including that the ants are assessing leaf quality and distance from the ground before performing the death-grip (D. Hughes et al., 2011). A simpler and more likely reason, however, is the repeated convulsions caused by the fungal parasitism in the ant zombies results in extremely poor balance (D. Hughes et al., 2011). The constant falling of the ant is more likely to be the cause of their staying in the understory, since leaf and distance assessment would require the fungi to invade and take over higher mental processes in the ant host.

After the death-grip and the subsequent demise of the host, *O. unilateralis* colonises the ant cadaver, growing from the ant’s head and releasing spores once it matures (Andersen et al., 2009; D. P. Hughes et al., 2011). Being a saprotroph, it is able to readily switch from using nutrients in the living host’s haemolymph to dead tissue in order to continue its growth (Andersen et al., 2009). The process begins with hyphae growing from the insect cuticle, securing the dead ant to the leaf surface in case the mandibles are unable to sustain the additional biomass of the growing fungus (Andersen et al., 2009). At this point, the fungus spreads through the cadaver, using it for protection during growth (Andersen et al., 2009). The ant cuticle provides a physical barrier between the fungus and the environment, serving as a protective casing for both the fungus and the carbohydrate store inside the cadaver, thus providing a secure source of energy and allowing

for continuous sporulation (Andersen et al., 2009). Additionally, the hyphae of *O. unilateralis* are full of molecules that have anti-malarial, anticancer and antibiotic properties, most likely to protect itself and its food source (the ant cadaver) from invasive microorganisms (Andersen et al., 2009).

This production of “zombie ants” is not restricted to the Ascomycetes. The Zygomycota genus *Pandora* also produces a type of “zombie wood ant” even though the last common ancestor of both fungal species was many million years ago (D. Hughes et al., 2011). This shows that convergent evolution often occurs within the parasitic fungi, and is likely due to the abundance of resource and nutrients (in the form of ant hosts). Additionally, this type of death-grip host behaviour is believed to have been around for a long time, with fossil evidence pointing towards its existence 48 million years ago (D. P. Hughes et al., 2011). This shows that the ant nutrient source has remained steady over this long period of time and other fungi may have “jumped on the bandwagon” within the last few million years and taken advantage of this nutrient source as well.

Biocontrol by zombification

In the same way that these fungi use the ants for their own devices, for decades humans have been actively seeking a way to make a profit from these zombie-makers. One much researched way is to use fungi as an “all-organic” form of biocontrol to reduce insect crop pests. While nematodes are currently the most widespread biocontrol agent, there is much benefit in using parasitic fungi instead (Fiedler & Sosnowska, 2007). Taking up less area and resources to multiply, fungi may also be stored in the form of spores for long periods without the need to subculture. Additionally, when under the right conditions, fungi are able to spread among a given population very quickly, ensuring a high rate of parasitisation and control (Deacon, 2006). As mentioned, research has shown that toxins produced by entomopathogenic fungi can be insecticidal, thus useful in the biocontrol of insect populations (Grove & Pople, 1980; Huxham et al., 1989). As such, biocontrol methods of insect pests using fungi are analysed below.

Many currently registered mycoinsecticides are Ascomycetes, including two *Cordyceps* clade members, *Beauveria bassiana* and *Lecanicillium*

lecanii, that control cocoa weevil pests and aphids respectively (Buenz et al., 2005; Holliday & Cleaver, 2008; Prior, Jollands, & le Patourel, 1988). Very recently, *Isaria tenuipes* (anamorph of *Cordyceps polyarthra*) and *B. bassiana* were identified as potential biocontrol agents against oak beetles in Japan as well (Qi et al., 2011). Outside the *Cordyceps* clade, *Paecilomyces lilacinus* has been used to control greenhouse pests such as aphids, thrips and whiteflies (Fiedler & Sosnowska, 2007). Known since the 1980s for its soil activity and ability to control root-knot nematodes, it may also be able to provide good control over soil-stage insect larvae, unlike many other entomopathogenic fungi currently available on the market (Dube & Smart, 1987; Fiedler & Sosnowska, 2007).

Crop pests aside, a wide variety of fungi are also able to infect mosquitoes and other disease-transmitting insects at different stages of their life cycles (Scholte, Knols, Samson, & Takken, 2004). Entomopathogenic fungi have been used successfully against insects causing trypanosomiasis (sleeping sickness), malaria and filariasis, all major problems in different parts of Africa (Scholte, Njiru, Smallegange, Takken, & Knols, 2003). In Canada, there are investigations on *B. bassiana*'s ability to parasitise the *Aedes aegypti* mosquito (dengue fever) (Miranpuri & Khachatourians, 1991). Conidiospores ingested by mosquito larvae germinated and travelled to many body parts including the head and abdominal exoskeleton, eventually killing the larvae (Miranpuri & Khachatourians, 1991). This means that spraying *B. bassiana* spores in pools of stagnant water would theoretically provide good and cheap biocontrol of mosquitoes, lowering the rates of dengue fever infection.

Despite such excellent preliminary results, the practical application needs further refinement before it is safe for use. In the current proposed scenarios, there is no room for error since the fungi will be distributed over wide areas and many people will be in contact with them.

Failed attempts at biocontrol

In an example of an early attempt at biocontrol, the use of yellow muscardine, *Isaria farinosa* (anamorph of *Cordyceps memorabilis*), was used to control caterpillars in Japan in the 1940s (Katagiri, 1969). Although fairly effective in

field trials, it was also highly pathogenic to the silkworm, an important commercial organism, and thus the plan was abandoned (Katagiri 1969). Since the 1950s, a virus alternative has been studied in its place (Katagiri, 1969). A more recent example from the 1990s is *Isaria fumosorosea*, which was originally considered a potential bioweapon against crop-destroying whiteflies (Jackson, McGuire, Lacey, & Wraight, 1997). Unfortunately, the spores of the fungus were not desiccation-resistant, and experiments were unable to increase spore-yield or tolerance to dry conditions (Jackson et al., 1997). As a result, it could not be implemented under field conditions.

Although both fungi were effective against their target insect, one had proven to be too effective (killing another insect as well) while the other was ineffective under environmental conditions. These examples show the importance of thorough research and experimentation under both laboratory and field conditions before a biocontrol agent may be put to use.

Factors when considering potential biocontrol agents

Temperature, water availability and exposure to UV light have great effects on the viability, germinability and growth of fungi, and are thus important considerations in biocontrol efficacy (Hallsworth & Magan, 1999). This is because fungal spores used for biocontrol need to be able to survive and germinate under the conditions of their intended use. As such, the correct fungus needs to be selected based on the environmental conditions that it will face.

For this reason, protectants such as oil can be added to the spores in order to help the fungus to survive the elements (Inglis, Goettel, & Johnson, 1995). An additional benefit of using oil is that it helps fungal spores to stick to insects, and allows the spores to be kept for longer in storage (Prior et al., 1988). This may be due to the anti-desiccating effect that oil has, forming a layer on the spores and allowing them to stay viable for longer periods of time. Alternatively, it may be that a layer of oil reduces the nutrient leakage rate from the spores, allowing them to survive for longer by reducing nutrient loss over time.

Research has also shown that some fungi naturally display key characteristics required in biocontrol agents. The fungi *B. bassiana*

and *I. fumosorosea* were observed to be able to control whitefly populations even at low relative humidities (Wraight et al., 2000). This shows that some fungi are able to resist desiccation, making them ideal biocontrol agent candidates.

Selective pressure from biocontrol

Where parasitism is concerned, selective pressure and evolution comes strongly into play. It is widely accepted that parasites exert huge amounts of evolutionary pressure upon their host, forcing them to come up with new defences in order to survive (Gullan & Cranston, 2010). More often than not, the evolution of parasite and host strategies are described as an arms race that nobody ever wins (Gullan & Cranston, 2010): The parasite first develops the ability to attack the host, after which the host evolves a mechanism to stop the parasite. The parasite then advances by producing a new method to overcome the host mechanism in order to continue parasitising the host, and so on and so forth.

An alternative model proposed is the Red Queen Hypothesis, where both host and parasite evolve at the exact same time, producing new defence mechanisms and virulence systems simultaneously (Gullan & Cranston, 2010). This results in the continuous creation of both defensive and virulent abilities, and neither host nor parasite triumphs over the other for long.

Regardless which theory is correct, the result is the same: Only the successful parasites, and the hosts able to fend off these parasites, are able to survive. Consequently, it has been put forward that the host insect is able to selectively favour particular genotypes of parasites and vice versa (Maurer, Couteaudier, Girard, Bridge, & Riba, 1997). The impact that hosts have on parasites are not without significant effect. In a genetic study of fungal species, it was found that the nutrients and signals necessary for successful germination were more closely linked by the species of parasitised host than by the genetic similarity between the parasites themselves (St. Leger et al., 1992).

Hence, although biocontrol using parasites may appear to be more favourable than current chemical-based methods of controlling pest populations, it is important to remember that it is not impossible for nature to introduce a mechanism to control a parasite if the selective

pressure on the host is strong enough (Deacon, 2006). If a parasite proves to be too successful, a new predator or parasite may prey upon the original (or primary) parasite. This secondary parasitism has been known to occur widely among insects and is unlikely to be restricted to the insect kingdom (Gullan & Cranston, 2010).

Zombies as a traditional medicine

Another way that people have found to make money from these fungi is to market and sell them as a medical “herb”. In the Far East, *Ophiocordyceps sinensis* is famous among traditional medicine enthusiasts and is said to possess a wide variety of health benefits (Buenz et al., 2005). Commonly known outside of the scientific community simply as “Cordyceps”, *O. sinensis* is a moth larvae parasite naturally found at high altitudes in southwest China (Buenz et al., 2005; Kinjo & Zang, 2001; Liu et al., 2006). Similar to other *Ophiocordyceps* species, after killing the host, the fungus grows and emerges from the host body underground to form a perithecial stroma on the soil surface after overwintering (Buenz et al., 2005). The sporangium, with or without the host, is treated as a traditional medical herb.

Consumption of the parasite is believed to have health benefits. There is evidence that molecules in *O. sinensis* is able to regulate apoptosis by down-regulating apoptosis-related genes or scavenging reactive oxygen species,

postponing death after total body irradiation (Buenz et al., 2005; Liu et al., 2006). Also, the molecule cordycepin found in “Cordyceps” is believed to influence the immune system. Similar to adenosine, cordycepin supposedly prevents RNA elongation when incorporated, inhibiting protein synthesis and giving it a possible anticancer property (Khan, Tania, Zhang, & Chen, 2010). As such, the demand of *O. sinensis* as a rare and very expensive traditional herb has even led to some scientists investigating and attempting hybridisation of members of the *Cordyceps* clade in order to obtain a higher quality product (Holliday, Cleaver, Loomis-Powers, & Patel, 2004).

Concluding remarks

In conclusion, there are many different entomopathogenic fungi in the wild today. Some have been studied for their ability to parasitise and kill insect pests, while others are valued for their perceived medicinal value. As such, there has been much work done to further investigate in an attempt to improve the virulence and efficacy that these parasites have on their hosts. However, it may be equally important to study the possible side effects of continuous pressure upon the parasitised host over multiple generations. It would be most unwise to create a new problem while attempting to solve an old one.

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Photo:Henriette Wathne Gelink

Negative attitudes prevent effective African wild dog conservation

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Abstract: African wild dogs (*Lycaon pictus*) are one of the most vulnerable carnivores found in small fragmented populations in sub-Saharan Africa. Human-wild dog conflicts have led to increased snaring, poaching and poisoning in rural communities, which consequently have reduced the wild dog population. The objective of this paper is to investigate the human-wild dog conflict by reviewing negative attitudes toward wild dogs and different alternatives to conflict mitigation. The situation with wild dogs parallels that of human-wolf conflicts in Norway, where rural communities regard wolves as livestock killers, although studies suggest that other carnivores kill more livestock. However, as with the human-wolf conflict, negative attitudes toward wild dogs could be a consequence of suppression and exclusion from the conservation process by central powers. The wolf case addresses the need for including social dimensions, and effective wild dog conservation should therefore focus on mitigating human-wild dog conflicts. This can be achieved through increased public involvement and participation, and ensure that conservation benefits rural communities.

Large carnivores are found in low population densities, and are often restricted to protected areas, because they depend on high quality habitats that frequently trigger conflict with humans over livestock (S. Creel & N. M. Creel, 2002). Human population growth and natural resource exploitation challenge carnivore habitat requirements, and large carnivores are therefore one of the most difficult species groups to conserve (Mech, 1995). Large African carnivores are often confined to fragmented protected habitats, and African wild dogs are today only found in small populations in sub-Saharan Africa (S. Creel, 2001; S. Creel & N. M. Creel, 2002). The African wild dog population consists of less than 6000 individuals and is listed on the IUCN Red list (Woodroffe et al., 2007). The

wild dog population has gone extinct in 25 of 39 sub-Saharan countries and is one of the most endangered carnivores in the world (Woodroffe, Thirgood, & Rabinowitz, 2005b; Woodroffe et al., 2007).

Wild dogs live in packs and follow prey over large distances until the prey stops due to exhaustion (Courchamp & Macdonald, 2001). Because of this hunting technique, wild dogs have one of the highest hunting success rates of large African predators (Hayward, Brien, Hofmeyr, & Kerley, 2006). However, interspecific competition with other carnivores, for instance hyenas stealing wild dog kills and lions killing wild dog pups, have a significant local impact on wild dog populations and forces wild dog packs to use areas beyond the boundaries of protected

areas (S. Creel & N. M. Creel, 1996; S. Creel, 2001; Woodroffe, 2011). Moreover, such areas are often within close proximity to humans.

Consequently, natural resource extractions and a growing human population have significantly fragmented both the historical wild dog range and population (Fuller et al., 1992; Inskip & Zimmermann, 2009; Manfredo, 2008; Woodroffe et al., 2005b). Kathleen A. Alexander and Max J. Appel (1994) argue that human population growth also increases the contact between wild- and domestic animals. The disease transmission is thus likely to escalate because the human population continue to grow and habitats become more fragmented. Wild dog populations with home ranges that exceed protected areas often have high mortality rates due to diseases transmitted from domestic dogs (Alexander & Appel, 1994; Woodroffe et al., 2007; Vial, Cleaveland, Rasmussen, & Haydon, 2006). Additionally, large carnivores generally have large home ranges and high-protein diets, and often compete directly with humans over food and space (Treves & Karanth, 2003).

Carnivores have often been portrayed as vermin and livestock killers, which have made them subjects to bounty hunting (Treves & Karanth, 2003). Poisoning, snaring and poaching are frequently related to human-wildlife conflicts and detrimental to the carnivore population (Davies & Du Toit, 2004). Human-wildlife conflicts are often related to livestock depredation, such as with wolves *Canis lupus* and brown bears *Ursus arctos* in Norway and pumas *Puma concolor* in Brazil (Mwakatobe, Nyahongo, & Røskoft, 2013; Swenson & Andrén, 2005; Zedrosser, Dahle, Swenson, & Gerstl, 2001; Palmeira, Crawshaw Jr, Haddad, Ferraz, & Verdade, 2008). As wild dogs often occupy areas dominated by livestock practices, both human-wild dog encounters and conflicts increase, which often leads to population decline and challenge the conservation of wild dogs (S. Creel & N. M. Creel, 2002; Mwakatobe et al., 2013; Treves & Karanth, 2003). Rosie Woodroffe (2000) reports that wild dog conservation will be in vain if human-wild dog conflicts are ignored.

Understanding human-wild dog conflicts

are therefore essential to wild dog conservation and persistence (Holmern & Røskoft, 2013; Newmark, Manyanza, Gamassa, & Sariko, 1994). The objective of this article is therefore to investigate why local communities have negative attitudes toward wild dogs and how wild dog conservation can reduce these negative attitudes. The human-wild dog conflict show several parallels to the human-wolf conflict in Norway, and the case of Norway is therefore used to highlight the social dimensions of what might cause unfavourable perceptions of wild dogs in Sub-Saharan Africa.

Negative attitudes toward wild dogs and management

Negative attitudes toward wild dogs have led to increased human-wild dog conflicts, which have resulted in poaching, poisoning, snaring and local resistance to management, ultimately contributing to a decline in the wild dog population (Davies & Du Toit, 2004). Harriet T. Davies and Joham T. Du Toit (2004) further report that 80% of the rural community adjacent to a protected area in Zimbabwe felt negatively toward wild dogs because they considered them competitors, as wild dogs and humans compete over the same declining game species. Furthermore, the rural communities also argued that wild dogs kill their livestock and that their children are unsafe in the presence of wild dogs.

The study clearly suggests that rural communities often feel that they pay a high cost for conserving wild dogs, in terms of the economic costs related to livestock depredation and the loss of game species (Davies & Du Toit, 2004). In the same study, local farmers in Zimbabwe express that the District Council both control the law enforcement and receive all direct benefits related to protected areas. The local communities further argue that the conservation of wildlife, including wild dogs, provide few community benefits (Davies & Du Toit, 2004). Local rebellion, such as poisoning, poaching and snaring of wild dogs could be the people's "voice of disapproval" to conservation exclusion, as have been the case of local communities' resistance to elephants in South Africa (Kideghesho, 2010).

Negative attitudes to wild dogs, local resistance and disapproval of management in Zimbabwe harms wild dog conservation as they prevent successful reintroduction, translocation and natural recovery (Treves & Karanth, 2003). Although the causes to negative attitudes toward wild dogs lack research, it becomes clear by reviewing the literature available that wild dog population decline has a social dimension. Local beneficial mitigation initiatives could be implemented, which could reduce negative attitudes toward wild dogs, especially the perception of wild dogs as livestock killers.

Livestock depredation by wild dogs

Wild dog packs are organized and successful hunters, they have the ability to hunt large prey, and they are often considered livestock killers. However, studies reveal that the spotted hyena *Crocuta crocuta* in Serengeti National Park in Tanzania accounts for more than 98% of the livestock losses adjacent the park (Holmern et al., 2007). In addition, wild cats *Felis lybica* and lions *Panthera leo* are responsible for most livestock losses in Zimbabwe (Davies & Du Toit, 2004). Lions are considered the biggest threat because they take the most valuable livestock. Moreover, baboons *Papio*, leopards *Panthera pardus*, spotted hyenas, crocodiles *Crocodilus niloticus*, snakes ssp. *Serpentes*, eagles fam. *Accipitridae*, honey badgers *Mellivora capensis* and jackals *Canis adustus* kill more livestock than wild dogs. Davies & Du Toit (2004) report that wild dogs are responsible for less than 2% of livestock predation in Zimbabwe.

Studies done in Kenya suggest that wild dogs noticeably prefer wild prey when available (Woodroffe, Lindsey, Romanach, & Stein, 2005a). If possible, they therefore avoid livestock areas such as open land, bomas, rangeland and human dominated areas where farmers practice traditional husbandry. (Woodroffe, 2011). In fact, Greg Rasmussen (1999) reports that livestock depredation in general is minimal compared to threats such as livestock swallowing foreign objects, diseases, rustling and livestock poaching. He argues therefore, that it is more economically viable to focus on livestock vaccination, herding

and management instead of wild dog control.

In addition, people with negative attitudes toward carnivores also tend to overestimate the number of livestock lost to carnivores (Holmern et al., 2007). This suggests that negative attitudes toward wild dogs can alter how people understand the threat that wild dogs pose to livestock. Little research has been conducted on local perceptions of wild dogs, although the literature reviewed clearly indicates that people living with wild dogs often think of them as livestock killers. However, the studies reviewed also suggest that livestock predation by wild dogs is insignificant. Most of the livestock killed in Sub-Saharan Africa is killed by spotted hyenas and lions, or dies from other causes (Alexander & Appel, 1994; S. Creel & N. M. Creel, 2002; Davies & Du Toit, 2004; L. H. Frame, Malcolm, G. W. Frame, & Lawick., 1979; Holmern et al., 2007; Mwakatobe et al., 2013; Rasmussen, 1999). This means that although wild dogs are not responsible for killing significant numbers of livestock, local people still maintain negative attitudes toward wild dogs.

Human-wolf conflicts in Norway

The case of human-wolf conflicts in Norway parallels that of African wild dogs and can help to explain the negative attitudes of communities in contact with these populations. Similar to wild dogs, wolves travel over large distances and are accused of killing livestock. For the past 200 years, wolves and other large carnivores have been hunted down to local extinction in Norway and, the absence of carnivores has enabled farmers to practice free ranging and unprotected husbandry. Norway is currently one of the few countries that still maintain this practice (Swenson & Andrén, 2005).

Because of a large carnivore recovery in Norway, unprotected free ranging livestock become more susceptible to carnivore attacks. However, out of 2 million summer grazing sheep, the Norwegian Environment Agency reports that an average of 125 000 sheep are lost during the summer grazing season and only 30% are compensated as carnivore kills (Eksperutvalget, 2011). Moreover, carcass finding only documents

a small proportion of the compensated sheep and, the Norwegian Environment Agency states that most sheep die due to injuries or diseases. This means that although unprotected free ranging livestock are more prone to carnivore attack, that more sheep die from non-carnivore related causes and, that wolf depredation is less significant than injuries and diseases in terms of economic loss amongst farmers.

Although wolf depredation can lead to economic loss amongst some livestock farmers, several studies suggest that social dimensions are more important in terms of why people are negative to wolves (Skogen, 2010; Skogen, Krange, & Figari, 2013). Rural communities in Norway often have a use-related perception of nature and have more negative attitudes toward wolves than people have in urban areas who mostly use nature for recreation (Skogen, 2001; Skogen, Mauz, & Krange, 2008). The rural population therefore more often regard wolves as threats to husbandry practices and their use of nature, while wolf recolonization is much more accepted amongst urban people (Skogen et al., 2008). The wolf has therefore become a symbol of urban power over rural value, practice and lifestyle, which has increased negative attitudes, rural resistance and rebellion toward wolves. Consequently effective wolf conservation has been delayed (M. N. Peterson, Birkhead, Leong, M. J. Peterson, & T. R. Peterson, 2010; Skogen et al., 2013).

The case of human-wolf conflicts in Norway illustrates that negative attitudes toward wolves have social dimensions. In addition, the wolf-case further highlights the need to study social dimensions of human-wildlife conflicts. Relative to the case of Norway, wild dog conservation could benefit from an increased focus on social dimensions as means to reduce negative attitudes toward wild dogs and ease human-wild dog conflicts. Social initiatives to reduce negative attitudes toward wild dogs could include increased community involvement and create more local benefits such as ecotourism and education.

Community involvement

Conservation initiatives have often been accused of causing poverty by not including local communities in the conservation process and this has led to negative attitudes and resistance among rural communities towards conservation (Kideghesho, 2010). Most people living near wild dogs are poor and rely on natural resources to survive. As a result, wild dog conservation has to address the need to reduce rural poverty and increase conservation support amongst locals (Kaimowitz & Sheil, 2007). To alleviate poverty, reduce local resistance to conservation and increase effective wild dog conservation, rural communities have to be included throughout the decision-making process, participate in community conservation initiatives and receive education about wild dogs (Rasmussen, 1999). Community involvement can benefit both decision-makers and rural communities through monitoring and education, respectively. Formal education has been proved effective for reducing negative attitudes toward other large carnivores and, could therefore reduce negative attitudes toward wild dogs (Holmern et al., 2007; Lindsey, Du Toit, & Mills, 2005b). Ultimately, investment in both natural- and social sciences can help decision-makers to understand negative attitudes toward wild dogs, local resistance and rural disapproval of management practices. This could possibly lead to a more effective wild dog conservation (Treves & Karanth, 2003).

Ecotourism

Local communities often argue that conservation rarely benefit the people living within close proximity to wildlife (Davies & Du Toit, 2004). Ecotourism could address this concern, as it has the potential to provide local communities with both revenue and alternative job opportunities (de Kock, 2010; Lindsey, Alexander, Du Toit, & Mills, 2005a; Reynolds & Braithwaite, 2001). Lindsey et al. (2005a) argue that wild dog conservation will not succeed before landowners receive economic incentives. They therefore suggest that ecotourism could provide economic benefits to both landowners and local communities, and increase local landowner

acceptance of wild dogs on their property. Ecotourism operators are required to support conservation and local cultures, and provide tourists with education (Reynolds & Braithwaite, 2001). Wild dog ecotourism therefore has the potential to benefit wild dog conservation, landowners and the local communities.

Interviews conducted in South Africa reveal that tourists regard wild dogs as top attractions, which means that tourists are willing to pay for wild dog ecotourism activities and that wild dog reintroductions could have both an economic and biological impact (Gusset et al., 2008). The annual income generated by general ecotourism in South Africa is estimated to be \$14 000 to \$66 000, depending on the park reputation, whereas the annual costs of a wild dog ecotourism operation is estimated to less than \$5 000 (Lindsey et al., 2005a). Community involvement and wild dog ecotourism could therefore improve local livelihoods through benefit sharing and local job opportunities. This could generate considerable revenue toward wild dog conservation, finance reintroductions and offsetting depredation costs (de Kock, 2010).

Active wild dog management and conservation

The current protected areas in Sub Sahara Africa are too small to sustain feasible populations of carnivores (Woodroffe et al., 2007; Holmern et al., 2007). Wild dog populations, whose home ranges exceed protected areas, often have higher mortality rates due to human-wild dog conflicts and diseases transmitted from domestic dogs (Alexander & Appel, 1994; Woodroffe et al., 2007). Interspecific competition with other carnivores favour lions and hyenas, which means that wild dog conservation is more successful in areas with moderate lion- and hyena presence (S. Creel & N. M. Creel, 1996; S. Creel, 2001). Wild dog conservation, as a result, should focus on management initiatives that allow wild dogs to thrive outside protected areas. Livestock depredation by lions and hyenas is much larger than depredation by wild dogs, implying that it is more economically viable to focus predator control on other carnivores than wild dogs (Woodroffe et al., 2005a).

Additionally, livestock vaccination, herders and possibly guard dogs could improve protection against depredation and diseases (Dickman, 2009; (Hansen, Staaland, & Ringsø, 2002). John A. Vucetich and Scott Creel (1999) argue that successful wild dog conservation has to involve active management in order to reduce interspecific competition, maintain migration between packs, ensure sustainable packs, prevent disease, and minimize human-wildlife conflicts. By ensuring migration between populations, active management could significantly reduce the risk of wild dog extinction within the next 100 years (S. Creel & N. M. Creel, 2002).

It is, however unlikely that protected areas will be set aside solely for wild dogs. Human-wild dog conflicts are therefore likely to occur, as wild dogs will continue to use areas in close proximity to people who see them as threats. Large carnivores can persist in human dominated areas as long as people allow them to. Linnell (2001) and Woodroffe et al. (2007) has confirmed that wild dogs can successfully thrive in areas with high human density. This suggests that effective conservation of wild dogs will benefit from an increased focus on social dimensions. The problem of reducing human-wild dog conflicts demand a multifaceted approach that increases understanding of negative attitudes toward wild dogs and boosts management support within the local communities (Treves & Karanth, 2003).

In conclusion, wild dog conservation should enable wild dog populations to persist in human dominated areas by investigating and focusing on the social dimensions of the problem and working to change negative attitudes. This could be achieved through community involvement and providing ecotourism opportunities and education, which enable people, livestock and wild dogs to coexist.

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Photo: Hanna Kavli Lodberg-Holm

Letter

Comparing organic and conventionally produced milk in terms of potential heart health benefits

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Studies show that the fatty acid (FA) composition of organic milk differs from that of conventional milk (Adler, Jensen, Govasmark, & Steinshamn, 2013; Butler et al., 2008; Ellis et al., 2006). Of particular interest is the amount of omega-3 FAs and the content of conjugated linoleic acid (CLA), which are believed to improve health in general and heart health specifically (Haug, Hostmark, & Harstad, 2007; Thorsdottir, Hill, & Ramel, 2004). The concentration of omega-6 FAs in milk varies, and it should ideally be no more than twice the amount of omega-3 FAs in order to prevent potentially negative health effects (Benbrook, Butler, Latif, Leifert, & Davis, 2013). This article will review two studies comparing organic and conventional milk production in terms of FA composition and determine whether choosing organic over conventional milk has a positive effect on heart health.

Ellis et al. (2006) investigated the effects of farming systems on FA composition between organic and conventional farms in the United Kingdom. They found no difference in the average amount of omega-6 FA or CLA; however, the average content of polyunsaturated FAs was 16% higher in organic milk. The beneficial omega-3 FA linoleic acid constituted 1.11% of

total milk fat for organic farms, compared with 0.66% of total milk fat for conventional farms. Ellis et al. (2006) found an omega-6:omega-3 ratio between 1.27 and 1.9 for organic milk, and a ratio between 1.99 and 3.66 for conventional milk. This indicates a benefit from choosing organic over conventional milk, remembering that high omega-3 content, and a low omega-6:omega-3 ratio is regarded as beneficial.

A similar comparison of milk fat composition between the two farming systems was recently performed in Norway (Adler et al., 2013). Milk was sampled from 14 organic and 14 conventional farms every second month for two years. Adler et al. (2013) also reported a higher content of the beneficial linoleic acid. The omega-6:omega-3 ratio was on average 2 for organic milk, and 3 for conventional milk, confirming the results and potential benefit indicated by Ellis et al. (2006). However, in this experiment organic milk contained on average 4% more saturated fat than conventional milk (p -value < 0.001), something Ellis et al. (2006) did not show.

The differences in FA composition reported here are likely due to the use of different feeding regimes between the two farming systems.

Cows from organic farms eat more clover than on conventional farms, which in turn increases the omega-3 concentrations of the milk (Adler et al., 2013). Adler et al. also showed 4% higher saturated FA content for organic than for conventional milk. The authors suggest that higher saturated fat content for organic milk may result from the fact that cows on organic farms eat less feed overall compared to cows from conventional farms. This behaviour of underfeeding can increase synthesis of saturated fats in the udder compared to the transfer of unsaturated fats from feed to milk (Palmquist, Beaulieu, & Barbano, 1993). However, two other studies reported no difference in total saturated fat content between the two farming systems (Collomb et al., 2008; Ellis et al., 2006).

While saturated fat has traditionally been linked to high cholesterol and risk of heart disease (Hu et al., 1999), recent reviews do not support this claim, making the relationship between milk and heart health a controversial one (Haug et al., 2007; Prentice, 2014). When assessing the risk, the type of saturated fat matters. The saturated FAs found in milk are either long, medium, or short chained based on the number of carbon atoms in their molecular structure. The short and

medium chained FAs constitute about 40% of the total saturated fat in milk and evidence actually links them to neutral or positive effects on heart health (Haug et al., 2007). Given the unclear link between heart disease and saturated fat and the diverse composition of the FAs found in milk, it is less probable that the higher amounts found in organic milk actually have adverse effects on heart health, something Adler et al. (2013) in the Norwegian study also suggest.

To summarize, the FA composition of milk from the two farming systems are quite similar in general, but both studies showed higher concentrations of the healthy linoleic acid and lower ratios for omega-6:omega-3 FA for organic milk, which are regarded as beneficial. Recent evidence does not support the idea that the 4% higher concentration of saturated fat in organic milk is detrimental to heart health. In conclusion, organic milk has a higher portion of FAs linked to a healthy diet and might be recommended over conventional milk based on the reported evidence. Still, in order to determine how drinking organic milk relates to heart disease, a double blind intervention study comparing organic and conventional milk should be designed.

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Photo: Henriette Wathne Gelink

Hvordan hantavirus smitter mennesker og hvilke sykdommer det gir

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Abstrakt: Infeksjoner hos mennesker med forskjellige sub-typer av hantavirus kan gi alt fra mild sykdom til alvorlige skader på nyre, blodkar og lunger, og også død. Utbredelsen av hantavirus er såpass vid at det er viktig å være klar over risikoen man utsetter seg for ved å håndtere gnagere og gnager-kontaminerte produkter. I Norge er dette en forholdsvis ukjent virusinfeksjon, selv om den er alvorlig, og det årlig rapporteres mellom tjue og åtti tilfeller. Det er grunn til å tro at dette er en underrapportert sykdom. I utlandet finnes det subtyper av Hantavirus som gir svært alvorlig sykdom hos mennesker, og med dagens turisme og trend for å besøke nye eksotiske land er det viktig å ha kjennskap til dette viruset.

Hantavirus tilhører virusfamilien *Bunyaviridae* og har sitt hovedreservoar i ville gnagere. Viruset forårsaker sykdom som smitter mellom dyr og mennesker og betegnes derfor som en zoonotisk sykdom. Gnagere blir vanligvis ikke syke av viruset, men mennesker som blir smittet kan utvikle nyresykdom, og i sjeldne tilfeller nevrologiske symptomer. Det finnes flere ulike varianter av viruset i forskjellige deler av verden, som gir ulike symptomer (Blystad, 2010). Det skilles mellom Old World Hantavirus (OWH) og New World Hantavirus (NWH), der OWH-subfamilien forårsaker blødningsfeber med nyresyndrom (Hemorrhagic Fever with Renal Syndrome (heretter omtalt som HFRS)) og epidemisk nyrebetennelse (*Nephropathia epidemica* (heretter omtalt som NE)) hos mennesker, mens NWH-subfamilien forårsaker lungesyndrom (Hantavirus Pulmonary Syndrome (heretter omtalt som HPS)) hos

mennesker. Sykdommene samlet blir ofte kalt musepest fordi det hovedsakelig er mus som smitter mennesker. I denne artikkelen vil vi se på hvor vanlig hantavirusinfeksjon er hos rotte og mus i Norge og resten av verden, hvilke sykdommer den gir, og hvor stor risiko det er for mennesker å bli smittet av sykdommen. Med risiko menes sannsynligheten for å bli smittet, samt konsekvensene av å bli smittet.

Bakgrunn

Som andre virus i *Bunyaviridae*-familien er hantavirus kappekledd, omtrent 129 nm i diameter, og med et enkelttrådet RNA-arvemateriale som er delt i 3 segmenter; small (S), medium (M) og large (L). L-segmentet koder for RNA-polymerase som setter i gang kopiering av arvemateriale. M-segmentet koder for to glykoproteiner som sitter i virusets yttervegg/kappe. S-segmentet koder for nucleokapsid-

proteinet som danner arvematerialet. Noen hantavirus har også et nonstrukturelt protein, som kan fungere som en svak interferon-inhibitor, det vil si den kan hemme immunforsvaret i verten (Mustone et al., 2013).

Infeksjon med hantavirus hos mennesker ble første gang beskrevet i 1951, da FN-tropper var utstasjonert i Korea under borgerkrigen. Sykdommen som da ble identifisert kalles i dag blødningsfeber med nyresyndrom (HFRS). Tjuefem år senere fant man ut at reservoaret for viruset var gnagerarten *Apodemus agrarius* (brannmus), og man klarte å isolere viruset som fikk navnet hantavirus, etter elven Hantaan i Korea. Senere fant man tilfeller av lignende sykdommer i urbane områder i Korea, Kina og Japan. Disse var forårsaket av seoulviruset med vertene svartrotte (*Rattus rattus*) og brunrotte (*R. norvegicus*) (Knipe et al., 2006). I deler av Skandinavia så finner man også tilfeller av sykdommen NE, og etter isoleringen av hantavirus, fant man at viruset som forårsaket NE tilhørte samme genus, og at det hadde klatremus (*Clethrionomys glareolus*) som vert. Man kalte det skandinaviske viruset for puumalavirus (Knipe et al., 2006).

Etterhvert isolerte man flere virus fra samme familie, her nevnes henholdsvis virusnavn og vert: thottapalayamvirus hos spissmus (*Suncus murinus*) i India, og dobravavirus hos storskogmus (*Apodemus flavicollis*) (Knipe et al., 2006). I 1993 så man at hantavirus forårsaket lungesykdom, kalt HPS, i sørvestlige deler av USA. Etter få uker, ble viruset kategorisert som *sin nombre*-virus, som er spansk for «uten navn», og verten viste seg å være gnageren hjortemus (*Peromyscus maniculatus*). I senere år har man påvist at lungesyndrom forekommer over store deler av det amerikanske kontinentet, forårsaket av ti ulike typer hantavirus, som hver har en egen gnagerart som reservoar (Knipe et al., 2006).

Epidemiologi og økologi

Den geografiske distribusjonen til ulike hantavirus har sammenheng med hvor gnagerverten lever. Hantavirus bæres av musen *A. a. mantchuricus*, som er vanlig på jorder i landbruksområder. Folk som bor i disse områdene er særlig utsatt for smitte. Her ser man økt forekomst av HFRS om høsten, noe som sannsynligvis skyldes høsting

av korn, kombinert med at mus vil søke mot hus etterhvert som det blir kaldere (Knipe et al., 2006). Seoulvirus forekommer over hele verden fordi svartrottene og brunrottene har blitt spredd til ulike kontinenter gjennom den internasjonale shipping-industrien. Seoulvirus er det eneste som forårsaker sykdom i urbane områder, siden andre hantavirus bæres av gnagere som trives best i landlige områder. Viruset er mest vanlig i Kina og Korea, hvor det forårsaker HFRS, og gir sykdom hovedsakelig om våren og sommeren (Knipe et al., 2006).

Storskogmus, som er verten for dobravavirus, finnes det mye av på Balkan-halvøya. Den går i liten grad inn i eller oppholder seg ved hus, men finnes ofte på rasteplasser eller andre steder der folk kaster mat. De fleste tilfeller av HFRS forårsaket av dette viruset forekommer i landlige områder der folk jobber og oppholder seg ute, der de er utsatt for smitte. Viruset gir vanligvis sykdom hos mennesker om sommeren, og epidemier har forekommet i perioder med spesielt mange gnagere (Knipe et al., 2006). Saaremaavirus er en variant av dobravavirus og bæres av Gulnakkemus (*A. flavicollis*) som lever i nordligere deler av verden. NE forårsaket av puumalavirus finnes i hele Skandinavia og i Europa vest for Uralfjellene (Knipe et al., 2006).

Siden oppdagelsen av sin nombre-virus (SNV) som den mest sannsynlige årsaken for HPS i 1993 (CDC, 2012), har viruset spredd seg med hjortemus til store deler av Nord-Amerika og Canada, og gitt sykdom hos mennesker der. I en undersøkelse av 2500 personer i risikogrupper i disse områdene fant man bare hantavirus-spesifikt antistoff hos 0,5 % (Knipe et al., 2006). Dette tilsier at infeksjon med SNV hos mennesker er sjeldent. Økt antall tilfeller kan sees når hjortemuspopulasjonen er spesielt stor, særlig om sommeren (Knipe et al., 2006). I østlige deler av USA finnes det ulike SNV hos forskjellige gnagere som gir HPS hos mennesker. Det finnes også flere virus som forårsaker HPS i Sør-Amerika. Seroprevalensen for antistoff, det vil si mengden antistoff i blodet, mot hantavirus her har vist seg å være høyere enn i Nord-Amerika, noe som indikerer at folk i Sør-Amerika er mer utsatt for smitte, og har høyere andel av sub-kliniske infeksjoner (Knipe et al., 2006).

Forekomst av hantavirus i dag

Infeksjoner med hantavirus er et økende helseproblem, og mer enn 30 000 mennesker blir affisert på verdensbasis årlig (Watson et al., 2013). Forskjellige virusstammer er påvist rundt om i verden, med ulike verter og påfølgende sykdomsbilder. I Amerika er den vanligste hantavirus-sykdommen HPS, mens HFRS er den vanligste i Europa og Asia (Vaheiri et al., 2012).

Puumalavirus er ansvarlig for de fleste tilfeller av HFRS i Europa. Finland har flest diagnostiserte pasienter per år, mens Sverige, Belgia, Frankrike og Tyskland kommer like etter. Andre affiserte land inkluderer blant annet Russland, Norge og Balkan (Jonsson Figueiredo, & Vapalahti, 2010; Vaheiri et al., 2012). I Norge var det et stort utbrudd i 1998 hvor 197 mennesker ble registrert i Meldingssystem for smittsomme sykdommen (MSIS) sitt varslingsystem med diagnosen NE (FHI, 2014). Etter dette har antall registrerte tilfeller fram til og med 2013 ligget mellom 20 og 80 (FHI, 2014).

Selv om HFRS sjeldent blir påvist i land som Estland, Latvia, Ungarn og Hellas, er seroprevalensen, andelen av mennesker med antistoffer i blodet mot viruset, allikevel høy i disse landene (Vaheiri et al., 2012). Dette kan bety at hantavirus er underdiagnostisert, og antallet tilfeller i Europa kan være mye høyere enn tidligere antatt. Smitte forekommer i områder hvor viruset er endemisk tilstede i gnagerpopulasjonen. I Nord-Europa ser man en topp i virusforekomst hos mennesker i august, november og desember (Jonsson et al., 2010). En mulig årsak til dette er at mennesker drar ut i naturen i sommermånedene og kommer i kontakt med gangere eller deres ekskrementer, og at gnagerne trekker inn mot låver og hus for ly og føde om vinteren. I Tyskland sees infeksjonstopp kun om sommeren, mens Kina har en topp i vintermånedene.

Epidemiologiske studier utført i Kina tyder også på at virusforekomsten er utpreget høyere hos de som bor i landlige omgivelser eller på utkanten av landsbyer, og hos de som eier katt (Jonsson et al., 2010). Seoulvirus er blitt påvist i tamrottepopulasjonen i store deler av verden, men det er usikkert hvor utbredt viruset egentlig er. Det ble påvist hos både tam- og villrotter i Storbritannia første gang i 2012, og året etter hos en tamrotte i Sverige (Taori et al., 2013;

Lundkvist, 2013). Viruset er fremdeles ikke påvist av Veterinærinstituttet i Norge (Heier & Lund, 2013).

Hantavirusinfeksjon hos mennesker

Overføring av viruspartikler fra infiserte mennesker til mennesker som ikke er infiserte skjer normalt ikke, men det finnes unntak. HFRS og HPS er delvis overlappende kliniske syndromer; mens NE, forårsaket av hantavirus serotype puumala, er en mildere variant av HFRS. Viremi, når viruset deler seg og pasienten er smittsom, oppstår etter at viruset har kolonisert forsvarscellene i lungene. De livstruende akutfase-symptomene forårsakes hovedsakelig av infeksjon i gass-væskeutvekslende cellene i lunger og nyrer. Dette resulterer i at cellens poreåpning økes, og cellene klarer dermed ikke å holde på vitale stoffer (Muranyi, Bahr, Zeier, & van der Woude, 2005).

Blødningsfeber med nyresyndrom (HFRS)

Sub-familien OWH forårsaker blødningsfeber med nyresyndrom (HFRS), og det er hantavirus-typene hantaanvirus og dobravavirus som forårsaker de fleste tilfellene (Walsh, 2012). HFRS er egentlig en samlebetegnelse for sykdommer karakterisert av nyreaffeksjoner og blødninger forårsaket av humanpatogene hantavirus. Normalt presenteres den med høy feber, blødninger og nyresvikt, og i sin alvorligste form er den forbundet med betydelig dødelighet.

Syndromet utvikles gjennom fem faser beskrevet av Michael Walsh (2012). HFRS starter ofte med rødme i kinn og nese, feber, frysninger, svette hender, diaré, utilpasshet, hodepine, kvalme, smerter i rygg og mage, respiratoriske problemer som ligner influensa og også gastrointestinale problemer. Disse symptomene opptrer 2 til 3 uker etter eksponering, og varer normalt opptil 1 uke. I løpet av denne tiden synker blodplatene og oksygenet i blodet synker og man får etter hvert økt hjerterefrekvens. Deretter følger nyresvikt og økt behov for vannlating hvor man urinerer 3 til 6 liter urin per dag. I tillegg vil økt utskillelse av proteiner i urinen føre til proteintap. Nyresvikten og det økte behovet for vannlating kan vare i alt fra ett par dager til flere uker før rekonvalensen starter.

Mildere former av sykdommen forekommer,

og affiserte individer trenger ikke vise alle stadier. I alvorlige tilfeller med spesielt hissig varianter av viruset, også kalt høyvirulente stammer, er sykdommen forbundet med høy dødelighet. Blodkarenes dysfunksjon sees som nedsatt kontraksjon og økt porøsitet i blodårene, og er årsaken til at lavt blodtrykk og sjokk kan forekomme, mens de lokale effektene trolig er årsak til utvikling av nyresvikt (Cosgriff, 1991).

Epidemisk nyrebetennelse (NE)

NE er karakterisert av plutselig høy feber, hodepine, ryggsmertor og magesmerter. I den tidlige fasen er det vanlig å finne forbigående reduksjon i blodplatene, som er ansvarlig for koagulering av blodet ved karskader. Det forekommer blødninger i slimhinnen som dekker øyet (konjunktiva), punktformige blødninger og punktformig utslett etter tre til fire dager. Omtrent én prosent av pasientene opplever alvorlige nevrologiske symptomer, som for eksempel kramper eller lammelser av blære. Blødningene er ledsaget av redusert urinproduksjon og unormalt høye andeler proteiner i urinen, samt økt andel av nitrogenholdige urinstoffer i blodet, og blod i urinen. Innen tre dager vil utslettet forsvinne dersom pasienten har hatt dette, og det vil utvikle seg unormalt stor produksjon av tynn urin. Rekonvalesensfasen strekker seg over flere uker og kan i sjeldne tilfeller gi nevrologiske komplikasjoner i form av betennelse i hjerne og hjerneinnene, og kramper (Beers & Berkow, 2005).

Lungesyndrom (HPS)

I motsetning til HFRS, som angriper nyrene spesielt, affiserer HPS hovedsakelig lungene. I innledningsfasen, som varer fra tre til fem dager, er det vanlig med høy feber, hodepine, muskelsmerter, frysninger, oppkast med mer. Pasienten vil deretter utvikle lungeødem, som ikke er forårsaket av hjertet, innen to til femten dager. Sykdommen tar en alvorlig vending når lavt blodtrykk og åndenød opptrer. Hoste og hyperventilasjon utvikles før lungeødem og i blodet vil det være tegn på oksygenmangel (McCoy, 2013). HPS vil i femti prosent av tilfellene være dødelig. Pasienter som overlever den akutte fasen av sykdommen vil komme seg normalt igjen i løpet av fem til sju dager uten

tilbakefall. Dersom akutt nyresvikt oppstår, er dette sekundært som et resultat av sjokk og respiratorisk svikt (Walsh, 2012).

Kontroll

Hovedprinsippet for å forebygge hantavirus-infeksjon er å redusere eksponering for gnagere. Dette innebærer blant annet å bygge gnagersikre hus, korrekt lagring av mat, luften ut i hytter som kun brukes i sesong, samt desinfeksjon og fjerning av døde gnagere og deres avføring. Man tror at immunitet mot hantavirus utvikles på grunn av nøytraliserende antistoffer mot kappeproteinene GN og GC (Knipe et al., 2006). Man har også funnet CD8⁺ T-celler, spesielle immunceller, i prøver fra infiserte mennesker, som trolig også har en betydning for beskyttelse. Man har ingen gode dyremodeller for å forske på immunitet mot hantavirus, ettersom gnagere i de fleste tilfeller ikke blir klinisk syke av viruset (Schmaljohn, 2009).

Det har blitt produsert flere ulike inaktiverede virusvaksiner i Asia, blant annet av hjernevev fra gnagere (Knipe et al., 2006). I Europa har man ikke gjort lignende forsøk på vaksineutvikling, men dersom man skulle produsert en vaksine mot hantavirus, måtte den ha inneholdt både en komponent fra dobravavirus og en fra puumalavirus. Siden det ikke er ønskelig å bruke gnagerhjerter, ville en molekylær vaksine vært mer aktuell her. Selv om HPS er en av de mest patogene virusinfeksjonene sett hos mennesker, er sykdommen sjelden. Fordi det er så få tilfeller av sykdommen bevilges det ikke midler til utvikling av vaksine mot hantavirus i de fleste land. Dette gjør det enda viktigere å redusere antall tilfeller ved reduksjon av gnagereksponeering (Schmaljohn, 2009).

Konklusjon

Betydningen av hantavirus som zoonose varierer veldig mellom ulike deler av verden. Det er ikke det samme viruset som gir sykdom i ulike land, og sykdommene har også varierende alvorlighetsgrad. Det forekommer et økende antall sykdomstilfeller i året, og sykdommen er antakelig også underdiagnostisert. De stedene vi ser smitte på mennesker, er virusene endemisk til stede i gnagerpopulasjonen. Antallet sykdomstilfeller hos mennesker vil dermed også svinge med antall gnagere i området. Dette er grunnen til at vi ser årstidsvariasjoner i sykdomsforekomst.

Hvor mye kontakt menneskene har med gnagere, varierer gjennom sesongen og hvor i landet man bor. Generelt kan vi si at de fleste virustypene har høyere forekomst i landlige områder, og at det dermed er større risiko for å bli smittet her. Det er kun seoulviruset som finnes hos gnagere i urbane områder, og som også er påvist hos tamrotter. Denne virustypen er til nå ikke påvist i Norge.

I Norge finner vi viruset puumalavirus, som gir sykdommen NE. Dette er en noe mildere form enn HFRS, og vi ser sjeldent alvorlige symptomer. Det er betydelig større dødelighet forbundet med HFRS, som man ser i Europa og Asia, og HPS, som er den vanligste formen i Amerika. Det medfører altså større risiko å bli smittet med de virustypene som vi finner andre steder i verden enn i Norge. Det er likevel, per i dag, ikke ansett

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som noen stor risiko å bli smittet av dette viruset i Norge dersom man ikke selv håndterer gnagere eller gnagermøkk. Det er derfor viktig å drive regelmessig gnager-bekjempelse for å holde spredningen minimal. Det er dog likevel viktig å huske at dette er et virus som på verdensbasis regnes som en voksende sykdom (Emerging disease) og står på Centers for Disease Control and Prevention (CDC) sin liste over sykdommer man skal være på vakt for i fremtiden. Man burde fortsettes å forske på viruset og en eventuell vaksine, siden dette er et virus som gir alvorlig sykdom når den først slår til. Tilfeller av sykdom som følge av hantavirus bør også meldes til overordnede kontrollorganer for å kunne følge utviklingen til viruset både her i landet og internasjonalt.

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The climate resilient green economy in Ethiopia: Transformational climate change policies or “business-as-usual” development?

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Abstract: Commentators have proposed that Ethiopia’s Climate Resilient Green Economy Strategy (CRGES) can deliver transformative climate change policies. However, this paper asks whether the strategy might be yet another “business-as-usual” model of development. The strive toward accessing the carbon market results in an unbalanced focus on mitigation initiatives at the expense of local adaptation initiatives. This might have adverse effects on rural stakeholders’ vulnerability to climate change. This paper thus argues that to deliver transformative climate change policies, the CRGES has to challenge the values, interests and power structures that reproduce the “traditional” winners and losers of “business-as-usual” development.

The Ethiopian government launched its Climate Resilient Green Economy Strategy (CRGES) in 2011. The purpose of the strategy is to drive Ethiopia toward middle income status within 2025 in a green, carbon neutral way. At the same time, the CRGES aims to increase climate resilience through adaptating initiatives that will reduce Ethiopia’s vulnerability to climate change (FDRE, 2011b). In this way, the strategy tries to reconcile economic growth with increasing environmental challenges. It integrates economic growth, sustainability and poverty reduction into one political plan, and commentators thus claim that the CRGES is an example of transformative climate change policy (Bass, Wang, Ferede, & Fikreyesus, 2013). However, when taking a closer look at the CRGE strategy, several challenges with its proposed measures appear. Even though the CRGES aims at combining a green economy strategy with climate resilience measures, the strive toward tapping into the carbon market results in an unbalanced focus on mitigation initiatives. This might have adverse effects on

local stakeholders’ vulnerability to climate change. It is thus relevant to ask whether the CRGES delivers transformational climate change policy, or if it represents yet another “business-as-usual” model of development.

This paper will discuss these challenges and the implications they have for the CRGES’s transformation potential. First, the paper presents the structure and advocates of the CRGES. Second, it identifies and discusses some of the strategy’s challenges. In the conclusory remarks, it is argued that to deliver transformative climate change policies, the strategy has to challenge the values, interests and power structures that reproduce the “traditional” winners and losers of “business-as-usual” development.

The CRGE strategy’s structure and advocates

The CRGES consists of three complementary objectives; to foster economic development and growth, ensure abatement and avoidance of future emissions (transition to a green economy) and improve the county’s resilience to climate change (FDRE,



Photo: Siri Hafstad Eggset

2011b). The strategy is further divided into one part comprising a Green Economy Strategy (GES) and the other part comprising a Climate-Resilience Strategy (CRS). The GES has been outlined in official federal documents and has already received appraisals and critique from independent organizations reviewing the strategy (FDRE, 2011a, 2011b). The CRS is still under development and has not been launched. There is thus limited information to retrieve about this aspect of the CRGES, which will be discussed later.

The CRGES is a comprehensive, expensive and ambitious strategy, and it thus needs vocal and influential advocates to acquire the necessary support from national ministries and international governments and institutions. Meles Zenawi, who was Prime Minister when the CRGES was launched, viewed the strategy as a way to tap into the emerging carbon market (Jones & Carabine, 2013). With his central position in UNFCCC, Zenawi was well situated to gather international support as he promoted the new CRGES to the international community. The strong drive from the Office of the Prime Minister (OPM) and the Prime Minister himself was thus crucial to get the necessary involvement from governmental and independent institutions within Ethiopia and abroad (Jones & Carabine, 2013). Moreover, by integrating the goals and measures of the Growth and Transformation Plan into the strategy, the OPM managed to involve ministries such as the Ministry of Finance and Economic Development (MoFED) that would otherwise be reluctant to support such an expensive and ambitious strategy (Jones & Carabine, 2013).

Instead of creating one separate institution that would work exclusively with the CRGES, the OPM formed an CRGES inter-ministerial committee. The Ethiopian Environment Council is in charge, MoFED manages the financial aspects of the strategy and the Environmental Protection Authority handles its technical aspects (Bass et al., 2013).

The CRGE strategy's challenges and shortcomings

The Ethiopian government separated the green economy and the climate resilience strategies within the CRGES. This may have implications for its effectiveness, because combining different strategies is essential when developing transformative policies (Mitchell & Maxwell, 2010). Furthermore, separating the GES and CRS removes the oppor-

tunity to take advantage of potential overlaps between the two strategies (Jones & Carabine, 2013).

The government's decision to separate the two aspects of the CRGES has furthermore resulted in unequal attention between the two. Whereas several documents outline the GES, there are currently no official documents published that outline the CRS (FDRE, 2011a; 2011b). This paper proposes two explanations for why there is a stronger focus on the GES within the CRGES.

First, a knowledge gap between the two strategies leads to more focus on the GES than the CRS. Research has revealed that knowledge sharing within the Ethiopian government is weaker on climate resilience than on green growth (Fisher, 2014). Climate resilience and transformation are also fairly new themes within the climate change discourse. One can thus assume that there was a lack of knowledge within the Ethiopian government and its international collaborators on how to integrate climate resilience into a green economy strategy. As a result, they might have considered it easier to keep the two strategies separated.

On this note, it remains to be seen whether the CRS will be fully and equally implemented into the CRGES as it gains importance within the climate change discourse, and as knowledge and understanding of the concept increases within the Ethiopian government. However, the current focus in the CRGES on increasing revenue through mitigation initiatives implies that financial opportunities also will have precedence in the future. This leads us to the second reason for the unequal focus between the two strategies of the CRGES.

The GES has larger financial opportunities than the CRS, and it was thus a priority to develop this aspect first because it opens for climate mitigation financing. Climate financing is economic support for greenhouse gas (GHG) mitigation and climate change adaptation measures, which former president Zenawi highlighted as an important source of income that would finance the comprehensive initiatives of the CRGES (Jones & Carabine, 2013). In the foreword of the CRGE outline, Zenawi wrote that, “...carbon finance could play an increasingly important role in the global economy and one that Ethiopia and its neighbors can benefit from” (FDRE, 2011a: 5). To benefit from the carbon market, the Ethiopian government focuses more on GES than the CRS because the green economy strategy outlines GHG-emission re-

duction initiatives that will generate carbon credit buffers (FDRE, 2011a).

Relying on mitigation initiatives as a way to finance the CRGES is efficient when it comes to attracting funding for single Clean Development Mechanism-projects (Bass et al., 2013). But due to the uncertain nature of the carbon market, it is unlikely that this can attract sufficient amounts of funding on a longer-term perspective (Bass et al., 2013). This uncertainty is also addressed by Anthony Giddens (2011), who warns against trusting the carbon market blindly, since it is not yet known how well it will work. Hence, the Ethiopian government relies on an uncertain and fluctuating carbon market to finance its comprehensive CRGE strategy, which may bring challenges for long-term funding.

The high focus on attracting foreign investments through GHG-emission reduction projects furthermore reflects the centralized decision-making process of the CRGES (Bass et al., 2013; Jones & Carabine, 2013). Several initiatives in the strategy imply that there will be a clash of interests between the central government's aim to increase revenues through climate finance and local stakeholders' interests.

For example, although afforestation and reforestation initiatives might increase rural people's vulnerability (Eriksen, Inderberg, O'Brien, & Sygna, 2015), these initiatives are referred to as “adaptation efforts” that will increase people's climate resilience in the CRGES (FDRE, 2011b). Afforestation and reforestation initiatives are in most contexts referred to as mitigation strategies and as ways to build CER-credit pools and not as adaptation measures (Boyd et al., 2009). Research also suggests that less than 1% of CDM-projects lead to sustainable development on the local level (Boyd et al., 2009). Tom Mitchell and Simon Maxwell (2010) attribute this to a knowledge gap on how to make mitigation strategies climate resilient. This means that mitigation initiatives often fail to integrate for example poverty reduction measures. Hence, by framing mitigation initiatives as adaptation strategies with universal benefits, the government legitimizes mitigation efforts such as afforestation and reforestation initiatives that in a worst case scenario might exacerbate vulnerability on local level (Eriksen et al., 2015). This shows how strategies or policies that are beneficial for one group of people can reduce resource access of other groups (Eriksen et al., 2011).

Another example of the centralized decision making process of the CRGES is its proposed reduction of Ethiopia's GHG-emissions through a shift from livestock production to poultry production. Even though this measure might result in reduced GHG-emissions, it does not account for values and priorities in rural areas (Bass et al., 2013). For instance, it does not consider social and cultural values of livestock in pastoralist societies. Such issues arise from framing climate change as a problem that can be solved through technical mitigation measures, with minimal attention to the social, cultural, political and ethical aspects of climate change adaptation.

The government's tactic to increase Ethiopia's climate change adaptation opportunities through mitigation projects might increase national revenue, but it will not necessarily lead to more climate resilient communities. The agricultural shift and the reforestation/afforestation initiatives are hands on technical mitigation solutions. However, the CRGES designers have failed to acknowledge that contrasting values and interests in these initiatives can affect the adaptation outcomes of the strategy (Eriksen et al., 2011). This means that the central government's interests of increasing revenues on a national level can reduce for example pastoralists' capacity to adapt to environmental and climatic changes since livestock are their livelihood buffers in times of drought (Getachew, 2001).

One of the reasons that the CRGES designers failed to acknowledge that rural stakeholders might be negatively affected by the mitigation initiatives is that they apply an outcome approach to vulnerability. This means that they see local stakeholder's vulnerability as produced solely from the environmental challenges posed by climate change and disregard social, cultural, political and economic stressors (Eriksen et al., 2011; O'Brien, Eriksen, Nygaard, & Schjolden, 2007). If the CRGES designers had adopted a contextual approach to vulnerability, however, the strategy would have included social, political, institutional and economic stressors *in addition* to environmental challenges (Eriksen et al., 2011; Eriksen & Marin, 2011; O'Brien et al., 2007). This would have made it possible for the strategy's designers to account for how mitigation initiatives can increase people's vulnerability to climate change while increasing national revenues.

The two examples of afforestation/reforesta-

tion initiatives and agricultural shift furthermore show that the CRGES fails to consider the nested and teleconnected nature of vulnerability. Vulnerability is part of the globalized world – it is not a local, isolated phenomenon (Adger, Eakin, & Winkels, 2008). This means that as the CRGES pushes farmers from keeping livestock cattle to for example producing poultry, they might become more exposed and vulnerable to either climate change, variations in the global economic market, or both. To account for the nested and teleconnected nature of vulnerability, the CRGES designers must “consider potential feedbacks between local and global processes” (Eriksen et al., 2011: 7).

Integrating local knowledge into adaptation initiatives is a precondition for successful responses to climate change (Eriksen et al., 2011; Eriksen & Marin, 2011). Pastoralists and rural farmers in Ethiopia have adapted to climate change for centuries and have vast knowledge of local areas that is valuable to the CRGES. Still, findings from the initial phases of the CRGES show that the strategy’s designers neither engaged rural stakeholders in the decision process nor integrated local knowledge into the planning of the strategy (Bass et al., 2013; Jones & Carabine, 2013). These findings moreover reflect the centralized and top-down development process of the CRGES.

The “green economy” concept, its lack of definition and its transformational challenges

One common problem with the current green economy discourse is that there is a lack of one common understanding of what a “green economy” is. When the green economy concept entered the climate change discourse in 2011, there was no single, unifying definition of the term. In his speech at the Royal Society for the encouragements of Arts, Manufactures and Commerce, Anthony Giddens expressed concerns about the lack of understanding of what “green economy” is and stated that “it’s just an empty phrase” (Giddens & Taylor, 2011).

Accordingly, the CRGES does not provide any clear definition of the concept “green economy”, it rather lists different measures that will be taken to transform Ethiopia’s economy in a “green” way. Most of these measures are technical with a heavy emphasis on renewable solutions (FDRE, 2011b). Renewable energy projects can indeed lead to sustainable development on a local level (Boyd et al., 2009), but it is still questionable if that alone brings transfor-

mational reform to Ethiopia’s economic system.

Transformational climate change-policies challenge the interests and power relations that shape the business-as-usual development model (Giddens, 2011; O’Brien, 2011). Transformational policies thus threatens those who benefit from business-as-usual development (O’Brien, 2011). This constrains transformation because the “winners” will aim to reproduce the system from which they benefit. Through the CRGES, the government benefits from focusing more on mitigation measures that might increase the climate exposure of the most vulnerable in the Ethiopian society. Hence, the CRGES reproduces the “traditional” winners and losers of the business-as-usual model.

This shows that even though the CRGES aims to provide a sustainable development model that will ensure what Nadarajah Shanmugaratnam (1991) terms “intergenerational justice” by focusing on lowering GHG-emissions, it does not sufficiently consider ‘intragenerational justice’. This means that the CRGES, while focusing on how to lower GHG-emissions through mitigation efforts that will ensure environmental, social and economic justice for future generations, does not necessarily take into account the social, economic and environmental welfare of the present generation’s communities. The challenges presented in this paper show that the CRGES fails to appreciate the interdependence between intra- and intergenerational justice, which is a prerequisite to achieve transformational, sustainable development (Shanmugaratnam, 1991). Hence, the CRGES does not present a transformational strategy for sustainable development, which is its ultimate goal (FDRE, 2011a). As it stands today, the strategy simply reproduces a “greener” version of the “business-as-usual” model of development.

Conclusion

Even though the CRGES needs more in-depth transformational initiatives than what its current mitigation projects and technical initiatives can offer, the strategy still represents one of the most far-reaching development plans in any developing country. The CRGES is thus transformational in its aims, scale and institutional reform.

However, this paper has shown that the most promising and remarkable aspect of the CRGES, namely its combination of a GES and a CRS, falls short of its potential of transformational change. This is because the financial opportunities that

come with a well-developed green economy makes the Ethiopian government trump the GES in favor of the CRS. When the government gives unequal attention to the GES, rural communities become less resilient to climate change because mitigation efforts might increase their vulnerability. The CRGES will thus struggle to reach its transformational potential with the GES and CRS as separated entities. Combined, and with more focus on the CRS, these two aspects can generate new and important

knowledge and insight to the field of climate change and development. But before this can be achieved, it is necessary to acknowledge the political nature of climate change and development, and that there are material values and economic interests in maintaining an unbalanced focus on the GES (Tanner & Allouche, 2011). These underlying ideas and interests have to be challenged. Otherwise, the CRGES will continue to reproduce the traditional winners and losers of the business-as-usual model.

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Photo: Marco Arana Zegarra

Letter

A battle for water: Social resistance in Peru's gold mining

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One of the main environmental conflicts in Peru is increased large-scale mining in the Andes. Although mining was meant to increase growth in Peru, modern gold extraction methods have consumed and contaminated water, and opposing interests over water resources have sparked confrontations between mining companies and local communities (Bury, 2004; Bury, 2005; Wilson, 2012; Bebbington & Williams, 2008). While export of precious metals has developed the national economy and created local job opportunities, it has also damaged the environment and retarded development in mining regions (Silva-Macher & Farrell, 2014). Open-pit gold mines transform peasant land into wasteland, consuming and contaminating water used by local communities (Budds & Hinojosa-Valencia, 2012). Eventually, mining affects local economies, livelihoods and health in areas of operation (Gifford, Kestler, & Anand, 2010). Regulation and provision of water are therefore central issues in social opposition against mining. To protect local communities' access to land, drinking water, livelihoods and clean environments, Peru's constitution and Water Law of 2009 should be amended. The amendments should limit mining locations, prohibit cyanide and mercury (in mining) and recognise water access as a human right (Balarezo & Wiig, 2012).

During 20 years of gold extraction, Minera Yanacocha,¹ the second largest gold mine in the world, transformed 600 square miles of mountains and peasant land into mining areas. Meanwhile, the region became the second poorest in Peru (Ramírez, 2011). In 1991, Newmont Mining Corporation, the main shareholder of Minera Yanacocha, discovered two new gold deposits, in conjunction, the Conga mine. President Humala expressed his support for the Conga project and emphasized that development in Peru depends on mining "...because it will allow us to achieve the great transformation and the social inclusion that we are offering to the Peruvian People" (D. H. Bebbington & A. Bebbington, 2012: 25). In October 2010, the government therefore approved the Conga project, which would be the world's largest cyanide leaching mine, without carrying out an adequate Environmental Impact Assessment (EIA) or gaining the consent of local communities (Bury, 2005). This triggered two months of turmoil and a general strike in four affected provinces. Newmont's security forces arrested more than 40 people, injured 30 and killed five. This situation forced Newmont,

¹ Minera Yanacocha is owned by the US based Newmont Mining Corporation (51.35%) Peruvian Minas Buenaventura (43.65%) and the World Bank's International finance Corporation (5%) (Silva-Macher & Farrell, 2014).

in agreement with the government, to suspend the Conga project until water protection efforts had been applied in the EIA (Yeager, 2012). Yet, the people of Camamarca believed that Conga would increase the region's already serious contamination, territorial degradation and health problems as well as damaging livelihoods (Poole, Rénique, Minister & Valdés, 2012).

The Conga project poses a threat to the people of Cajamarca because of the project's immense scale of environmental destruction and contamination. If the Conga mine eventually gets approved, it will cause ecological changes in three farming districts and five river basins diverting water from two large mountain lakes. Toxic waste containing cyanide, mercury, arsenic, lead and cadmium will be discarded into two other lakes and seep into groundwater, which sustains 680 springs that run into larger rivers (Gifford et al., 2010). The mine is expected to consume 228,000 litres of water per hour, and this together with contamination, will affect people's access to clean water over a large geographic area, from the Andes to the Pacific Coast and Amazon rivers (Budds & Hinojosa-Valencia, 2012; Sullivan, 2014). Peru's current environmental regulations are insufficient when such devastating practices are tolerated. The absence of clear and transparent information of the risks of the Conga mine caused vast mobilisation against the project, where people made a call to the government to improve Peru's environmental regulations (Bebbington & Williams 2008).

When the government changed its environmental regulations in the early 1990s, it also reduced its control over environmental impacts. The interests of transnational mining investors were prioritized over public policies and local economies. These structural changes attracted multinational companies that do not operate open-pit mining in countries with firmer environmental regulation. Newmont for example, uses extraction methods that are banned in the US and other developed countries, and in Peru, they are not even held responsible for long-term clean-up costs. Therefore, many nongovernmental and civil society groups express concerns about the impacts on water sources in mining areas (Bebbington & Williams, 2008; Slack, 2012).

To protect Andean socio-environmental and economic values, mining-opponents are working to promulgate three vital principles on the political agenda; firstly, to stop mining activities in headwaters of rivers and aquifers; secondly, to prohibit the use of cyanide and mercury in mining; and thirdly, to recognise water access as a human right. The first principle improves Peru's environmental regulation by prioritising resource protection and social rights over economic gain (Bebbington & Bury, 2009). The second reduces the risks of water contamination because cyanide and mercury are highly toxic (gyi Szilvia, 2011). The third principle obliges mining companies to take measures to avoid contaminating or misusing water used by local populations. By constitutionalising water as a human right, the government would also follow the 2010 UN General Assembly's call on States to recognise this fundamental right (Assembly, 2010). These three principles would improve water policies and decision-making, which in turn would strengthen human rights and assure environmental protection.

Newmont (2015) admit that water access, availability and quality have become a challenge in mining locations. They also recognise the need to focus on "further developing our technical expertise in water treatment, water control, dewatering systems and water monitoring" (Newmont, 2015). Therefore, Newmont plans to provide technical solutions to counteract impacts on the region's water sources. To improve their relation with local communities, Newmont has initiated community development in Cajamarca, such as providing water, electricity, schools and health services. They also contract local people and suppliers to support local development. This way, Newmont gain legitimacy by providing benefits to poor communities, which are supposed to recompense the environmental and social problems of mining (Gifford et al., 2010). Still they elude the three ethical principles outlined above that caused the Conga-conflict: to protect water sources from contamination, to stop over-extraction of aquifers, and to respect the citizens' right to clean water.

Since the shift to neo-liberal economic policies, transnational mining companies have reconfigured water governance and deprived

many peasant communities of their land and access to water. According to Gifford et al., "The communities around mining operations not only tend to be poor and vulnerable, but also lack government protection, regulation and oversight" (304). In Cajamarca, more than 20 years of mining has not generated social development as foretold; instead, it has turned Cajamarca into an impoverished, contaminated environment. Mining opponents promote constitutional changes, because they see it as the government's

responsibility to ensure that natural sources and human rights are protected (Slack, 2012). Local people and social movements will not accept the Conga project before their claims are followed up. Implementing the prescribed amendments would restrict and reduce production, as well as prescribe and promote new standards in mining. Therefore, the best way to respect Peruvian's rights to water, land, livelihood and clean environments, would be to "leave Conga's gold in the ground" (Silva-Macher & Farrell, 2014: 751).

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Photo: Neil Davey

From Waltz to Kier: Evaluating U.S. nuclear policy*

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Abstract: This article aims to discover how and why the United States constructs its nuclear foreign policies. Although predicated upon rational deterrence, they are also founded on an idiosyncratic and contradictory understanding of the world. This paper examines events and the rhetoric of U.S. statesmen in different administrations, revealing consistency in using nuclear weapons for rational strategic purposes of self-preservation and security.

Why do states build nuclear weapons? Given that states use nuclear weapons for a specific utility, possessing an accurate understanding is critically important both for discerning historic and current foreign policy trends and for predicting the long-term future of international security (Sagan, 1996). However, meagre attention has been devoted to examining the idiosyncratic behaviour of nuclear-armed states. William Walker (2010) contends that the nuclear powers, although uniformly utilising their arsenals for rational deterrence purposes, possess a highly individualised and distinct relationship with nuclear weapons. These differences stem from their unique history of involvement with atomic programmes, atypical domestic and regional politics, and the value and intensity of meaning that both a government and nation attach to its nuclear stockpile. In an attempt to identify to what extent the United States acts as a rational actor, case studies exploring U.S. nuclear policies

are examined through the theoretical frameworks of realism and constructivism as espoused by Kenneth Waltz and Elizabeth Kier respectively.

The first segment will evaluate Waltzian realism in relation to U.S. nuclear behaviour, and argue that the United States has a mutable relationship with nuclear weapons wherein it has frequently adapted its nuclear strategies to overcome new challenges. With policies significantly influenced by zero-sum calculations the government aspires to increase its relative power vis-à-vis competing nations and achieve primacy. The second section will provide an inter-paradigm critique of Waltz using Kier's constructivism by examining the influence of military subcultures on the formation of U.S. nuclear policies. Through the case studies of the Korean and Vietnam War, this article will argue that international relations, to an extent, is socially constructed. However, there exists much uniformity of action across the administrations. In response to new threats, the United States has frequently aimed to consolidate its national security interests, which on a macro-level has been the American government's primary

* For my grandfather Harry Willey: A repository of knowledge

** I am indebted and thankful to Paul Beaumont for his tutelage throughout the writing process. The ideas and recommendations he provided were instrumental in the formulation of this article.

objective within global politics. This suggests that the United States, although displaying a heterogeneous theoretical approach to international relations, behaves mostly as a rational unitary actor.¹

Waltz's realism

In his book *Theory of International Politics* (1979), neorealist Kenneth Waltz seeks to explain how states behave in the international political system that has no central authority. As a result, politics is inherently anarchical – a static characteristic of the international system. The primary referent object in this system is a nation-state which is sovereign and functionally uniform. Consequently, states exhibit similar institutional features and are socialised into the international system through a combination of competition and imitation. Furthermore, Waltz's neorealism postulates that these units have similar needs yet possess different capabilities. Some states are thereby more capable and powerful than others, which cultivates fear and insecurity. Thus, states are unable to discern the precise intentions of other states and this is subsequently known as the Security Dilemma (Waltz, 1979). According to this paradigm, nation-states are rational and egoistic, and their paramount concern is to maintain safety and survival.

Therefore, governments seek power to maximise their security vis-à-vis competing nations, a pursuit predicated upon the state's perception of diametrically opposed agendas. The competition is thus viewed in zero-sum terms, which means that within the international system one state's gain is equal to another's loss (Li, Xie, Meng, & Xu, 2011). However, states will only seek the requisite amount of power needed to ensure their own survival (Smith, 2014). Waltz similarly argues that states are profoundly defensive actors in the international arena and will abstain from pursuing greater control and

influence if that jeopardises their own security. In essence, such intrinsic anarchy necessitates that nations ratify foreign policies aimed at preserving and enhancing their strategic objectives (Jepson, 2012). Alex Bellamy concurs, asserting that states, within the international political system, overwhelmingly focus on consolidating their security interests (as cited in Jepson, 2012). Waltz views this as the primary impetus guiding the formation of a state's national security doctrine.

Kier's constructivism

In contrast to Waltz's realism, the constructivist school of thought is based upon the principal notion that national security is socially constructed. The social construction involves intersubjective interaction; the mutual constitution of agents and structures; and the central role of ideational factors, such as norms and identities. Accordingly, constructivists avoid advancing universal and abstract definitions of security, placing emphasis on its innate particularities (Williams, 2008).

A seminal theoretician within this school of thought is Elizabeth Kier who posits that national security is socially constructed; however, she deviates from standard constructivist standpoints in her examination of international politics (Kardaş, 2006). According to Tuncay Kardaş (2006), Kier evaluates how military subcultures shape a state's national security doctrine, and suggests that military doctrines are partly the products of a state's domestic political machinations. This theoretical model includes a consensual partisan framework, and Kier argues that all the main political actors share the same view of the military. The exposure to a nation's societal and cultural ideas and values shapes the identities and beliefs of political actors (Kardaş, 2006). Kier has thereby suggested an alternative account of how military doctrines are formed via non-systematic determinants. In the view of Kardaş (2006), such focus addresses the crucial function of a civilian policymaker's perception and agency have in the construction of national armed forces, which, according to Kier, influence the creation of a state's security strategy. In order to evaluate the theoretical examples of Waltz and

Kier an analysis based upon empirical examples is presented beginning with U.S. Nuclear Policy and MAD.

U.S. Nuclear Policy and MAD

Throughout the majority of the Cold War, the United States and Soviet Union were deadlocked in a nuclear stalemate, both possessing powerful and sophisticated nuclear arsenals. A nuclear war would have resulted in the Mutually Assured Destruction (MAD) of each nation, an impasse that fundamentally influenced the global balance of power and led to the emergence of a bipolar political system (Kennedy, 1983). According to Keir A. Lieber and Daryl G. Press (2006), many policy analysts during this period contended that such behavioural restraint produced a more stable world. In consequence, the superpowers were actively discouraged from employing nuclear threats in their dispute resolutions.

The behavioural restraint is illustrated by the rhetoric of leading American statesmen during the Cold War. For example, during the heyday of communist expansion in the 1950s Admiral Arthur W. Radford, chairman of the U.S. Joint Chiefs of Staff, suggested that the communist government, in formulating policies to attain political objectives, was "reluctant to use organised armed forces." This strategy, he perceived, would be "last resort" of the Soviet regime. Ergo, the advent of nuclear-armed states reduced "a reasonable chance of quick victory" (as cited in Parrington, 1997: 6-7). Thus, engaging in overt militant activity posed substantial risks for both sides. Furthermore, the American diplomat and political scientist Henry Kissinger (1994) posited that because of American and Soviet nuclear weapons "the much advertised Soviet invasion of Western Europe [was] a fantasy (...) a fear widely recognised by posterity and chimerical" (as cited in Parrington, 1997: 7). Similarly, Parrington (1997) asserts that although American and Soviet arsenals did not solely deter a conventional attack, the possession of atomic weapons unequivocally deterred nuclear war.

Thus, during the Cold War nuclear weapons were a central theme of American and Soviet

defence planning. As Waltz's theory predicts, the subsequent apprehension of MAD illustrates that both factions largely refrained from expanding their spheres of influence and pursuing greater relative power because such actions jeopardised their security. This indicates that the United States, in attaining national and strategic interests, was driven by an egoistic approach to international relations, and therefore behaved as a rational unitary actor.

The United States' Calculated Ambiguity Doctrine

The current global balance of power influences American foreign policy, which is driven by the government's rational and strategic goals. In recent years, the key ambition has been to increase its hegemonic position abroad, and the U.S. nuclear stockpile has become an integral element in pursuit of this policy. For instance, consecutive administrations have threatened to deploy the nation's comprehensive arsenal – a strategy of deterrence named the Calculated Ambiguity Doctrine (CAD) (Sagan, 2000).

The CAD-strategy is highlighted by the 1996 rhetoric of the American Secretary of Defense William Perry, hypothesising the extent of an American retaliation:

For obvious reasons, we choose not to specify in detail what responses we would make to a chemical attack. However, as we stated during the Gulf War, if any country were foolish enough to use chemical weapons against the United States, the response will be 'absolutely overwhelming' and 'devastating'. (as cited in Sagan 2000: 85)

Later Secretary of Defense William Cohen underscored the use of such policy in November 1998 (Sagan, 2000). Cohen stressed that the government strategically aimed to persuade its potential adversaries from challenging and attacking the United States using the implicit ambiguity in its threat to use nuclear weapons. This, he maintained, significantly contributed to the protection of U.S. interests (as cited in Sagan, 2000: 85). Scott D. Sagan (2000) similarly argues that the doctrine's proponents, both inside and outside the government, claimed

¹ Although the United States exhibits structural-realist tendencies, the question must be posed: to what extent is Waltz's model prescriptive and self-reproducing? This article cannot adequately answer this contention. However, this caveat must nonetheless be identified and considered.

these threats were necessary for the preservation of national security.

Sagan (2000) has argued that the overall tone of Perry and Cohen's language is inflammatory and strong, and by disseminating the CAD via press releases and articles, successive American governments emphasised the dire consequences of any state altering the current power dynamics. Through this asymmetric deterrence strategy, the United States intended to deter and contain aggression from antagonistic states, thereby sustaining its worldwide primacy. The application of zero-sum policies subsequently highlights the intense focus on the consolidation and retention of national security objectives within the government. Ultimately, the U.S. government primarily behaves rationally and unitarily in the international system.

NPT and its extended nuclear deterrence guarantee

The United States aims to preserve the global status quo, as consecutive administrations believe this will augment American control within the international system. Therefore, the United States continues to prevent the proliferation of nuclear weapons, which is visible through the symbiotic relationship between U.S. involvement in the Nuclear Weapons Regime (NPT) and its extended nuclear deterrence policies. According to Jeffrey Record (2012), the NPT regime is a bifurcation organisation that mediates between nuclear "haves" and "have-nots." The United States has provided other countries with knowledge and assistance to develop nuclear energy for non-military purposes in exchange for renouncing the development of an arsenal. Accordingly, states such as Argentina, Brazil and South Korea have ceased construction of nuclear weapons (Record, 2012). In addition, the Japanese and German governments have disassembled their arsenals, which shows that the U.S. nuclear guarantee has provided the disincentive for numerous American allies to negate their offensive nuclear aspirations. (Record, 2012).

Zero-sum calculations subsequently influenced U.S. nuclear policies. As described by

Waltz's (1979) theoretical model, U.S. relative power was maximised and the United States safeguarded its interests abroad. Subsequently, this strengthened its monopolistic position and facilitated the consolidation of national security. In other words, the United States behaves mainly as a rational unitary actor within the international system.

Changing U.S. nuclear policy under President George W. Bush

In recent years, the United States has transformed its foreign policy because of new international developments, such as 9/11, which have threatened national security. Thus, in order to confront these challenges, the United States altered its military doctrine, which is illustrated by the rhetoric of George W. Bush during his presidency. For instance, according to François Heisbourg (2003), the president's State of the Union address in 2002 similarly conveyed the essence of the new U.S. defence operations post 9/11: "We [as a people] must prevent the terrorists and regimes who seek chemical, biological, or nuclear weapons from threatening the United States and the world." Bush took personal ownership of this mission evocatively stating, "I will not wait on events, while dangers gather" (as cited in Heisbourg, 2003: 1). The administration sought primacy in every dimension of its military technology, and Bush explicitly stated that the armed forces would "be strong enough to dissuade potential adversaries from pursuing a military build-up in hopes of surpassing, or equalling, the power of the United States" (as cited in Lieber & Press, 2006: 5). Jeffrey Record (2012) argues that the new doctrine represented a disbelief in an overall utility of nuclear weaponry for deterrence purposes. The subsequent pursuit of pre-emptive and preventative action was, according to Lieber and Press (2006), entirely consistent with the United States' declared policy of expanding its global dominance.

Thus, as suggested by Waltz's theoretical model, during the post 9/11-period the United States viewed worldwide politics in binary terms.

The dichotomy of agendas between the United States and its rivals highlights that the American government aimed to acquire a monopoly of control through the implementation of zero-sum policies. This purports that the United States largely behaves as a rational unitary actor within the international system.

The Disarmament Regime under President Barack Obama

The current American administration, under the tutelage of President Barack Obama, has renewed the enthusiasm for reduction of nuclear weapons worldwide altering the modus operandi of the United States' national security doctrine (Schachter, 2011). Accordingly, the United States is driving the nuclear weapons agenda within international politics, as can be observed in Obama's letter to the Arms Control Association in 2008. Obama stated that:

The United States will maintain a nuclear deterrent that is strong, safe, secure, and reliable. (...) As president, I will set a new direction in nuclear weapons policy (...) and will not authorise the development of new nuclear weapons. And I will make the goal of eliminating nuclear weapons worldwide a central element of U.S. nuclear policy. (as cited in Schachter, 2011: 27-28).

Furthermore, Obama has demonstrated his commitment to the disarmament objective, which is reflected most prominently in the *Nuclear Posture Review Report* (2010) (NPR). For example, the NPR states that it "reflects the President's national security priorities and the supporting defence strategy objectives" that will advance the United States' broader security interests (U.S. Department of Defense, 2010: iii). Thus, echoing Obama's earlier rhetoric, this NPR aims to reduce nuclear dangers.

Thazha V. Paul (1999) anticipated the rise of the current American disarmament dogma. He contends that the possession of Weapons of Mass Destruction (WMDs) by smaller international actors will likely constrain the United States' capacity to manage international security. Hence, a removal of nuclear weapons globally will multiply American relative power

and influence, given that other states do not possess the technological capabilities to develop countervailing systems (Paul, 1999). President Obama is using a normative agenda for Waltzian aspirations, which is based upon zero-sum calculations. If challengers to American hegemony are curbed, the United States can more easily procure its national security objectives. This suggests that the United States, in its management of the international system, acts as a rational unitary entity.

Elizabeth Keir's constructivism: A critique of Waltz

However, the disuse of atomic weapons remains the single most important phenomenon of the nuclear age, and there has been a widespread opprobrium against their offensive application (Tannenwald, 1999). This de-legitimation stems from a normative prohibition developed within the international system, which according to Nina Tannenwald (1999) has altered the identity of nations. Consequently, such moral norms have stabilised and restrained the self-help behaviour of the United States: a taboo against using nuclear weapons has emerged.

The Korean War

This taboo is illustrated by U.S. statesmen during the Korean War. For instance, although the government deployed atomic bombers, the usage of such weapons was rejected privately within the government. An officer in the State Department's Bureau of Far East Affairs warned in November 1950 that the A-bomb had "the status of a peculiar monster conceived by American cunning (...). [T]he military results achieved by atomic bombardment may be *identical* to those attained by conventional weapons, [but] the effect on world opinion will be vastly different" (as cited in Tannenwald, 1999: 444). Particularly, the U.S. statesman acknowledged that utilising the nuclear arsenal would erode the country's moral legitimacy and control over the national narrative. This "would be exploited to the United States' serious detriment" (as cited in Tannenwald, 1999 : p. 444).

Furthermore, President Harry S. Truman also reflects this sentiment in his rhetoric during the Korean War. In response to General Douglas MacArthur, Truman refused to initiate nuclear war against China, because such a declaration would likely escalate the conflict to an unwanted “Third World War.” Truman defended his decision by referring to the existence of objective moral values: he could not “order the slaughter of 25,000,00” (as cited in Tannenwald, 1999: 446).

Thus, realistic considerations concerning America’s security, strategic interests abroad and prestige played an important role in forming U.S. policy. However, the quotations above also highlight that officials were uncomfortable with atomic bombing. Normative concerns and moral arguments within American society and culture therefore also influenced the military. The agency and identity of U.S. statesmen moulded the function of the state’s armed forces. International relations is therefore partly socially constructed. In sum, U.S. nuclear policy retains conflicting trends and ideas, which challenges central elements of Waltz’s theory and suggests that the United States does not behave completely as a rational unitary actor.

The Vietnam War

The rhetoric of political leaders during the Vietnam War further illustrates the decreased legitimacy of nuclear weapons within the United States. For instance, the Joint Chiefs argued that “nuclear attacks would have a far greater probability” of repelling a Chinese invasion than conventional weaponry (as cited in Tannenwald, 1999: 455). However, the Secretary of Defense Robert McNamara stated that he was “appalled” by this approach (as cited in Tannenwald, 1999: 452). McNamara morally objected to the utilisation of nuclear weapons as he “could not

imagine a case where they would be considered” (as cited in Tannenwald, 1999: 453). Dean Rusk who was Secretary of State to both Presidents John F. Kennedy and Lyndon B. Johnson echoes this perception. Rusk similarly posited that the American government “never seriously considered using nuclear weapons in Vietnam.” (as cited in Tannenwald, 1999: 453).

Thus, many high-ranking U.S. officials harboured private commitments not to employ nuclear weapons despite it directly contradicting official U.S. deterrence policy (Tannenwald, 1999). Moreover, identity and moral reasoning heavily influenced the decisions of the nation’s political elite. As a result, international relations is partly socially constructed.

Conclusion

In conclusion, the United States’ nuclear policies have been influenced by a dominant military subculture within the administrations. This has resulted in the U.S. displaying idiosyncratic behaviour and implementing contradictory foreign policies. The U.S. nuclear security strategy, whilst displaying structural-realist concerns, coexists with incongruous themes. This potentially falsifies key elements of Waltz’s theoretical model and advances the idea that the United States does not behave entirely as a rational unitary actor. However, consecutive governments, when confronted with new obstacles and threats within global politics, have acted somewhat uniformly. Thus, on a macro-level, the overall preservation of national security has been the government’s primary ambition. This suggests that the U.S., whilst not homogeneous in its theoretical approach towards the international political system, behaves largely as a rational unitary actor.

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Photo: Caileigh Derksen

Tar sands: The slippery future of oil

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Abstract: The Canadian oil sector is planning to maximize the production of the Albertan tar sands. Influenced by the oil-infatuated global economy, the current Canadian government prioritises such short-sighted corporate interests over long-term public benefits. Due to the strong opposition from a concerned public on national and international levels, the proponents of tar sands attempted to legitimise the expansion of the industry as well as the infrastructure planned to cross North America. This paper examines pro-extraction propaganda launched by the government-industry alliance in light of the counter-arguments expressed by the opposition. It discusses the need for better governance of natural resources and a focal shift from short-term economic gains towards protecting natural resources and investing in renewable alternatives. Emerging social movements is a promising, if not even the only way, to impose positive change.

We are like tenant farmers chopping down the fence around our house for fuel when we should be using Nature's inexhaustible sources of energy — sun, wind and tide. [...] I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that.

*- Thomas Edison
(as cited in Newton, 1987: 31)*

The world faces rising demands for oil and since oil is a non-renewable source of energy, the demand is expected to irreversibly deplete the resource. The first decades of the 21st century are predicted to mark the peak of global crude oil production and as a result, less accessible, low quality sources of oil will become the focus of extraction ambitions (Bardi, 2009). With its ample supply of bituminous sands, tar sands in Alberta represent the world's third biggest reserve of oil after Venezuela and Saudi Arabia (EIA, 2014a). Despite the 2002 ratification of the Kyoto

Protocol, emissions from tar sands extraction have tripled between 1990 and 2012, and it will continue to rise as the country's dependency on hydrocarbons increases (Grant, Angen & Dyer, 2013).

Since bituminous sands represent a low quality source of oil, they require one of the most emission-intensive forms of oil production. Moreover, large amounts of valuable resources, such as fresh water from local sources and high quality natural gas are used to extract and process crude bitumen for transportation through pipelines. This energy-intensive process is a toxic sludge, deposited in large tailing ponds, collectively covering an area of well over 170 square kilometres, clearly visible from space (Lemphers, 2010; European Space Agency, 2014). Consequently, pollutants from tailing ponds are leaking into the environment, harming the health of aquatic ecosystems and boreal forests, polluting freshwater aquifers, and soil (Woynillowicz, Severson-Baker & Reynolds, 2005). In addition,

the government and energy corporations have developed plans for a network of pipelines connecting inland tar sands to the East and West coasts of Canada, as well as to the Southern coast of the United States.

However, the government is met with increasing opposition by non-governmental organisations, local communities, indigenous peoples and individuals concerned with the potential oil leakages along the routes of proposed pipelines. The cumulative environmental impacts of tar sands extraction should be of great governmental concern, yet the economic benefits of oil trading seem to overshadow environmental degradation. The pro-extraction wing has developed slogans to promote tar sands as an ethical source of oil and an important foundation of domestic energy security. Furthermore, Canadian authorities claim that the planned pipelines are nation-building and job-creating projects. This paper examines pro-extraction propaganda launched by the government-industry alliance in light of the counter-arguments expressed by the opposition. It discusses the need for better governance of natural resources and a focal shift from short-term economic gains towards protecting natural resources and investing in renewable alternatives. Emerging social movements is a promising, if not even the only way, to impose this change.

Ethical vs. conflict oil

One of the first attempts to legitimise oil deriving from tar sands was by trying to portray it as more ethical and conflict-free than the oil from other oil-exporting countries. Albertan tar sands are of great interest not only to Canada, but also to the United States, which is the main importer of oil deriving from this source. The favourable geopolitical proximity between the two countries enables the United States to reduce its dependency on other top suppliers known to be more challenging to U.S. foreign policy such as Saudi Arabia, Mexico, Venezuela and Russia (EIA, 2014b).

To further legitimise tar sands extraction and enhance the oil trading alliance between Canada and the United States, conservative movements and the fossil fuel industry introduced the term “ethical oil.” With the intent to placate the civil

society’s environmental concerns and to justify the accelerating pace of extraction, they promote tar sands oil as ethically superior in comparison to the “conflict oil” from other, politically less stable countries (Levant, 2010). This kind of corporate campaigning focuses only on the contrasting image of the “safe exporting neighbour” against the portrayal of “unstable and hostile” foreign exporters with repressive regimes and a history of internal and external conflicts (Levant, 2010). In this way, they kept the devastating long-term environmental, economic and social implications of tar sands out of the debate, which benefits the industry.

Thus, the Canadian tar sands industry is not conflict-free, and there is a growing opposition both among Canadian and U.S. citizens against the expected environmental degradation caused by extraction, and the proposed pipeline routes. In addition, a large proportion of Canadian oil exported to the United States is directly fuelling U.S. worldwide military operations that strengthen its hegemony in the international system (Klare, 2005). Taking into the account the nature and consequences of U.S. military interventions in recent decades, the division between ethical versus conflict oil seems heavily biased and based on faulty logic.

Domestic energy security vs. export ambitions

Another important argument raised by proponents of tar sands and pipeline expansion is the promise of ensuring domestic energy security. If Canada’s main concern were to ensure energy security, it ought to have developed a long-term national energy plan that looks beyond non-renewable energy sources. Instead it remains short-sighted and rooted in fossil-fuel dependency. Canada has an abundance of renewable sources of energy, such as solar, wind, water, biomass and waste. However, despite the recent trend to increase the use of renewables in other industrialized countries, the Canadian government seems to be far behind in planning a sustainable future (Smith, 2015; Liming, Haque & Barg, 2008). Instead of focusing on a single and finite source of energy, Canada should look onwards and strive to create a diverse and localised energy market. For example, by investing in research and development of new technologies to harvest more energy from

renewables; by introducing compulsory policy instruments to promote renewable energy; and by removing generous subsidies that are currently favouring the oil industry (Hofman & Li, 2009).

Moreover, to justify expansion with claims of ensuring energy security makes little sense because the majority of produced oil is intended for export (Nikiforuk, 2009). Canada has been trading with the United States through the North American Free Trade Agreement (NAFTA) since 1994. New free trade agreements were signed with European Free Trade Association (Canada-EFTA) in 2009, with South Korea in 2014 (CKFTA) and several Central and South American countries in the course of the past decade. Canada is currently engaged in ongoing negotiations for 12 free trade agreements out of which the Comprehensive and Economic Trade Agreement (CETA) between Canada and European Union has high priority (Government of Canada, 2015a). The CETA deal is prioritised because of great economic consequences for Canada, and will probably surpass NAFTA (Government of Canada, 2015b). These agreements are, among other mutual trading benefits, set to enhance export and diversify its market to various locations worldwide. However, in order to reach new markets, Canada must build efficient transportation infrastructure (Hoberg, Rivers & Salomons, 2012).

A proposed intra-continental pipeline infrastructure is the key component of realising the full potential of tar sands export. It will increase the demand for tar sands oil and create a boom in Canadian tar sands industry {Dobson, 2013 #400}(Dobson, Lemphers & Guilbeault, 2013). This boom, however, can expose Canada to the possibility of contracting the “Dutch disease.” The phenomenon was first explained by scientists observing the negative impacts of newly-discovered natural gas reserves on the manufacturing sector in the Netherlands in the late fifties. The Dutch disease is most commonly found in resource-based economies with significant influxes of foreign currencies due to the high-demand for a particular resource. The value of domestic currency is thus increased, which stimulates the import of non-resource based goods from foreign markets and therefore reduces the competitiveness of the domestic manufacturing sector (Ebrahim-zadeh, 2003).

Although much debated, the symptoms of the Dutch disease are visible in the current Canadian economy and are predicted to harm Canada’s long-term economic competitiveness (Dobson et al., 2013). The rise of the energy sector in Canada has had immediate benefits for provincial and federal economies in the first decade of this century, but increasing dependence on oil, as well as declining revenues from manufacturing sectors, makes Canada vulnerable to fluctuations of the global oil prices (Beine, Bos & Coulombe, 2012).

Nation-building vs. nation-alarming

As leading advocates for the proposed pipeline constructions, the Canadian government and corporations are labelling them as “nation-building” projects that will create jobs, progress and prosperity (O’Neil, 2011). Four major pipeline routes are planned from Alberta: the Keystone XL pipeline across the United States to the refineries on the Gulf Coast; the Energy East pipeline towards the East coast for export to European markets; the Enbridge Western Gateway pipeline and; Trans Mountain pipeline towards the West coast for export to Asian markets (Bird, 2014). The pro-pipeline wing often compares these projects to the construction of the Canadian railway system, emphasising nationwide benefits (Krugel, 2013). These claims only have propaganda value, as the two projects have little in common, and the proposed job opportunities are limited to the construction stage, which makes them temporary, low-wage and foreign-worker oriented (Hoberg, Rivers & Salomons, 2012).

Furthermore, what makes pipelines controversial is the threat of pipeline defects that resembles a ticking bomb. An extensive network of pipeline infrastructure built for crude oil transport in Canada and the United States already exists, and the incidence of pipeline defects is alarmingly high. In the United States alone, more than 3700 leakages have been reported in the past decade, usually with a late detection and slow response time by environmental emergency response officers (Skinner & Sweeney, 2012). Terrestrial oil spills contaminate the soil and potable water sources with highly complex, carcinogenic toxins, which make it difficult to remediate. Pipelines carrying diluted bitumen

from tar sands have a higher likelihood of defects than conventional crude oil, due to the heavy and corrosive nature of such oil. For the same reason, remediation of spills is also much more demanding and costly than that of conventional crude oil (Skinner & Sweeney, 2012). If constructed, these pipelines will become the longest in the network of operating pipelines in Canada and the United States. This would expose several provinces and states with vast areas of agricultural land, rangeland, surface waters, aquifers, forests, vulnerable ecosystems and protected areas to the environmental and health hazards of potential leakages.

In contrast to studying the effects on ecosystems, less research is conducted on how terrestrial oil spills affects human health; however, such effects should be taken seriously. According to Aguilera et al. (2010), human exposure to volatile organic compounds found in liquid petroleum derivatives results in both acute and chronic health risks. Contact through inhalation, ingestion or dermal absorption leads to nausea, headaches, hormonal disturbances, changes in the genetic material and various types of cancer (Aguilera et al., 2010). Effects on the indigenous communities living downstream of tar sands extraction sites in Alberta were implied by a study the Alberta Cancer Board (ABC) conducted in 2009. However, the study provided inconclusive results on the link between extractive industry and an outbreak of rare types of cancer in those communities (Bianchi, 2009). Even though the research did not find a significant correlation between tar sands industry and cancer, the report has been criticised for inadequate sampling and monitoring methods (Ayles, Dube & Rosenberg, 2004). Thus, the credibility of ACB's findings is compromised and more research should be conducted.

Nevertheless, despite the apparent discrepancies, the government and the industry use these findings to justify tar sands extraction (Kelly et al., 2010). Both proponents lack motivation to conduct any further research because a solid proof of causality between the two variables would empower the opposition and jeopardise tar sands expansion.

A way forward and the role of social movements
Increasing dependency on oil revenues and the

absence of long-term economic and environmental strategies on sustainable management transform Canada into a "petro-state." As many other oil exporting countries, Canada is faced with the "paradox of plenty." This is a situation where the dependency on a single - abundant, but finite - commodity negatively affects the economy. It over-centralises the state and institutions that shift from serving the people toward serving the alliances between public and private sectors (Karl, 1999). Despite the extent of environmental damage due to accelerating tar sands extraction, remediation planning remains poor and relatively inefficient. With the predicted rates of production, the majority of oil sand reserves will be exhausted in a period of 40 years (Nikiforuk, 2009). Therefore, the focus of Canadian social movement's should be to demand governmental transparency and social responsibility from the oil industry. A proportion of oil revenues should be invested in preventive and restorative practices, as well as investing in research for the transition to the post-carbon economy.

The proposed pipeline projects have disturbed local communities across the continent and made them aware of the seriousness of environmental and health hazards connected to increased tar sands production and potential terrestrial oil spills (Davison, 2014). Consequently, social groups concerned with climate change are strengthened, and the opposition consists of two main groups; environmental activists and aboriginal peoples. The latter protests against pipelines planned to cross their territories and endanger their livelihoods. From previous experiences, they expect little gain from these projects, as both the Canadian and the U.S. governments have a history of mistreating aboriginal land rights. Despite this, the aboriginal peoples of Canada, called the First Nations, did not enhance a strong collective identity before, but this has now changed because of the tar sands development and pipeline plans (Wilkes, 2006). A social movement called *Idle No More* was established in 2012 and begun a series of political protests against environmental degradation and social and economic inequality (Idle No More, n.d.). Furthermore, *Indigenous Environmental Network*, a U.S. organisation formed in the early nineties is now connecting aboriginal communities in North-America. Their aim is to develop mechanisms to protect

their land, natural resources, health and create a sustainable future (Indigenous Environmental Network, 2014). These movements have organised a number of protests, petitions, blockades of roads and railways, walks, flash mobs and social media campaigns in order to spread the awareness and increase the pressure on governments.

Alongside aboriginal groups, many other environmental organisations are campaigning against tar sands and pipelines. One of them, the grassroots movement *350.org*, has launched the Fossil Free divestment campaign, which has spread from the United States to Canada and is continuing to spread worldwide. The campaign's main goal is to reduce fossil fuel emissions by imposing pressure on institutions such as universities, religious-, city- and governmental institutions to stop investing in fossil fuel development. The campaigners are aiming to achieve full divestment from the largest fossil fuel companies and to protect the majority of the current fossil fuel reserves from extraction by keeping them intact (Fossil Free, 2014a). Students, whose tuition fees are invested in fossil fuel industries through university endowments, especially support the campaign. Since its launch in 2012, the Fossil Free campaign has spread on campuses of universities and colleges all over North America, Europe as well as Australia and New Zealand (Douglass, 2015). While sceptics doubt that the campaign will directly affect the financial well-being of the powerful fossil fuel sector, they recognise its growing influence on shaping the public debate on climate change and energy security (Ansar, Caldecott & Tilbury, 2013).

It is through the pressure of the divestment activists that institutions have started to consider restructuring their investment plans. For example, a Fossil Free movement petition in April 2014 addressed the Harvard university leadership to stop investing in oil and coal companies, and was signed by nearly 100 faculty members (Goldenberg, 2014). An anti-fossil fuel signal coming from faculty members of such a renowned institution has undoubtedly set a strong example; in the same year more than 20 universities made a commitment to divest from fossil fuels. For now, these are predominantly U.S. institutions, with a couple from Europe and New Zealand (Fossil Free, 2014b).

In Canada, the divestment movement is present on campuses of around 30 universities in addition to numerous local *350.org* movements (Prystupa, 2015). This shows the campaign has been well accepted and is gaining momentum; however, despite the raising pressure of the petitioning students, no real commitments for full divestment have been made apart from Concordia University in Montreal, which made a mere symbolic divestment obligation in December 2014 (Seidman, 2014). In my view, these movements have not been as successful as in the United States and Europe due to the dominating petro-capitalist political setting, which prioritises tar sands exploitation over less harmful alternatives. Even if the divestment activists' actions do not directly affect the Canadian fossil fuel industry, the social awareness is effectively spreading and gaining publicity. As universities represent generators of knowledge and innovation, they can and should be the generators of the change by investing their brain power as well as funds in the development of sustainable energy solutions for the future.

Conclusion

If the current rate of extraction continues, the global oil reserves will eventually be depleted and alternative energy sources will have to be utilized. As the Canadian government continues to depend on fossil fuels and ignores their negative consequences, the most promising way out is through the bottom-up activation of people. The directly and indirectly affected victims of land degradation and water and air pollution have started to organize an opposition to tar sands extraction and construction of supporting infrastructure. It is too early to predict what impacts the social movements have on policy- and decision-making processes, and it would be naïve to expect a change to a fossil-free economy overnight. A transition from heavy dependence on fossil fuels to a post-carbon society will require a long period of adjustments and structural changes in Canadian natural resource governance and energy strategy. However, the role of social movements is to inform the general public about the necessary transition to renewable energy use, and pressure the governments to begin this process sooner rather than later.

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Photo: Saroj Upadhyay

Conservation benefits and costs as sources of inequality and injustice in Chitwan National Park, Nepal

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Abstract: Distribution of wildlife damage costs and park related benefits relates to injustice and inequality. This study conducted a survey of 140 households from Meghauri and Bachhauli Village Developments Committee in the buffer zone of Chitwan National Park. face wildlife damages. These damages reduce food security and income options, fostering poverty and increasing economic inequality. The distribution of conservation benefits and costs between these two communities is skewed, which contributes to injustice.

Protected areas have long been regarded as the most common tool for *in situ* conservation of biodiversity worldwide (Ferraro, 2008). The creation of protected areas often generates a myriad of benefits and costs. Benefits are more often universal whereas people living adjoining to these parks disproportionately assume the costs of conservation (Mackenzie & Ahabyona, 2012). This undermines the social and economic welfare of subsistence-based rural communities especially in developing countries (Spiteri & Nepal, 2008).

One of the most prominent costs associated with protected areas are human-wildlife conflicts. According to World Park Congress (2004), human wildlife conflict occurs “when the needs and behavior of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife” (259). These types of conflicts occur worldwide and their frequency and severity

have increased in recent years (Treves, 2009). In Nepal, especially in Terai, the protected areas in the southern lowlands of the country, human-wildlife conflicts are an ever-increasing problem (Sharma, 1990; Studsrød & Wegge, 1995).

Human-wildlife conflicts are found to have a negative impact on the wellbeing and livelihood of local people in Chitwan National Park in Nepal (Thapa, 2010; Wang, Lassoie, & Curtis, 2006; Bailey, 2011). Studies have shown that poor people and people from marginalised groups suffer particularly high economic losses and food insecurity because of human-wildlife conflicts (Barua, Bhagwat, & Jadhav, 2013). The non-derogatory term “marginalised” denotes people that are considered to be from a low or untouchable caste in the Nepalese society, and these people have been facing discrimination and the deprivation of many socio-economic, political and cultural rights for decades (Mulepati, 2012). The poorest and marginalised people without

large landholdings and alternative sources of income face a compounding vulnerability as a result of human-wildlife conflicts because they can neither absorb the losses nor protect themselves from such losses (Naughton, Rose, & Treves, 1999; Dickman, 2008).

Study area

Chitwan National Park, a UNESCO world heritage site since 1984, lies in the subtropical lowlands in the inner Terai-region of Nepal, neighbouring India. In 1972, it was established as the first protected area of Nepal, and it presently covers 932 square kilometres. An additional 750 square kilometres was designated as a buffer zone surrounding the park in 1996. Chitwan National Park is renowned worldwide for its unique and diversified ecosystems and fauna. It is considered as one of the most important refuges for the endangered one-horned Indian rhinoceros (*Rhinoceros unicornis*) and is also home to other species such as Royal Bengal Tiger (*Panthera tigris*), Asian Elephant (*Elephas maximus*), wild boar (*Sus scrofa cristatus*) and spotted deer (*Axis axis*) (Stræde & Helles, 2000).

The Village Development Committees (VDCs), Bacchauli and Meghauli, were randomly chosen for this study as the research areas from a set of 34 VDCs around the Chitwan National Park. VDCs are the smallest political and administrative unit in Nepal. The Chitwan National Park has been divided into four management sectors: eastern/Sauraha, central/Kasara, southern/Bagi/Madi, and western/Amaltari. Meghauli lies on the central/Kasara sector covering an area of 3067.2 hectares with a population of 14,149 and 3,086 households; Bachhauli lies in the eastern/Sauraha sector of the park and covers an area of 2111.12 hectares with a human population of 10,905 and 2,321 households (Central Bureau of Statistics, 2011).

Theory and methods

The government in Nepal created most of the protected areas in the Chitwan National Park with the “Stick and fence” or “fortress” approach. This method to conservation involves forceful

eviction of people from their traditional land in order to establish heavily guarded protected areas. However, there are cases where protected areas, particularly in developing countries, have failed in achieving their goals of protecting natural habitats and endangered wildlife species, while at the same time negatively impacted local populations (Barrett & Arcese, 1995; Hutton, Adams, & Murombedzi, 2005).

In response to this type of authoritarian approach, there was a global paradigm shift towards a participatory and community based conservation, and the concept of Integrated Conservation and Development Project (ICDP) came into vogue in the 1980s (Baral, Stern, & Heinen, 2007). ICDP aims at improving both the management of natural resources and quality of life for local people through an emphasis on the participation of local people in sustainable development, land management and conservation initiatives (Brown & Wyckoff-Baird, 1992). However, the conflicts between conservation and development still exist, and the effectiveness of ICDP in achieving these goals in various parts of the world has been questioned by different scholars such as Clark C. Gibson and Stuart A. Marks (1995) and William D. Newmark and John L. Hough (2000).

As mentioned, the ICDP was a consequence of the underlying limitations of traditional protected area management. However, after one and a half decades of vigorous promotion, there is a growing recognition that ICDP may not contribute to effective reconciliation of both conservation and development goals (Ojha & Sarkar, 2012). Conservation and development efforts in Nepal are often characterised by the irony that certain groups of people or communities are plagued by the costs of conservation while another group reaps the benefits of development (Shrestha & Alavalapati, 2006). This unfair distribution of benefits and costs has the potential to exacerbate the already existing inequality and injustice in the adjoining communities.

This study tries to examine such inequality by analysing the consequences of wildlife damages on the economics of local households

and how the distribution of benefits, or lack thereof, contributes to injustice. One of the limitations of the study is that among the many costs of conservation, only the wildlife damages have been taken into account. The following specific research questions were formulated to answer issues related to injustice and inequality.

- Does the wildlife damage and mitigation cost differ among households and how does it impact the income of the local people?
- Are the ones who suffer from wildlife damages the same as those who accrue conservation benefits?
- Is a recipient of a particular benefit also more likely to be recipient of other benefits?

Data collection and analysis

A total of 140 households were selected for the questionnaire survey that was conducted using both structured and semi-structured questionnaires. All the names of the households provided by the VDC office were noted down separately and 70 households from each VDC were chosen randomly. Questionnaire responses were coded and analysed using Statistical Package for Social Survey (SPSS) version 20.

To calculate the total household assets/wealth and total household income the following calculations were used:

- Total Household assets/wealth = value of land + value of buildings + value of livestock + value of bicycle/motorbike + other machineries + savings
- Total Household income = income from agricultural production + income from livestock + non-agricultural income + compensation from wildlife damages

Also, the cost of damages to the crops was calculated using the formula:

- Volume of loss = average yield × % area planted × % of yield lost
- Value of crop loss = volume of loss × value of crop

The respondents were asked to estimate the percentage of yield lost due to wildlife damages.

The reference for the average yield for particular crop for Chitwan district was taken from the Statistical Information of Nepalese Agriculture 2011/2012, published by Ministry of Agricultural Development, Government of Nepal (2012). Finally, the chi-squared test for independence was employed to assess whether two categorical variables were related. Binary logistic and multiple regressions along with correlation were used to examine relationships between variables. The level of statistical significance was defined at 0.1, 0.5 and 0.01 levels. The data were screened for co-linearity and outliers prior to analysis.

Results

Wildlife damage and mitigation measures

Nearly 74% of the respondents in Meghauli suffered damages from wildlife, while in Bachhauli only about 17% of the respondents suffered damages. Three types of direct costs of wildlife damages were observed, including crop loss, loss of livestock and damage to property. Crop damage was the most common damage suffered from wildlife in Meghauli and Bachhauli. Four wildlife species (rhino, elephant, wild boar and deer) were responsible for all the crop damages, and rhinos were reported as responsible for 62.5% of all crop damages. Seventy-one percent of the households used some sort of measures to protect against wildlife damages in Meghauli, while only 4% employed such measures in Bachhauli. Noise and fire making, watchtowers and guarding were some of the most commonly used mitigation measures. Indirect costs in defensive measures such as labour investment and lost opportunities were beyond the scope of this study. Total wildlife damage costs per year per household (cost of wildlife damages and mitigation measures) was found to be Nepalese Rupees (Rs.) 19,091.04 for Meghauli and Rs. 8,712.27 for Bachhauli, which is equal to 8.75% and 4.45% of the mean household income for Meghauli and Bachhauli respectively.

Justice issues

Are the ones who suffer from wildlife damages

and those who benefit from the park the same or different? To investigate the issue related to distribution of costs and benefits, a cross tab is performed between the cost variable (occurrence of wildlife damages) and different benefits variables, to calculate the observed frequency for a particular benefit-cost pair as shown in Table 1. The expected frequency (in parenthesis) is then calculated using the following formula:

$$\text{Expected frequency} = \frac{\text{row total} \times \text{column total}}{\text{total number of sample}}$$

It is then analysed if there is clumping or repulsion between cost and benefit variables and if it is significant in terms of chi-square statistics. A clumped distribution arises when the occurrence of one variable increases the probability of occurrence of another variable. The results in Table 1 show that buffer zone activities/programs exhibited significant clumping with incidences of wildlife damages.

That is, households that have suffered wildlife damages were significantly more likely to have benefited from buffer zone activities and programs. Tourism and access to electricity on the other hand have significant repulsion to incidences of wildlife damages. This means that households that have suffered wildlife damages were significantly less likely to have benefited from access to electricity and tourism.

Equality issues

Correlation and multiple regression analyses were conducted to examine the relationship between total income and independent variables such as location of household, sex of household head, area of landholding, caste/ethnicity, household wealth, wildlife damage cost and mitigation cost. Of the seven variables, only wildlife damage costs (p<0.1) and cost of mitigation measures (P<0.001) added statistically significance to the prediction. Table 2 summarizes the descriptive statistics and analysis as well as regression

Table 2. Correlation and multiple weights from the regression analysis of the factors affecting total income.

Variables	Correlation with Total income	Multiple Regression weight	
		B	β
Wildlife damage costs	0.212***	-1.159*	-0.194
Mitigation costs	0.426***	44.106***	0.543

*, ** and *** indicates significance at levels of 0.1, 0.05 and 0.01 respectively, N=140

results for significant predictor variables, wildlife damage costs and mitigation costs. The correlation coefficient for wildlife damage costs and mitigation costs is positively and significantly related to household income, indicating households having higher damage and mitigation costs tend to have higher income. The regression weight (B) is the expected increase or decrease in the dependent variable when there is a one standard deviation increase in the independent variable with all other independent variable held constant.

The sign of these regression weights can observe the direction of multivariate relationship between dependent and independent variables. Hence the respondents that have higher costs of wildlife damages were expected to have a lower income according to the model (negative regression weight), and respondents having higher costs of mitigation measures have a higher income (positive regression weight) controlling all other variables. At the same time as the costs of mitigation measures have a significant positive weight; it indicates that respondents having higher costs of mitigation measures have a higher income controlling all other variables. This can be explained by the fact that investment in mitigation measures helps to reduce wildlife damages and hence has a significantly lower impact on income. In absence of mitigation measures however, costs of wildlife damage increases and this corresponds to a decrease in income.

Additionally, it was examined if the incidences or occurrence of wildlife damages is different with respect to household economic

indicators. The chi square test revealed that wildlife damages were significantly related to household income ($\chi^2(1) = 6.760, p = 0.009 < 0.01$) and wealth ($\chi^2(1) = 6.445, p = 0.011 < 0.05$). The cross tabulation between wildlife damages and household economic indicators revealed that people with an income and wealth lower than the mean income and wealth tend to suffer more incidences of wildlife damages.

Coverage of benefits

To study if a recipient of a particular benefit is more likely to be recipient of other benefits, an analysis of interdependence adapted from David M. Tumusiime and Sjaastad (2013) among the five most frequent benefits was conducted. The most frequent benefits realised by the households in this study are involvement in buffer zone programs (75%), electricity (67.14%), and access to loan facilities (64.28%), yearly grass cutting (53.57%) and tourism (39.28%). The two most frequent benefits, involvement in buffer zone and access to electricity, was cross tabulated and the number of households that have access to both these benefits was obtained as shown in table 3. Then the observed frequency was obtained by dividing this number by the total number of respondents (140). Then the numbers of households that have access to all three most frequent benefits was obtained and the observed frequency was then calculated accordingly. This was then done for the three most frequent benefits and so on until the five most frequent benefits.

On the other hand, the expected frequency for a given set of benefits should be equal to the

Table 1. Expected and observed frequencies from cross tabulation of occurrence of wildlife damage and realization of various benefits.

Benefits realized	Wildlife damages in last 12 months			Relationship	Sig
	Yes	No			
Access to loan	Yes	40 (41.1)	50 (48.9)	Independence	
	No	24 (22.9)	26 (27.1)		
Yearly grass cutting	Yes	23 (34.3)	52 (40.7)	Independence	
	No	41 (29.7)	24 (35.3)		
Tourism	Yes	12 (25.1)	43 (29.9)	Repulsion	**
	No	52 (38.9)	33 (46.1)		
Community development	Yes	18 (20.6)	27 (24.4)	Independence	
	No	46 (43.4)	49 (51.6)		
Park related income	Yes	6 (7.8)	11 (9.2)	Independence	
	No	58 (56.2)	65 (66.8)		
Compensation	Yes	2 (0.9)	0 (1.1)	Independence	
	No	62 (63.1)	76 (74.9)		
Electricity	Yes	34 (43)	60 (51)	Repulsion	***
	No	30 (21)	16 (25)		
BZ activities and programs	Yes	59 (48.0)	46 (7.0)	Clumping	***
	No	5 (16.0)	30 (19.0)		

*, ** and *** indicates significance at levels of 0.1, 0.05 and 0.01 respectively, N=140

Table 3. Deviates from the expected and observed frequencies for respective benefit combinations.

Benefit combination	Exptd. (a)	SD (b)	Obsvd. (c)	Diff (d=c-a)	Deviate (d/b)
Two most frequent benefits	0.5036	0.0423	0.5143	0.0107	0.2541
Three most frequent benefits	0.3237	0.0395	0.3357	0.0120	0.3030
Four most frequent benefits	0.1734	0.0320	0.2143	0.0409	1.2770
Five most frequent benefits	0.0681	0.0213	0.1357	0.0676	3.1731***

*, ** and *** indicates significance at levels of 0.1, 0.05 and 0.01 respectively, N=140

observed frequencies. Based on this assumption, the expected frequency for the two most frequent benefits will be the product of proportion of respondents involved in buffer zone programs (0.75) and proportion of respondents having access to electricity (0.6714) and so on for all the benefit combinations. The difference in observed and expected frequency was then divided by standard deviation to obtain the deviate for respective benefits combination. This was then checked for respective level of significance.

Wildlife damages related to loss of crops, livestock and/or property were the only considered cost variable that could have occurred in the last 12 months prior to the questionnaire survey, while the realisation of benefits is not limited to the last 12 months. This difference in time period is mitigated by the assumption based on Tumusiime and Sjaastad (2013) that there is some temporal stability in terms of whether a household suffers from wildlife damage costs. Table 3 shows that beyond the four most frequent benefits, there was a significant clumping of benefits. This suggests that those who benefit from tourism are more likely to also receive other benefits as well, which indicates a concentration of benefits in places where tourism and tourist related activities take place.

Discussion

Crop damages, especially from rhino, were the most prevalent type of wildlife damage in the study areas. However, there was a significant difference in the occurrence of wildlife damages between the two study areas. The incidences and loss from wildlife damages are far more prevalent in Meghauri compared to Bachhauli.

One of the major reasons for this is the absence of functional electric fencing. Such fencing exists along the park border in Bachhauli constructed by the government to safeguard tourism interest in the area. The fences exclude most wildlife and hence fewer incidences of wildlife damages were observed. Maniratna Aryal (2008) reported an 80% reduction in crop damages in Bachhauli and adjacent Paithani VDC after the installation of electric fences. In addition, Reed Bailey (2011) reported a dramatic decrease in crop damages from rhinos in places where electric fences are installed.

A part of any conservation initiative is to ensure that community development or other initiatives target households that are adversely affected by park wildlife, and the park management often claim to be doing this. To scrutinise these claims and assess the success and failure of any conservation effort, it is important to examine allocation of benefits and costs originating from conservation efforts. If the allocation of benefits is unequally distributed on a local scale by only reaching a certain already prosperous fraction of communities while poor people experience most of the costs, it contributes to injustice and inequality. This study found that tourism related benefits and wildlife damage costs were the major sources of injustice and inequality in the study areas.

Firstly, it is important to note that tourism benefits in particular are inherently locational in nature and often correspond with better access to other benefits and services. Institutions and structures that provide such benefits are often clustered around the tourist areas. This illustrates that Bachhauli, being a tourism hub,

has better access to other benefits and services (e.g. electricity, electric fencing). Similar to this study, Arian Spiteri and Sanjay K. Nepal (2008), who looked at the same geographical area, also found that residents who experience the greatest cost of crop damages were the ones who profited least from the benefits of conservation.

Additionally, it was found that the households with a lower income and wealth tend to suffer more incidences of wildlife damages. In a study on Mikumi National Park in Tanzania, Vedeld et al., (2012) also found that the poorest segment of the community suffered the most crop raiding. Our study indicates that the cost of wildlife in terms of loss of crops and livestock and the subsequent need to invest in mitigation measures represents a substantial portion of annual income for poor households. In addition, wildlife damage and mitigation cost further increases inequality when higher costs of wildlife damages correspond to a lower income. Wealth on the other hand acts as a buffer and allows people to reduce risks by having increased access to capital or labour that enables the use of more efficient protection measures (Naughton-Treves & Treves, 2005). However, a lack of resources and wealth combined with high wildlife related costs means poor are getting poorer as they can neither absorb the losses nor protect themselves from such losses, thus contributing towards greater injustice and economic inequality in our study areas. Such injustice and inequality may ultimately lead to antagonistic attitudes towards the park and park authorities as wildlife damages (Mehta & Heinen, 2001) and capacity of protected areas to provide tangible benefits (Wang et al., 2006) are some of many factors that shape the attitude.

Conclusion

Given the households' reliance on crop and livestock production, reduced yields due to wildlife damages have a devastating impact by reducing food security and options for cash generation in local communities surrounding Chitwan National Park. This can have serious consequences for livelihood and welfare of local people and the ability of households to cope with shocks. The poorest face compounding vulnerability because they lack resources, which is combined with further economic constraints because of damages from wildlife. Hence, it can be concluded that wildlife damages are responsible for creating a greater economic inequality the area studied here. Furthermore, it is found the allocation of benefits as tourism and electricity varied locally and reached only a certain fraction of communities, while less resourceful groups are experiencing most of the costs associated with wildlife damages. This is contributing to injustice contrary to the principles of Integrated Conservation and Development Projects that aim to reconcile conservation and development goals.

Finally, it is recommended that future policies should be adopted so that all members of local communities get equal access to services. These policies should supplement livelihood strategies of local people in dealing with wildlife damages especially for marginalized groups. New institutional structures within conservation are needed to make adequate representation of poor, women and excluded groups in decision-making and financial matters to close the gap between different social and wealth classes.

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Photo: Hanna Kavli Lodberg-Holm

Letter

Prostitution should remain illegal in Canada

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Prostitution occurs in almost every culture, but not every culture legalizes it. The “oldest profession” has been permitted in several countries around the world in the past few decades. Recently, a discussion of this subject has emerged in Canada, a nation that suspended its prostitution laws in 2013. The Supreme Court of Canada decided to spend one year to re-evaluate their position and draft new laws (Perrin, 2014). Looking at examples of other countries with various prostitution laws helps to formulate a more informed evaluation of the critical issues such as human trafficking and violence toward women. Based upon these effects, I believe that prostitution should remain illegal in Canada.

Legalizing prostitution will lead to a higher demand of prostitutes. Janice Raymond (2004) analyses the sex trade from such a business-like perspective. She argues that demand is the primary factor for expanding the sex industry. When prostitution is legalized, demand increases substantially because sex for money becomes legitimized and non-stigmatized. For example, the use of brothels in Victoria, Australia was legalized in 1994. The number of brothels tripled in only four years (Raymond, 2004). In the Netherlands where prostitution is also legal, demand for sex is high, especially in the famous red light districts (Huisman & Kleemans, 2014). Thus, legalisation of prostitution will create a

bigger demand. This is problematic because a higher demand can be difficult to satisfy locally.

Therefore, legalizing prostitution increases human trafficking by making it a trade in terms of supply and demand – if not met locally, supply shifts globally. Farley (2003) argues that human trafficking is simply a global form of prostitution. In recent years, higher numbers of local women in Amsterdam, for example, are not as interested in working in the sex industry. However, with fewer workers and rising numbers of consumers the supply must come from abroad. Women from Eastern Europe or Africa meet the demand on visas especially built for sex workers; others are smuggled by traffickers (Raymond, 2004). In the United States where sex work is *not* legal, with the exception of the state of Nevada, around 50,000 women and children are trafficked annually for prostitution (Brents & Hausbeck, 2005; Monto, 2004). If legalized, demand will be substantially higher (Raymond, 2004). Prostitution therefore promotes human trafficking.

Legalizing prostitution legitimises violence against women directly and gender inequality indirectly through valuing women as commodities that can be bought (Raymond, 2004; Aghatise, 2004). Violence in brothels is something seen consistently, as they are difficult to supervise and violence is accepted as an occupational hazard (Aghatise, 2004).

Unfortunately, violence towards women occurs whether prostitution is legal or not; however, when women can be purchased, their rights as humans are ignored. Women labelled as commodities become nameless and faceless products for the pleasure of the patrons, which makes them easier to handle without ethical consideration. This attitude not only creates a gap in gender equality, it broadens it legally.

There are several arguments for legalizing prostitution. Supporters of legalized prostitution claim that sex work could be carried out safely in brothels and the government could maintain the industry through taxation (Weitzer, 2014; Immordino & Russo, 2015). Theoretically, tax revenue could serve to preserve worker safety and fuel the economy. For example, in Victoria, Australia, out of a population of 3 million people, 60,000 customers spend approximately 7 million dollars on sex in a single week (Raymond, 2004). Another argument is that if prostitutes were able to work in brothels, they would be away from high crime areas and dangerous situations (Weitzer, 2014). This seems like an attractive argument for legalizing prostitution in Canada.

There are, however, two problems with these ideas of safety and tax-generated profit. Firstly, there is not always a guarantee of safety in legalized brothels. In a modern day example, as in the case of the Netherlands, we see little difference in trends of violence (Huisman & Kleemans, 2014). Women can still be trafficked and forced to work under inhumane circumstances where there is not a large enough police presence for protection (Huisman & Kleemans, 2014). According to a study carried out in Canada, women in prostitution experience a death rate 40 times higher than women who are not (Farley, 2003). And in a study looking at people in various forms of prostitution, 68% of them met the criteria for post-traumatic stress disorder (PTSD), similar to combat veterans and

victims of torture (Farley et al., 2004). Secondly, both public and private long-term cost of damages associated with legalisation easily outweigh any benefits (Huisman & Kleemans, 2014). Law enforcement of trafficking and regulating brothels would face similar administrative expenses such as looking for trafficked victims or minors. Moreover, when considering the potential violence endured by the workers, trafficked or not, no amount of money is worth the human suffering that went into procuring it, especially if it was done legally.

The Supreme Court of Canada recently decided on new laws regarding prostitution. The Senate approved Bill C-36 in December of 2014. The new laws are similar to the Swedish model, criminalizing the purchasing of sex, but not sex work itself (Perrin, 2014). By making the purchasing of sex illegal, demand decreases. By decriminalizing the selling of sex, sex workers can report violence without fear of punishment for being employed as a sex worker, improving overall safety (Perrin, 2014). Benjamin Perrin (2014) argues that positive changes can only occur with proper implementation and monitoring of these new laws. The framework is there; it is now up to the people to realize and normalize these policies.

By looking at nations that have previously legalized prostitution, it is clear that some of the greatest problems that face the oldest profession have only worsened over time. Trafficking and violence continues to be a problem, and there are no simple answers to such complex issues. It is important to be aware of the problems associated with legalization because the laws can always be appealed and changed. By knowing the positives and negatives of legalization, one can apply this knowledge to other countries that may be thinking about re-evaluating their own prostitution laws. In terms of Canada, the Supreme Court has made the right decision to keep prostitution illegal.

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Photo: Maribel Roldón

The UN Global Compact: Soft law, CSR and human rights violations in the Colombian workplace

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Abstract: The UN Global Compact was launched in 1999 in a bid to curtail abuses carried out by corporations as the world faced rapid globalisation and increased trade liberalisation. Although the initiative for corporate social responsibility has attracted many members from around the world, its soft law and voluntary nature has not been enough to suppress many of the human rights and labour violations still in practice. A decade and a half later, abuses are still widespread, and evident in many countries. Moreover, some of the crimes can only be described as horrific. This is especially visible in Colombia – one of the most violent countries in the world – where anti-trade union violence is rife, and the perpetrators are seldom brought to justice.

In the latter half of the twentieth century, multinational corporations (MNCs) largely ignored, contested and resisted corporate social responsibility (CSR). Human rights abuses and labour violations became more evident and widespread throughout the global private sector in tandem with rapid globalisation and the rise of neoliberalism. Moreover, human rights breaches and corruption were commonplace in sectors such as mining, oil, banking, agriculture and telecommunications, according to James E. Post (2012). In addition, societies struggled to adjust to the ever-increasing pace of the free market. However, campaigns by non-political actors drew attention to the now well-documented practises of companies such as Nestlé, Shell, Wal-Mart and Nike among others (Kell, 2012; Post, 2012).

Therefore, the United Nations (UN) launched the UN Global Compact (UNGC) to set standards for global corporate responsibility and act against human rights, labour and environmental violations, and corruption (Post, 2012).

Many human rights violations still take place under the auspices of “Western” MNCs such as Coca-Cola, who operate in less developed countries, including Colombia (Needleman, 2013). Moreover, this is despite many of these countries being party to various human rights treaties (Human Rights Watch, 2014). Colombia has been fraught with anti-trade union and political violence for many years and provides the basis for the case study that follows. Colombia is an extreme and complex case but demonstrates the urgent need to prevent abuses such as threats

and violence when companies are held to account by their employees. Therefore, Colombia is a suitable case to assess the effectiveness of the UNGC and its ten founding principles, in particular Principle 3, which is directly aimed at upholding labour rights. Additionally, the situation in Colombia highlights that the soft law approach of the UNGC is flawed in certain areas such as preventing frequent violations related to labour practises and in bringing the perpetrators to justice.

The UNGC

The UNGC started as a speech delivered by the then UN secretary-general, Kofi Annan, at the 1999 World Economic Forum in Davos, Switzerland (Post, 2012). Annan addressed increasing globalisation, various human rights abuses, labour violations and environmental abuses by corporations, along with trade agreements advocating liberalisation such as the North American Free Trade Agreement (NAFTA). He highlighted the need for the UN to “initiate a global compact of shared values and principles, which will give a human face to the global market.” (as cited in Post, 2012: 54). Moreover, he called for accountability from businesses partaking in such abuses. Annan launched the UNGC without a mandate from UN General Assembly Member States and it subsequently had a slow start. Whilst OECD countries¹ welcomed it, believing it would address hostility towards liberalisation, developing countries were less hospitable and feared trade barriers if implemented. However, the UNGC is now “the largest voluntary corporate responsibility initiative in the world” spanning 145 countries, with over 12,000 members (United Nations, 2013).

The UNGC has expanded since its inception, continually addressing corporate governance and accountability in order to integrate CSR within the global market. Furthermore, although membership is voluntary, the UNGC’s Communication on Progress requires that participants “publicly report

on their implementation efforts to enhance their own accountability and promote transparency in the eyes of the public.” (Kell, 2012: 44). If they do not abide by this, the UN can terminate their membership.

The UN Global Compact is based on ten principles derived from The Universal Declaration of Human Rights, The International Labour Organization’s Declaration on Fundamental Principles and Rights at Work, The Rio Declaration on Environment and Development and The United Nations Convention Against Corruption (United Nations, 2013). They are as follows:

- Principle 1: Businesses should support and respect the protection of internationally proclaimed human rights; and
- Principle 2: make sure that they are not complicit in human rights abuses.
- Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
- Principle 4: the elimination of all forms of forced and compulsory labour;
- Principle 5: the effective abolition of child labour; and
- Principle 6: the elimination of discrimination in respect of employment and occupation.
- Principle 7: Businesses should support a precautionary approach to environmental challenges;
- Principle 8: undertake initiatives to promote greater environmental responsibility; and
- Principle 9: encourage the development and diffusion of environmentally friendly technologies.
- Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery.

In addition to the UNGC, it is also important to

provide a brief summary of the UN’s more recent “Protect, Respect and Remedy” Framework for Business and Human Rights, as presented by UN Special Representative John Ruggie in 2008. This three-pillar framework is relevant when considering human rights and labour practices. The first pillar - protect - relates to the obligations that states have under international law to protect their citizens from human rights abuses including those carried out by third parties in the corporate sector (U.N. General Assembly, 2011). Even if the state is not responsible for the violations, it still has a duty to prevent such abuses. Moreover, companies have a corporate responsibility to respect human rights within their own activities and relationships. Finally, along with the state’s obligation to protect against human rights violations, they are also obliged to provide adequate access to remedy within their jurisdiction, ensuring justice for victims and their families.

UNGC Principle 3

Trade unions and private corporations have long had a volatile relationship. If the neoliberal ideology is to maximise profit in the name of economic growth, one may ask why businesses would want their workers to have more rights, better conditions or a higher basic wage at the companies’ expense. However, in a battle of left wing verses right wing policies, some stakeholders in the world of corporate business *have* taken steps to alleviate discrimination against those workers who mobilise and bargain for what they think is fair. However, there is still a long way to go. Principle 3 of the UNGC states “[b]usinesses should uphold the freedom of association and the effective recognition of the right to collective bargaining” (United Nations, 2013).

Principle 3 allows workers to join and associate with any organisations or unions without discrimination from their employer – “freedom of association” (United Nations, 2013). Moreover, the employer may not meddle in or restrict the decision of the employee. In addition, unions should be permitted to take industrial

action to defend employee interests if necessary. Furthermore, negotiations in the workplace between employer and employees should be done amicably and without fear of discrimination, employers terminating contracts or retribution – “collective bargaining”. However, even with the guidelines of Principle 3 and various other conventions and treaties in place, these rights are still frequently violated. Businesses *are* required to adhere to national laws and states *are* obliged to protect their citizens (Human Rights Watch, 2014). Nevertheless, laws are often ignored, or legal loopholes exist to allow continued trade union violations. Nowhere are such violations more evident than in Colombia.

MNCs, human rights violations and trade unions in Colombia

For decades, Colombia has demonstrated serious breaches of freedom of association and recognition of collective bargaining. Violence, homicides and threats against trade unionists, their families and associates have plagued the Colombian workforce and earned the Latin American country the top spot for anti-unionist violence (Needleman, 2013). Close to 3000 trade unionists were killed since 1986 as of 2010. Furthermore, countless other cases of torture, abuse and threats have been recorded. Killings increased even after the UN laid out the UNGC principles and the crisis continues with no sign of abatement (Montoya et al., 2009). The year 2008 was particularly brutal for anti-trade union violence in Colombia with a significant increase of 72.8% recorded violations compared to the previous year. Mario Novelli (2008) states that the number of unsolved murders in Colombia is as high as 96%. Furthermore, membership of trade unions has shown a significant decrease, in fear of attacks, since the 1960s (Bolle, 2011).

The high number of violations to life and liberty against those connected to trade unions includes death threats, which can lead to forced displacement, attempted murders and murders (Novelli, 2008). In 2008 there was a case where a pregnant woman, Luz Mariela Diaz Lopez died

¹ Members of the Organisation for Economic Co-operation and Development.

at the hands of anti-trade unionists (Montoya et al., 2009). Furthermore, threats to family members including children are commonplace. Many of these crimes are the work of various paramilitary organisations. Moreover, some well-known MNCs involved in trade union scandals include Coca-Cola and General Motors (GM) (Needleman, 2013). Some of their actions in Colombia will be highlighted further on in this article.

In Colombia in the 1960s, left-wing guerrilla groups that were encouraged by the Cuban Revolution formed to fight against the state (Bolle, 2011). Two decades later, right-wing paramilitary groups formed to defend landowners against the leftist groups. The paramilitary groups are often regarded as those responsible for the violence and abuses directed towards trade unionists (Montoya et al., 2009). Furthermore, there is evidence of the state colluding with paramilitary organisations in order to spread fear, or worse, to carry out assassinations.

Despite alleged efforts by the state to demobilise those paramilitary organisations, including the “Justice and Peace Law,”² collusion still prevails and is often ignored by national and international authorities (Novelli, 2008; Needleman, 2013). Suggestions include that such groups receive intelligence from state security forces in order to carry out attacks against trade unionists (Novelli, 2008). Moreover, after the confusing demobilisation process, the once paramilitary groups have now reconfigured into dissident groups or gangs such as “The Black Eagles,”³ who use similar practises to their predecessors. These include justifiability in the name of national security; demands to leave the union and areas of residence; as well as allegations of communist or guerrilla involvement (Montoya et al., 2009). The government regards such acts as common crimes but very few perpetrators are brought to justice. This is counter to the main aims of Principle 3 of the UNGC – freedom of

association. Furthermore, from this it is evident that the Colombian government does not take the necessary actions to remedy the situation, despite being party to various human rights treaties obliging them to do so (Human Rights Watch, 2014).

In 1997, a United Nations High Commissioner for Human Rights in Colombia was established to monitor the serious situation, along with a more recent ILO mission which commenced in 2007 (Novelli, 2008). Ironically, Colombia has ratified all four of the ILO core labour standards and the conventions defining them, which include to “protect the right of workers to organize and bargain collectively” (Bolle, 2011: 9). Although law permits some workers to form unions, many restrictions still exist and many agencies hire employees indirectly, thus avoiding a direct contract with the employer and the option of joining a union. Even at a municipal level, the governments are obliged to assist victims in need of humanitarian assistance, for example because of displacement. However, these obligations are seldom carried through, or the displacements even recorded.

Colombia’s obligations were intensified and the violations scrutinised during the run-up to the signing of their Free-Trade Agreement (FTA) with the United States in 2011. The government adopted a Labour Action Plan (LAP) to curb human rights violations against trade unionists, along with other labour issues, but immediately fell in for criticism (Nicholls & Sánchez-Garzoli, 2011). Proponents of the FTA argued that economic growth would lead to greater protection for Colombia’s trade unionists (Bolle, 2011). Although opponents called for more time for Colombia to prove that it can take sufficient action against trade union violence and the high rate of impunity with convictions. Proponents also argued that homicides had declined since the government implemented personal protection programmes. However, opponents stated that this was down to fewer targets, that is, less union members, along with an increase in other forms of intimidation, such as death threats.

Although perhaps considered not as serious, they still constitute grave violations of human rights for trade unionists, quashing their right to freedom of association and collective bargaining. Furthermore, as activist Danelly Estupiñán from the port of Buenaventura explained,

The FTA would deepen the crisis that we are living here because the FTA is synonymous with privatization and privatization is synonymous with unemployment, unemployment is synonymous with poverty and misery and misery is synonymous with loss of autonomy and sovereignty for our people and as a country. (as cited in Nicholls & Sánchez-Garzoli, 2011: 7)

The LAP also states that employers should directly hire those employees doing “core work” (Needleman, 2013). However, no one has issued guidelines on what constitutes core work. One of the employment sectors under this superficial piece of legislation is port work, such as the majority of that available in Buenaventura.

Buenaventura is Colombia’s most violent city. There have been, and still are countless murders, disappearances, displacements, gang violence and infamous “chopping houses”⁴ (Human Rights Watch, 2014). Proponents of the FTA argue that such an agreement can lift cities like Buenaventura out of poverty, along with reducing crime rates (Nicholls & Sánchez-Garzoli, 2011). However, the evidence is contrary to this argument. The port of Buenaventura, in line with neoliberal thinking, was privatised in 1994, seventeen years before the FTA. A direct consequence of this was an attempted disbandment of the existing unions and a general worsening of working conditions and standards. As a result, 31 dockworkers lost their lives between the privatisation in 1994 and 2008 and no charges were ever brought about – an all too common occurrence still in Colombia, and in particular Buenaventura. Moreover, incidents of collusion between state security forces and successor paramilitary organisations have been witnessed on the streets of Buenaventura, according to Human Rights Watch (2014).

In Buenaventura, the private Port Society employs 6000 workers, but less than half of them are union members (Needleman, 2013). Even then, those who are affiliated with unions or try to mobilise are vilified. Other workers are hired through labour cooperatives known as CTAs. Contracts, benefits and rights to collective bargaining are non-existent for these workers in Buenaventura and throughout the rest of Colombia. Although third-party hiring was outlawed under the LAP, new agencies that use a legal loophole to act as fake unions in order to hire workers without permanent contracts replaced the practice in Colombia.

In one Colombian Coca-Cola plant with a chequered history concerning trade unions, only 30% of operational staff and 15% of distribution workers are direct employees with contracts (Needleman, 2013). Moreover, employers can force workers to sign pacts denouncing the union – otherwise they lose their jobs. Under the LAP, the government was supposed to stop this practice, but they failed to do so. One MNC using the pacts since 2003 is GM in their plant in the capital, Bogota.

GM and Coca-Cola are both examples of MNCs operating in Colombia that flout human rights guidelines in relation to labour practises. In addition to using collective pacts, GM at their Colmotores plant contravened confidentiality agreements by sharing employees’ medical records between their doctors and management concerning workers injured on the job (Needleman, 2013). Charges were filed but the courts dismissed the case after the records vanished. Subsequently, 68 injured workers mobilised in protest and two months later the chief organiser, Jorge Parra, lost his job. Protests took place in Bogota and the United States (the home of GM) and included a hunger strike where the sacked workers sewed their lips shut. The result of this was an offer from Colmotores of 5000 U.S. dollars split between eleven of the workers; a far cry from the 50,000 U.S. dollars cost of one surgery. Moreover, Coca-Cola’s human rights abuses towards workers span the globe, according to the website *killercoke*.

² A 2005 law which helped with the demobilising process of armed groups.

³ A newly emerged paramilitary force.

⁴ Where victims are dismembered alive and body parts disposed of in the nearby bay.

org (n.d). Furthermore, its crimes in bottling plants in Colombia are well documented – including union crushing, assassinations and close cooperation between management and paramilitary organisations. The majority of cases result in impunity; the perpetrators are not held responsible for their actions.

Conclusion

Actions of the MNCs and the Colombian government are not concurrent with the guiding principles of the UNGC, in particular Principle 3 – freedom of association and recognition of collective bargaining as addressed in this paper (United Nations, 2013). Moreover, the lack of compliance with the three pillars of the “Protect, Respect and Remedy” framework is evident (U.N. General Assembly, 2011). Workers are not protected from abuse by the State. In addition, guidelines and even signed

treaties and conventions are not respected by either corporations or the State. The high rate of impunity highlights that the measures taken by the State to bring the perpetrators to justice and to assist the victims is inadequate.

The history of inadequacies of justice in regards to anti-trade union violence in Colombia has developed a pattern. Governments have made efforts to disguise or play down the severities over the last few decades instead of concentrating on prevention and remedies (Montoya et al., 2009). With impunity rates estimated to be as high as 98.3%, this guarantees that the violations continue. The UNGC is a step in the right direction, but contradictions between human rights and business practices prevail. Furthermore, the soft law guiding principles do not earn the respect of much of the corporate community, not just in Colombia, but globally too.

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Photo: Connie Veronica Linden

Variations of mercury levels within the eastern Beaufort Sea beluga population due to individual feeding behaviour

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Abstract: Although few measurements indicate that the mercury (Hg) levels of the eastern Beaufort Sea beluga exceed the threshold level for aquatic mammals, the long-term effects of pollutants and environmental stress together with increasing Hg levels are poorly understood. The food web in deeper ocean waters starts with higher methyl mercury levels in low trophic level organisms, increasing Hg levels in beluga prey. Beluga, which prefer deep ocean habitats for feeding, have higher Hg concentrations than animals with different feeding behaviour. Consequently, feeding behaviour correlates with Hg level. A similar correlation between the feeding behaviour and the Hg levels may be the case for Arctic foxes, Arctic seal species and polar bears.

A certain dose of Hg is toxic, because of its interaction with biological cells. Therefore, research focuses on monitoring the mercury levels in biota. Human activities have caused an increase in mercury emissions, since the second half of the nineteenth century (AMAP Working Group, 2011). The key question is not the total quantity of mercury in an environment but rather its bioavailability due to different Hg species, and how this is influenced by abiotic factors. Loseto et al. (2009) characterise the eastern Beaufort Sea beluga population (*Delphinapterus leucas*) as the beluga population with the highest Hg concentration in the Canadian Arctic Sea. A variation of Hg levels and different feeding behaviour exist within the population. Can the feeding behaviour of individual eastern Beaufort beluga have a significant impact on the quantity of biomagnified mercury, and does climate change

have any impact on the internal dose of mercury in biota?

In order to answer these questions, this paper will consider the sources and chemical properties of the pollutant mercury, its uptake pathways into biota, the unique Arctic ecosystem, monitored Hg levels in possible prey for the beluga, and feeding habitat preferences. These factors must be considered in order to assess Hg levels in the eastern Beaufort beluga population, and predict the local Hg trends.

The xenobiotic mercury

Mercury baseline

A natural presence of Hg exists in the environment, and must be considered when assessing recent Hg levels. Dietz, Outridge & Hobson (2009) establish a natural baseline for Hg in the Arctic, that varies from 0,001µg/g dry weight (dw) to 3,1µg/g dw.

The calculations of these concentration baselines are based on data that differ from the origin of the sample, more precisely the Arctic region the sample is taken from, the matrix, species, and year. Species analysed include aquatic mammals, birds and humans. The data cover dates from the thirteenth to the eighteenth century. To determine the background level for the eastern Beaufort beluga population, 11 teeth samples from 1550 to 1993 from the Mackenzie Delta were used, from the age groups 20, 40 and 60. The background level based on the year 1550 was 0,001µg/g dw for the 20 year group, 0,005µg/g dw for the 40 year group, and 0,017µg/g dw for the 60 year group. These levels occur due to biomagnification of naturally emitted Hg (Dietz et al. 2009). Biomagnification means the enrichment of xenobiotics with each trophic level (Walker, Sibly, Hopkin, & Peakall, 2012).

Natural Mercury cycle

Natural sources of the heavy metal Hg are volcanoes, forest fires and weathering of rock that contains a high percentage of Hg (Laws, 2013). These sources release Hg directly or indirectly from the earth's crust into the environment (Ravilious, Symon, & Wilson, 2011). During the natural geochemical Hg cycle, surface oil, surface ocean water, ocean deep water and air mostly affect the accumulation of Hg. Re-emission and re-deposition within these matrixes make the cycle dynamic and the research complex. 2000t Hg are emitted globally each year by natural sources and through different pathways (Outridge et al., 2008). There are two main transport pathways for Hg: atmospheric transport and transport through water (Ravilious et al., 2011). Both of these transport pathways have a significant impact on the levels of Hg in the eastern Beaufort Sea. Robie W. Macdonald and Lisa L. Loseto (2010) emphasise the importance of considering the atmospheric transport as unique to Polar Regions, which have an impact on the Hg cycle.

Anthropogenic sources

Most Hg deposited in the Arctic was emitted in other parts of the world and arrived through

atmospheric transport. Industry states in the northern hemisphere – especially the United States, Europe, and China – are the main emitters of gaseous Hg. Recent human activities generate as much Hg emissions per year as the quantity emitted naturally (AMAP Working Group, 2011). The burning of fossil fuel, especially coal, causes the main emission of Hg. Dietz et al. (2009) refer to 1850 as the year in which Arctic wildlife including the beluga populations first experience significant exposure to anthropogenic Hg. The Hg input by Atlantic waters is much higher than the Pacific input. The absence of local anthropogenic Hg sources is characteristic for the Arctic Ocean because there are very few anthropogenic local sources of Hg in the eastern Beaufort area (AMAP Working Group, 2005). For the local beluga population, the anthropogenic contribution to present-day Hg levels varies from 71.2% to 94.4% (Dietz et al., 2009).

Speciation

It is essential to consider the different chemical properties of all forms of Hg when assessing the levels of mercury in the ecosystem of the eastern Beaufort Sea. There is a variation in the distribution in the Arctic environment, the bioavailability for beluga and its prey, and toxicity to aquatic mammals. Hg forms are grouped into elemental Hg ($Hg_{(0)}$), inorganic Hg (iHg or Hg_{II}), reactive Hg (HgR) and organic Hg (MeHg). For studies on toxic effects in beluga, the MeHg is most important (Stern, Ostertag, Wang, Lemes, & Chan, 2013).

Methyl mercury is the predominant lipophilic form of organic mercury (Stern et al., 2013). Primarily biological processes form it, specifically by methylation of iHg. That means that Hg becomes bound to carbon-hydrogen groups (AMAP Working Group, 2011). In the methylation process a single carbon methyl group (e.g. CH_3^-) is transferred from an organic compound and as a second step becomes bound to an inorganic mercury ion (e.g. Hg^+) (Laws, 2013). The reaction rate from $Hg_{(0)}$ or iHg to MeHg depends highly on the redox potential of the medium. The methylation rate increases in

deeper water due to the tendency of lower oxygen concentrations (Macdonald & Loseto, 2010). Consequently, the amount of dissolved organic Hg increases with depth. Thus, the main source of MeHg is the deep ocean water and not the runoff from the coast or the euphotic zone (Loseto et al., 2008).

MeHg is the most toxic form of Hg for organisms; it is bioavailable and biomagnifying (AMAP Working Group, 2011). The most common forms of MeHg in biota are Mercuric chloride (CH_3HgCl) and Dimethyl mercury ($(CH_3)_2Hg$). MeHg has a sulphur- or nitrogen-seeking tendency to form covalent bonds, giving it a high affinity to proteins (Walker et al., 2012). Organisms protect themselves against exposed MeHg by excretion or storage in fat tissues. Due to its lipophilic character, the highest accumulations of MeHg are in the tissues of the liver, kidney, muscles and brain (Loseto et al., 2009; Sonne et al., 2009). With regard to the maximum accumulation rates, these tissues are of special concern when measuring the Hg level in beluga. A large amount of research focuses on the total amount of mercury (tHg) in biota, without differing between the chemical forms of Hg. In a study on mercury levels in grey wolves (*Canis lupus*), McGrew et al. (2014) focus solely on tHg. Consequently, the toxicity is difficult to assess due to the properties of the different forms of mercury.

There is a gap between the amount of the species $Hg_{(0)}$, iHg and MeHg in media such as the atmosphere and the beluga tissue. A variation of the distribution of the different Hg types occurs depending on the species, the type of tissue, and the individual animal. Stern et al. (2013) conclude that in the cerebellum, a part of the beluga brain, 32 % to 41 % of the tHg is MeHg and 59 % to 68 % is labile iHg. In the beluga muscle, 99 % of the tHg is MeHg (Loseto et al., 2008). Consequently, rather than the concentration of tHg in an environment, the distribution of the chemical forms of Hg is important. Hg levels in the beluga brain are caused by the biomagnification of Hg within the Arctic food web, which is influenced by climate and the beluga food web.

Arctic

Enrichment of mercury in Arctic biota

A median annual amount of 200 to 300t Hg from both, natural and anthropogenic sources enters the Arctic. The enrichment of Hg within Arctic organisms is based on bioavailability, bioconcentration, biomagnification, persistence and toxicity. "Bioconcentration" describes the increase of a xenobiotic in an organism compared with the ambient medium in which the organism lives (Walker et al., 2012). In this case, the important xenobiotic is mercury, the important organisms are predominately beluga, and its food sources and the ambient medium is the ocean water. To quantify the levels of bioaccumulated Hg caused by the water medium, the bioconcentration factor (BCF) is used. BCF is the ratio of the concentration of the xenobiotic in an organism to that of the ambient medium (Laws, 2013). This steady-state ratio reflects the tendency of mercury to accumulate in biota from the ambient environment. BCF values are measured under laboratory conditions and exclude the impact of dietary sources. Thus, BCFs reflect the uptake from the medium of Hg, which tends to be most important for explaining Hg levels in organisms at a low trophic level, like phytoplankton.

The uptake of MeHg in predators on a high trophic level, like the beluga, results predominately from the ingestion of food containing MeHg. The flux of MeHg from the ambient medium is irrelevant (AMAP Working Group, 2011). To quantify the Hg uptake through diet, the biomagnification factor (BMF) is used (Walker et al., 2012). BMF is the difference from the concentration of a xenobiotic in predator and prey. To consider the different chemical forms of Hg the Methyl mercury biomagnification factor (MeBMF) is used.

Role of climate

Climate factors have a significant impact on the transfer and transformation of Hg in the Arctic Ocean, which then affect the methylation of mercury (Macdonald & Loseto, 2010). As an adaption to the cold conditions, Arctic animals insulate their organs with layers of fat tissue

(AMAP Working Group, 2005). Lipophilic xenobiotics, for example MeHg, may be enriched there, which makes Arctic predators vulnerable to Hg contamination. Furthermore, laboratory measurements like threshold levels are measured under standardised conditions. Especially the standardised temperature and pH differ from the conditions in the Arctic environment. These differences in the key factors lead to the concern whether the scientific results are appropriate for Arctic ecosystems. The global/regional atmospheric heavy metals model, also named GRAHAM model, developed by the Meteorological Service of Canada, suggests that the pollution of Hg in the Arctic is significantly higher in winter from all the sources worldwide (AMAP Working Group, 2011).

Macdonald and Loseto (2010) emphasise the uncertainties about atmospheric deposition predicted by the GRAHAM model, caused by a lack of field measurements of the change between air and sea of Hg. How climate change may influence the Hg deposition is characterised as a poorly understood pattern by Macdonald and Loseto (2010). Recent research indicates that rising concentrations of carbon in ocean water increases the methylation process, and consequently affects the bioavailability of Hg (Macdonald & Loseto, 2010). Thus, the predicted climate change can affect the methylation rate. More dissolved carbon in ocean water can lead to a trend of increasing methylation rate. A higher methylation rate would increase the bioavailability of Hg to aquatic organisms. If this prediction proves true, beluga populations could be exposed to higher amounts of Hg due to higher mercury levels in their prey. This is supported by Macdonald and Loseto (2010), who emphasise that Arctic predators are vulnerable to climate change due to the predicted trend of methylation process.

Role of feeding behaviour in the eastern Beaufort Sea beluga population

The aquatic food web in the Arctic is characterised by long diverse food webs and long-lived top-predators (AMAP, Working Group, 2011). The

temporally changing habitats in the Arctic are diverse due to a large gradient in the salinity, the temperature, the depth of the ocean water and seasonal sea ice cover (Loseto et al., 2008; Loseto, Richard, Stern, Orr, & Ferguson, 2006). Seasonal sea ice changes patterns in the feeding behaviours of various animals as well as interactions within the food web (Loseto et al. 2006). Macdonald and Loseto (2010) describe the diet of the eastern Beaufort beluga as poorly understood. Reasons for this may be the difficulty of observing the feeding behaviour of the predators and insufficient data of prey content found in beluga stomach. The few data of Greenlandic beluga and Alaskan beluga stomach content suggest the diet of beluga may be population and habitat specific.

The research by Loseto et al. (2009) indicates Arctic cod as the main food source for the eastern Beaufort beluga. They established the estuarine-shelf and the epibenthic as simplified food web groups. To measure the Hg concentration at different trophic levels of the food web, samples from zooplankton, epibenthic invertebrates and fish, both herbivore and carnivore species, were analysed. To establish data about the feeding behaviour of the eastern Beaufort beluga the measured Hg level in beluga prey were grouped and linked to its associated food web. Beluga habitat groups based on data from satellite tagging were established and the MeBMFs were calculated.

Prey

Samples to detect the tHg and the MeHg level of beluga prey organisms assumed important in the beluga food web were collected in 2002, 2003, 2004 and 2006. These samples were taken from different locations, including the western Arctic region, Mackenzie Delta, Amundsen Gulf, Franklin Bay and the eastern Beaufort Sea (Loseto et al., 2008). The accuracy for the Hg measurements ranged from 0.001µg/g to 0.090µg/g (dw).

Estuarine fish

The sampled estuarine fish live in brackish

waters, which are mixing zones of seawater and fresh water in the delta of the Mackenzie River. Due to a large gradient of salinity, temperature and depth, brackish environments are diverse habitats that offer a variety of niches. The samples were collected in a range of depth less than 20 metres, down to 200 metres (Loseto et al., 2008). The Mackenzie River is an important source of Hg. Estuarine fish samples had the lowest MeHg levels, ranging from 0.1 to 0.27µg/g dw in arctic cisco (*Coregonus autumnalis*) and saffron cod (*Eleginus gracilis*).

Epibenthic invertebrates

Samples for the group epibenthic invertebrates were collected directly on and in the upper 60 centimetres of the seafloor. These organisms live in deep ocean water. The fourhorn sculpin (*Myoxocephalus quadricornis*) had the highest MeHg level with an amount of 0.5µg/g dw (Loseto et al., 2008). Compared to estuarine fish sample, epibenthic invertebrates have predominately the highest MeHg levels. The reason for these high levels may be differences in the redox potential of the two ecosystems. The deep ocean benthic ecosystem has a high rate of Hg methylation due to chemical processes in sediments. Consequently, epibenthic organisms are exposed to 10⁶-fold higher MeHg than organisms feeding in water (AMAP Working Group, 2011). The Hg flux to epibenthic organisms may also be influenced by previously processed or dead organic material containing a high concentration of MeHg or Hg₍₀₎. Due to this, the benthic food web may start at higher Hg levels (Macdonald & Loseto, 2010). As a next step, in order to find out if the differences of Hg levels in the different marine ecosystems have an impact on Hg levels in beluga, it is necessary to link the prey item data with beluga habitat groups.

The MeHg concentrations vary from the low concentration of 28% in zooplankton, which has a low trophic level, to high concentrations of 97.2% in Arctic cod, which is an organism on a much higher trophic level. This suggests a correlation between the percentage of MeHg in

the total amount of Hg and the trophic level of the organism.

Beluga habitat groups

From 1993 to 1997, 24 beluga, with a minimum length of 3 metres, were satellite-tagged in order to collect data about their habitat preferences (Loseto et al., 2006). The detected location data is used to calculate habitat use for each beluga individually. Based on this data, three beluga habitat groups were formed. The first beluga group preferred shallow open water near mainland. Therefore, this beluga group feeds mainly on estuarine fish. Individuals belonging to this group are females with calves, females without calves and males smaller than 4 metres in length. The second beluga group preferred habitats close to sea ice edges. Individuals belonging to this group are males from 3.8 metres to 4.3 metres in length, and some females without calves with a length less than 3.4 metres. The third beluga group preferred the heavy sea ice concentration in deep, offshore waters. This is the largest group, with males from 4 metres to 4.6 metres.

The data highlights differences in the habitat use due to sex and life stage of the beluga. For the splitting of the population, the term segregation is used. Loseto et al. (2008) name protection of the offspring, beluga social structure, and different intra-specific energetic demands, as possible reasons for segregation within the eastern Beaufort beluga population. In the deep offshore water, some predators, like killer whales, have their own hunting area. In the shallow waters of the coast, they hunt infrequently due to limited mobility. Offshore sea ice areas are habitats for polar bears, which feed on beluga. Consequently, the habitat near the coast is safer for female beluga with offspring. There is a lack of knowledge about possible social structures in beluga populations. Loseto et al. (2008) suggest that males in the first beluga group may help the females protect the offspring. Due to the sexual size dimorphic, males have on average a higher energy demand, and need to find rich food sources, which might be located in deep offshore water.

MeBMF calculation

The beluga habitat groups are used to calculate the MeHg between beluga and the potential prey (Loseto et al., 2008).

The following formula is used:

$\text{MeBMF} = (\text{MeHg predator} / \text{MeHg prey}) / (\delta^{15}\text{N predator} / \delta^{15}\text{N prey})$

The difference between the MeBMF of the estuarine-shelf group and the epibenthic group is high. The MeBMF for the estuarine-shelf group is medial 14.45 and for the epibenthic group 22.63. The level of grouped fish linked to MeBMFs correlate. Consequently, MeHg levels in prey and beluga Hg levels correspond. Beluga belonging to the third habitat group are exposed to the highest MeHg levels due to higher MeHg levels in their prey.

An uncertainty in the data is that the trophic level transfer processes from crustaceans to beluga might be different in comparison to the transfer process from fish to beluga. The MeBMF could also be influenced by different energy content of prey, which leads to a different amount of food consumed by beluga. Different food amounts might influence the biomagnification of Hg. The study of Loseto et al. (2008) shows the connection between feeding behaviour and Hg uptake of the eastern Beaufort beluga and recommends considering the diet factor in studies about biomagnification of Hg, as well as the focus on MeHg uptake on low trophic level of the food web. The importance of getting knowledge about the feeding behaviour in order to understand the varying Hg concentrations is not limited to the beluga species. Other Arctic animals like Arctic foxes, Arctic seal species, and polar bears may show a similar correlation (Sonne et al., 2009; Rigét et al., 2011).

Toxic effect

Sonne et al. (2009) emphasise that it is difficult to prove a cause and effect relationship of Hg level in biota. Due to its high chemical affinity to interact with thiols, MeHg is of special concern (Laws, 2013). MeHg can cross the blood-brain

barrier and the placenta. Thus, Hg can result in a neurochemical disruption and may lead to paraesthesia, ataxia, sensory loss or memory loss (Dietz et al., 2013). The element selenium may play a role in the detoxification of Hg in the brain by binding iHg. MeHg can also harm lungs and kidneys, as well as offspring (Laws, 2013). Studies have shown that high levels of Hg are linked to an increased risk of cardiovascular diseases in humans. Hg threshold levels are mostly based on studies exposing laboratory animals to a high acute dose of Hg (Dietz et al., 2013). In the Arctic environment, beluga are exposed to lower, chronic doses plus a mixture of xenobiotic and environmental stressors (AMAP Working Group, 2011). The threshold level for liver and kidney tissue in marine mammals, including beluga, is 60 µg/g dw (Sonne et al., 2009). Rigét et al. (2011) found that the temporal trend in beluga liver from the eastern Beaufort beluga population has increased from 1992 to 2002. Stern et al. (2013) monitor 14% of the samples from the local beluga population to exceed the threshold levels.

Conclusion

Loseto et al. (2008) study shows that the variation of mercury within the eastern Beaufort Sea beluga population is due to variations in habitat, which is shaped by individual feeding behaviours of beluga. A huge difference between the concentration of Hg in the medium water and the muscle tissue of beluga exist, caused by bioconcentration and biomagnification. The speciation within different media varies. Therefor monitoring studies should focus on the analysis of mercury species. The uptake of mercury reaches levels that cause Hg levels in beluga exceeding the threshold level. Consequently, the feeding behaviour plays an important role in the enrichment of Hg in beluga.

The trend of Hg in eastern Beaufort Sea beluga is increasing, which may cause a risk for Inuit population, who consume beluga. To predict the future trend of Hg level in this population the role of climate change on the methylation ratio and other factors have to be considered (Macdonald & Loseto, 2010). Climate change may lead to an

increase in the bioavailability of Hg for arctic biota and higher levels in top predators like the beluga. Macdonald and Loseto (2010) emphasise that research should focus more on the uptake of Hg by marine biota as well as the transfer and

transformation of mercury in aquatic systems in different species like Arctic foxes, Arctic seal species and polar bears that may show a similar correlation (Sonne et al., 2009; Rigét et al., 2011).

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Photo: Neil Davey

Letter

Insects: The food of the future

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Humankind is facing a future with growing populations and limited food. Humans have overexploited about 25% of the world's fisheries and currently use 30% of the world's land area for livestock rearing (Grafton, Kompas & Wilborn, 2007; Shockley & Dossey, 2013). Insects, while not widely eaten in Western countries, provide a more sustainable food source and could therefore help provide food security. With increasing pressure on the world's resources and environment, Western societies should accept insects as a food source because they are a more efficient source of nutrition than conventional animal husbandry (Shockley & Dossey, 2013).

By converting feed more efficiently than traditional sources of animal protein, insects use less land and water (Premalatha, T. Abbasi, T. Abbasi & S. A. Abbasi, 2011). Insects have short life cycles and procreate in large quantities, producing a big supply of edible biomass in a short timeframe (Shockley & Dossey, 2013). Where a cow requires around eight grams of feed to gain one gram of mass, insects need less than two grams (Vogel, 2010). Consequently, insects require only 25% of the land that livestock feed-production needs. Using fewer crops for insect feed would also mean reduced water use. Moreover, insects obtain water directly from food, which further decreases water use, in comparison to livestock that needs additional

water sources (Shockley & Dossey, 2013).

The production of livestock also accounts for 8% of all manmade greenhouse gas (GHG) emissions, and switching to insects would therefore be more environmentally friendly (Shockley & Dossey, 2013). Oonincx et al. (2010) concluded in a study that edible insects emitted roughly 90 times less CO₂ equivalents per kilo mass gained compared to cattle, and around 40 times less than pigs. In addition, insects can replace animal feed and reduce organic waste from food production. Housefly larvae (*Musca domestica*), for example, can convert chicken manure into biomass, thus reducing waste (Rumpold & Schlüter, 2013b). The larvae can also be dried and fed to chicks, covering their protein requirement (Rumpold & Schlüter 2013b). The black soldier fly pupae (*Hermetica illucens*), on the other hand, can be fed fish offal and retain enough omega-3 fatty acids to replace fish oil and fish meal in animal diets (St-Hilaire et al., 2007). Converting to insects as a protein source would therefore decrease both emissions from the food source and the feed production.

In addition, insects can provide similar nutrition to livestock. The house cricket (*Acheta domesticus*) has twice the protein content of beef, even though its nutritional value is not extraordinary compared with other edible insects (Rumpold & Schlüter, 2013a; U.S. Department of

Agriculture, 2008). A review by Xiaoming, Ying and Hong (2008) showed that the protein content of raw, common edible insects varied between 20% and 70%. These proteins contain a suitable amount of amino acids for human consumption and have high digestibility (Premalatha et al., 2011). The fat content of insects depends on their developmental stage; larvae and pupae can have up to 50% fat content, while the fat content of adults can be as low as 2% (Xiaoming et al., 2008). The wide range in nutritional value could be favorable for Western consumers with differing dietary needs.

However, most people in Western society find insects unpalatable, and this is best understood as a cultural taboo, since insects are a widespread food in many tropical and subtropical countries (Shockley & Dossey, 2013). Reluctance to eat new types of food is called food neophobia and is easiest to overcome during childhood by, for example, introducing insects through school meals at an early age (Birch, 1999). However, tests on Western adult consumers by Megido et al. (2013) also showed that insects were more desirable after tasting. When the food containing insects were associated with familiar flavors, the respondents were more prone to rate the food favorably and cook it in the future. Lensvelt and Steenbekkers (2014) support this, finding that information and taste tests had a positive influence on consumers' perception of insects as food. Educating people through tasting would be

an effective way of combating the insect taboo.

Full-scale farming of insects for human consumption is rare, and there are still obstacles to be overcome. It is desirable to avoid some of the pitfalls seen in livestock production, such as the excessive use of antibiotics that leads to resistant bacteria (Walker, Rhubart-Berg, McKenzie, Kelling, & Lawrence, 2005). In the European Union (E.U.) the Novel Food Regulation puts restrictions on the trade of insects, as it regulates foods that were not commonly used prior to 1997 (European Commission, 1997; Hermann, 2009; Huis et al., 2013). However, insect rearing has shown to be viable, particularly outside the Western world. In Peru, the production of a food dye based on the cochineal (*Dactylopius coccus*) had an export value of 39.6 million U.S. dollars in 2006. In addition, the production has been commended for providing social benefits to Peruvians, as well as being environmentally beneficial (Huis et al., 2013).

Insects are a novel way of approaching food security issues, yet they remain largely unexplored in terms of mass production for human consumption. There are still challenges concerning the legal framework and the practical implementation of mass production. Nonetheless, seeing how insects can potentially be produced in great numbers, and with more sustainable methods than conventional animal husbandry, it should be implemented sooner rather than later.

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The *NMBU Student Journal of Life Sciences* Volume 6 is expected to be published in spring 2016.

