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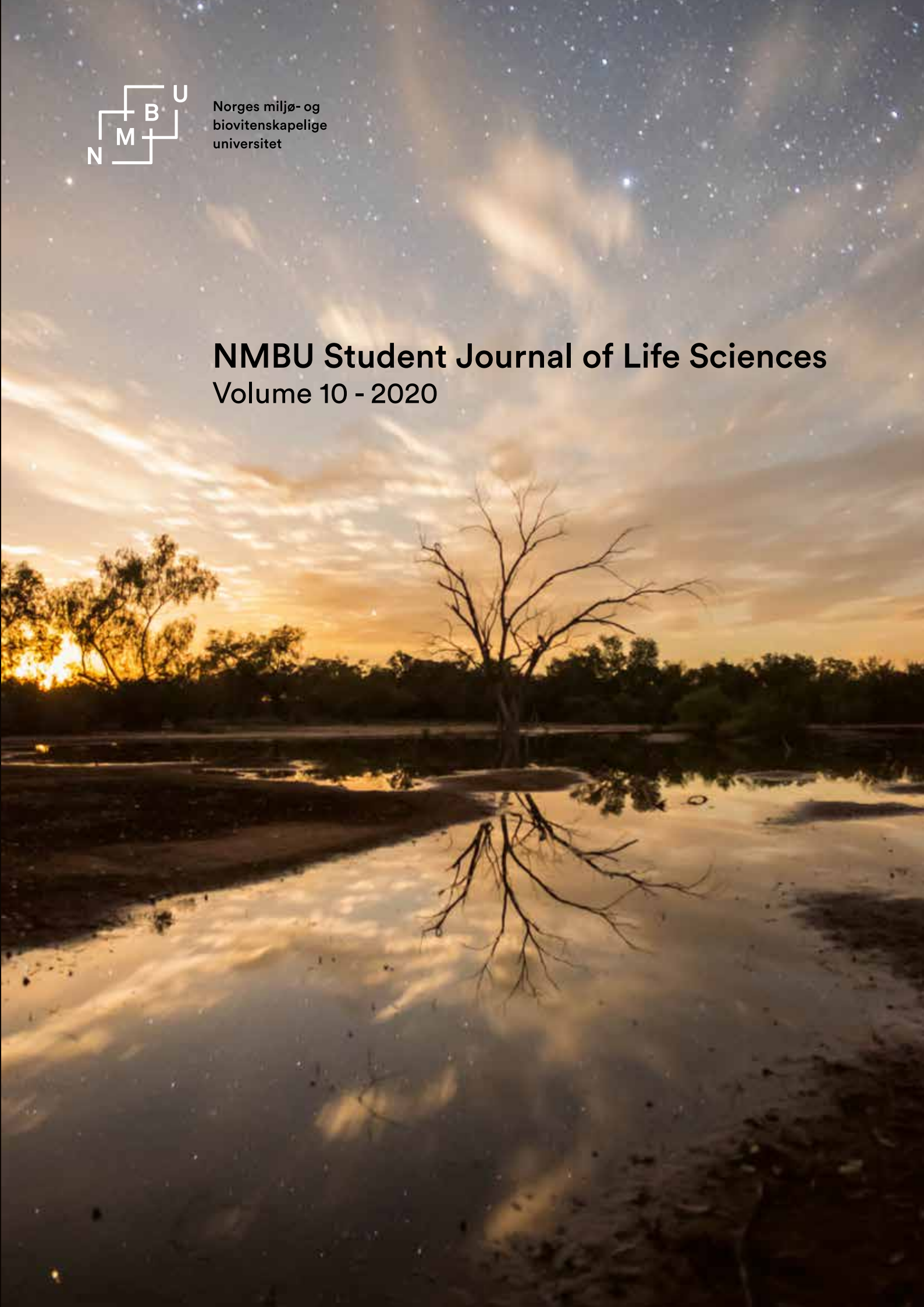

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P.O. Box 5003
1432 Ås
Norway

studentjournal@nmbu.no

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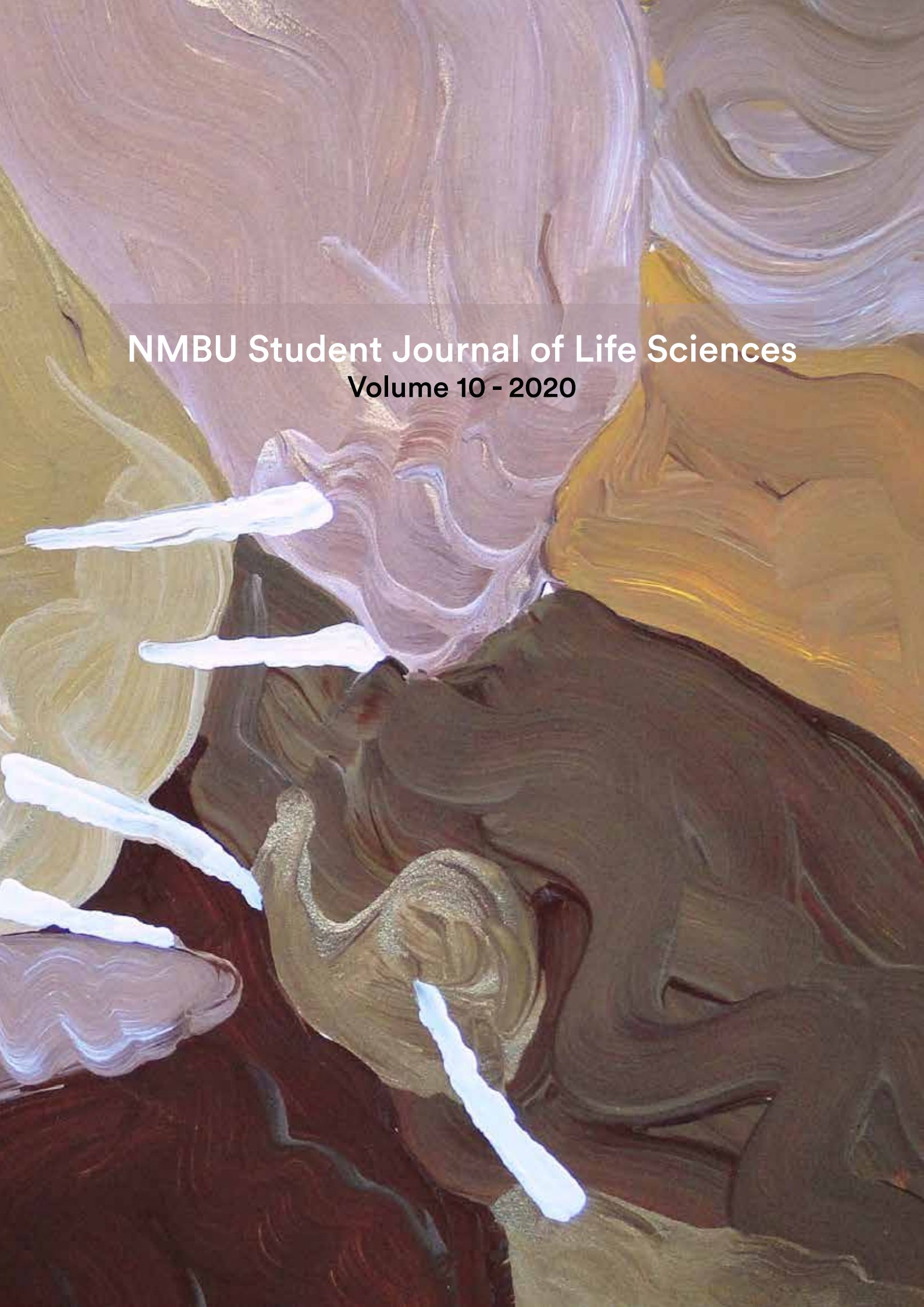

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Credits

Editor's note

The NMBU Student Journal of Life Sciences is the work of NMBU students with the support of the Writing Centre, the Learning Centre, and NMBU institutes. Our collective mission is to showcase outstanding student research at NMBU and to develop students' scholastic skills. The NMBU Student Journal of Life Sciences includes research by international and Norwegian students from all faculties at NMBU and publishes articles in English and Norwegian (both Bokmål and Nynorsk).

Volume 10 is published in different surroundings from the previous nine. The world is in the midst of a pandemic that is straining healthcare systems and affecting the livelihoods of millions of people. It is difficult to predict how the post-COVID-19 world will look once the global economy recovers, borders are reopened, and self-confinement ceases. Nonetheless, the coronavirus crisis has demonstrated that a successful response to global challenges requires an interdisciplinary approach born at the crossroads of science, politics, humanities, and economics. As vaccine research intensifies, companies transition to digital platforms, and people deliver solutions to the lockdown; the old adage of *adversity is the mother of innovation* shows its veracity.

In this regard, the Journal has accepted the challenge to transition to the new global status quo. Volume 10 crystallizes the industriousness of the Editorial and Review boards which worked relentlessly to enhance the quality of the submissions. Likewise, the finished product is evidence of the authors' commitment to improving their work, and the artists' and photographers' creativity and craftsmanship. All of them worked under challenging circumstances given the current lockdown implemented in Norway, questioning whether or not the pandemic would halt publication. All in all, the completion of this year's volume rewards their hard work.

In addition to the members' joint efforts, the Journal also depends on the invaluable support from the Learning Centre, the Writing Centre, and the different NMBU institutes. Accordingly, we want to acknowledge Michael Moulton, Hedvig Bjørge, and Niklas Mintorovitch for their constant support, Lukas Leitinger for his insight and expertise, the layout team at NMBU, and the printing team at Merkur Grafisk AS. Finally, we want to thank our new Faculty Advisor, Erik Aschehoug, for his encouragement and guidance throughout this process. We owe immense gratitude to all of them.

It is with joy that we herewith present Volume 10 to the academic community at NMBU as a sign of resilience and commitment to quality.

Alejandro Herrera-Cano & Stine A. Bosheim
Editors-in-Chief
NMBU Student Journal of Life Sciences

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About the Authors

Kulsum Abbasi

Kulsum is a candidate for Masters in Global Development Studies at Noragric, NMBU. She is interested in aspects and drivers of inequalities. She aims to focus her thesis on the political economy of taxation, and its interface with governance, institutions, state legitimacy, and inequality. Before immersing herself in academics, she enjoyed translating works of literature from her native Urdu language to English.

Marie Tangen Olafsen

Marie is currently completing her master's degree in International Relations. Her academic interest and focus for master's thesis is international climate policy, specifically international climate negotiations. She also engages in advocacy work through a Norwegian youth organisation, and has participated in and gained practical experience from the UN climate negotiations.

Carolina Herrera-Cano

Carolina Herrera-Cano is enrolled in the MSc in Global Development Studies (NMBU). She holds bachelor and master degrees in International Business. Carolina has served as associate professor and lecturer at different universities in Colombia. She has published several academic papers on gender, sustainability, and international trade, and has participated in different international conferences. Her professional experience also includes consulting services for governmental and international institutions, such as the Colombian Ministry of Environment and Development and the Inter-American Development Bank.

Sven Emil Hinderaker

MSc in Ecology, specialising on Tropical Ecology and Management of Natural Resources. Mostly doing work in inhospitable deserts tracking lizards. Main interests are Behavioural Ecology, Spatial Ecology, and Animal Cognition. Otherwise avid and curious pedestrian.

Anna Buckley Cahill

Anna is a second year student in the Global Development Studies Masters program. Before NMBU, she received a bachelor's degree in physics from Wellesley College in Wellesley, Massachusetts, USA. Anna enjoys basketball, running and orienteering. Following an internship position at the Norwegian Refugee Council, she is currently writing her thesis on the social integration of migrant background youth in Norwegian sport.

Sheyda Shapouri

Sheyda Shapouri is completing a master's degree in Ecology at NMBU after finishing her Bachelors in Zoology at the University of Glasgow in 2017. Having been interested in fish and their unique behavior from a very young age growing up in Southern California, she plans to continue working with them in the future through research and writing. She is also currently learning Norwegian and hopes to forge new connections and opportunities in Norway.

Elena Sabina Salmansperger

Elena is in her second year of the bachelor's programme for International Environment and Development Studies at NMBU. Her academic interest lies in studying the root causes of inequality and how to address them. She sees a solution to social and environmental issues in the framework of degrowth. Her passion is skate- and snow-boarding as well as dumpster diving to salvage potentially perfect sources of nourishment. Besides that, she has co-founded a small company that re-designs secondhand clothes. The company's aim is to raise awareness about issues in the conventional textile industry while offering a more sustainable and affordable alternative.

Julie Elise Trovaag

Julie er en masterstudent i akvakultur ved NMBU. Ved siden av studiet jobber hun i et par forskningsprosjekter samtidig som hun er ansatt i næringen. Hun ønsker å kunne utvikle og bruke sin erfaring slik at hun i fremtiden kan bidra til å finne løsninger innen dyrevelferd og bærekraft innen akvakultur.

Simen Moflag Talleraas

Simen is a first-year master's student in Ecology at NMBU. He is especially interested in biodiversity conservation and the relationship between science and policy. He aims to focus his thesis on the spatial distribution of the invasive shrew Crocidura russula.

Andrea Heitmann

Andrea is a first-year master's student in Ecology at NMBU. During her BA she did a semester in Greenland and is interested in Polar regions.

Photo: Sven Emil Hinderaker

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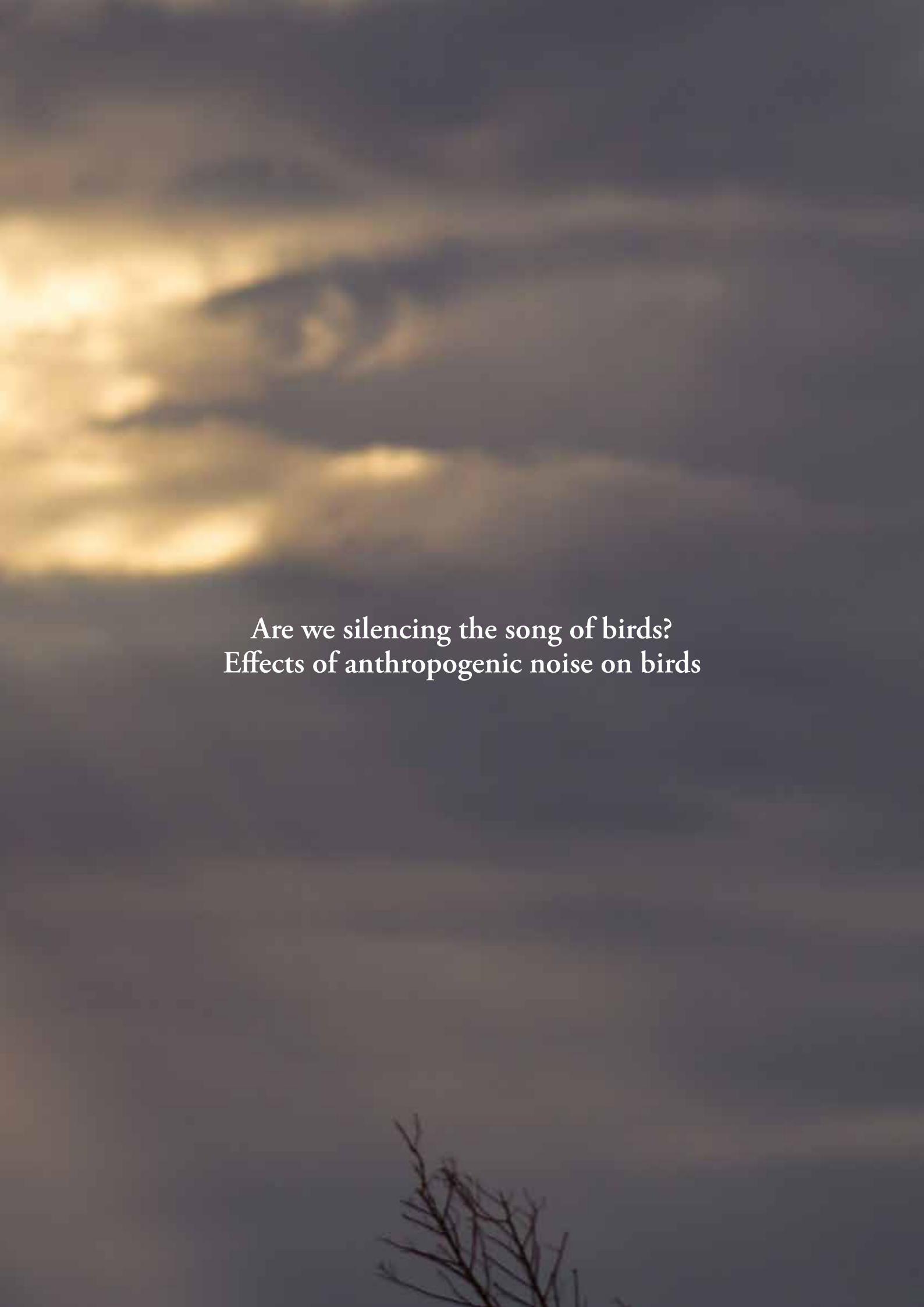

Are we silencing the song of birds? Effects of anthropogenic noise on birds

Are we silencing the song of birds? Effects of anthropogenic noise on birds

Simen Moflag Talleraas

For centuries, humans have been altering the Earth in myriad of ways. Human impact has touched virtually all aspects of our environment, including the hydrosphere, lithosphere, atmosphere and biosphere (Ellis, 2011). Many have suggested that these changes provide support for a new geological epoch, the Anthropocene (Crutzen, 2016).

Due to the significant declines in biodiversity caused by human impacts (Dirzo et al., 2014), it is important to understand what factors are responsible (Francis, 2015), including the role of human-made noise. The noise humans produce every day through wind farms, traffic and building projects generates dramatic impacts and has become pervasive across nature. Not even protected areas are safe from anthropogenic noise, with 63% of protected areas in the United States having doubled background noise levels as a result of human activity (Buxton et al., 2017). Increasing noise levels pose significant problems for animals that depend on sound to perform vital tasks (Halfwerk, Lohr, & Slabbekoorn, 2018), including birds.

The increased prevalence of noise is among the most studied man-made changes to the environment (Shannon et al., 2016). Studies investigating how noise affects birds have found that increased noise levels can disrupt acoustic communication (Halfwerk et al., 2011), alter predator-prey interactions (Francis, Ortega, & Cruz, 2009), elevate stress (Blickley, Blackwood, & Patricelli, 2012), cause population declines (Bayne, Habib, & Boutin, 2008), and ultimately alter community structure (Francis et al., 2009; Francis, 2015). While birds may adapt to noise in differing ways, the efficiency of these modifications is unknown. Some species may even gain indirect benefits through effects on predators, prey and competitors. However, the overall impact of anthropogenic noise on birds is clearly negative (Halfwerk et al., 2018).

Knowing how man-made sounds affect animals allows us to limit our negative impacts on wildlife. We also gain a broader understanding of how animals cope with changing environmental conditions. The latter may be especially important, as we move towards a future of increasing human impact, with climate change, urbanization, and plastic pollution among the many problems that face us. This paper will examine how anthropogenic noise affects populations and communities of birds by disrupting acoustic communication, predator-prey interactions and stress levels.

Disruption of Acoustic Communication

The most important effect of anthropogenic noise on birds is masking their acoustic communication (Habib, Bayne, & Boutin, 2007). Birds use auditory signals to attract mates, warn others of predators and deter rivals (Halfwerk et al. 2018). This communication is vital for reproductive success and survival, and its disruption can induce major fitness consequences (Halfwerk et al. 2011; Read, Jones, & Radford, 2013). Fitness is a measure of an individual's reproductive success, thus the higher fitness an individual has the more they will contribute to the next generation (Orr, 2009).

In order to cope, many birds adapt their vocalizations to elevated environmental noise, and particularly to increased low-frequency sounds (Shannon et al., 2016; Slabbekoorn, 2013). Birds typically increase pitch, song duration, and amplitude (Slabbekoorn, 2013). While altering song characteristics might alleviate the masking effect of noise, few birds are able to maintain vocal performance under such conditions (Luther, Phillips, & Derryberry, 2016). Vocal performance is a measure of how well an individual bird's song compares to others on characteristics such as trill rate and bandwidth (Ballentine, Hyman, & Nowicki, 2004). Decreased vocal performance can lead to decreased song attractiveness and transmission distance (Luther et al., 2016), and changes in song characteristics may also incur other costs, like increased predation

My Choice: Victoria Thomas

Photo: Sven Emil Hinderaker

(Mougeot & Bretagnolle, 2000) and higher energy expenditure (Oberweger & Goller, 2001).

Perception of fitness is important for females when selecting males. Low-frequency songs usually indicate higher fitness (Hasselquist, Bensch, & von Schantz, 1996), so one would expect females to prefer males with low-frequency songs. However, with increased noise females can lose the ability to differentiate between song frequencies (Halfwerk et al, 2011). Halfwerk et al. (2011) showed experimentally that female great tits (*Parus major*) responded more to low-frequency song types under normal conditions, but in noisy conditions this preference disappeared. Luther et al. (2016) suggest that birds face a trade-off between signal transmission and vocal performance, where pitch modifications increase transmission distances but decrease signal efficacy. Modifying song might therefore give birds a masking release, but for high-quality males, this will come at the cost of reduced attractiveness. Females also suffer from the apparent lack of quality males, as they can no longer detect males with high fitness, and these factors may decrease habitat quality.

Altered Predator-Prey Interactions

Background noise also masks many signals that birds rely on just to stay alive. Birds depend on environmental cues to detect predators and locate prey. Environmental cues important for birds include the sound of approaching predators or nearby prey (Hansen, Holen & Mappes, 2010). As background noise amplifies, auditory cues become harder to detect. To compensate for compromised cue detection, birds may respond with increased vigilance. Quinn, Whittingham, Butler, and Cresswell (2006) found that in the presence of noise, the common chaffinch (*Fringilla coelebs*) increased the time spent vigilant while foraging. Similar effects were also found in some other species, such as great tits (Klett-Mingo, Pavón, & Gil, 2016; Templeton, Zollinger, & Brumm., 2016). While such modifications mediate the effect of masked cues, they come at a cost of decreased food intake. In this way, noise decreases habitat quality by forcing birds to spend more time on the look-out and less time foraging.

Barber, Crooks, and Fristrup (2010) suggest a similar mechanism in predators relying on acoustic cues to detect prey, but few studies have related background noise levels to changes in predation success. Foragers relying on sound to detect prey, such as terrestrial insectivores and saw-whet owls, have been shown to avoid road construction sites (Canaday & Rivedeneyra, 2001) and have limited provisioning rates in human-altered landscapes (Hinam & Claire, 2008) respectively. However, noise

effects are difficult to disentangle from chemical pollution, habitat destruction and fragmentation. More certain results are reported from bats, where Schaub, Ostwald, & Siemers (2008) showed that greater mouse-eared bats (*Myotis myotis*) preferred silent feeding compartments over noisy ones. Further research is needed to determine how noise affects predation success.

Impact on Stress Levels

In addition to the effects on acoustic communication and predator-prey interactions, anthropogenic noise can also alter avian stress physiology. To date, most studies have focused on the impact noise has on the stress hormone corticosterone. Corticosterone plays an important role in regulating metabolic functions such as energy intake, storage, and mobilization, and is also involved in emergency responses to acute stress (Landys, Ramenofsky, & Wingfield, 2006; Wingfield et al., 1998). While research has been going on for years, the relationship between baseline corticosterone levels and noise exposure is still unclear, and studies have shown conflicting results (Halfwerk et al., 2018). For example, Blickley et al. (2012) observed an increase in feacal concentration of corticosterone in lekking sage grouses. On the other hand, Crino, Johnson, Blickley, Patricelli, and Breuner (2013) found that traffic noise decreased corticosterone levels in white-crowned sparrows. California spotted owls (*Strix occidentalis occidentalis*) exposed to chainsaw noise did not respond with elevated baseline levels (Tempel & Guiterrez, 2003), but this might be due to the low intensity of the noise. Further research is needed to determine the actual relationship between man-made noise and stress levels in birds.

Changing corticosterone levels impact fitness, but the effect is not always present or consistent (Bonier, Moore, Martin, & Robertson, 2009a). The cort-fitness hypothesis predicts a relationship between elevated baseline corticosterone levels and fitness, with high levels associated with low fitness and habitat quality (Bonier, Martin, Moore, & Wingfield, 2009b). This relationship is expected because unfavourable environmental conditions increase corticosterone secretion (Bonier et al., 2009b) and since corticosterone levels are heritable and associated with other traits linked with fitness (Øverli et al., 2007). Crino et al. (2013) found that white-crowned sparrow nestlings exposed to traffic noise had low baseline levels of corticosterone and higher body mass than controls exposed to silent speakers, while Kleist, Guralnick, Cruz, Lowry, and Francis (2018) found that high corticosterone levels during provisioning reduced fitness, while it decreased fitness during hatching. There is still no scientific consensus on how corticosterone levels impact the fitness of birds, as some studies indicate that higher corticosterone levels negatively impacts fitness, while other studies have found the opposite effect (Angelier, Wingfield, Weimerskirch, & Chastel, 2010; Bonier et al., 2009a; Bonier et al. 2009b).

Impact on Populations

Anthropogenic noise can also decrease breeding densities (Bayne et al., 2008; Francis et al., 2009). Bayne et al. (2008) showed a 50% decrease in breeding densities of birds close to gas-compressor stations that were turned on compared to those turned off, providing support for a strongly detrimental effect of noise on population levels. Follow-up studies from Francis, Ortega, and Cruz (2011) and Francis (2015) have added support to these findings. While anthropogenic noise generally affects birds negatively (Francis, 2015), not all species are as adversely impacted. Variance in characteristics such as hearing ranges, vocal plasticity, and song frequency determine how bird species react to elevated noise levels (Halfwerk et al., 2018). A study by Francis, Ortega and Cruz (2011) found that abundance and nesting densities decreased more for birds with lower-frequency songs. Similarly, Rheindt (2003) found that birds singing high-frequency songs are the least affected by noisy roads. The differences in susceptibility can in turn lead to indirect benefits for other species, with less competition and predation.

The need for longer-term studies

There is a large body of evidence indicating ecological impacts of noise, but most research is conducted over short time scales (Shannon et al., 2016). Since animals can adapt to changing environmental conditions, long-term studies are needed to assess the long-term consequences. Understanding exactly how birds adapt to noise will be vital for determining the full impact, and several frameworks have been proposed (Francis & Barber, 2013; Swaddle et al., 2015). Swaddle et al. (2015) describes three adaptive mechanisms for birds affected by noise: behavioral flexibility, developmental plasticity, and microevolution. Gross, Pasinelli, and Kunc (2010) suggest behavioral flexibility, but more studies are needed to determine how different species adapt. Animals who adapt through developmental plasticity may be better able to cope with anthropogenic noise, but this is not necessarily picked up in short-term studies.

Moreover, altered environmental conditions such as increased noise do not operate in a vacuum, and the interactions between noise and other anthropogenic

pollutants like light and chemicals are poorly understood (Shannon et al., 2016). Exposure to other pollutants, such as heavy metals or pesticides (Walker, 1983; Goutte et al., 2014), might increase or decrease the effect of man-made noise, and knowledge about such effects is vital for determining the full burden of anthropogenic noise (Halfwerk & Slabbekoorn, 2015).

Conclusion

Noise can impact birds by altering stress hormone levels, disrupting communication, and by making it harder to detect predators and prey. While the literature is clear on the detrimental effects of short-term noise, long-term studies can give us an understanding of the ultimate effects. Studies examining the effects of several pollutants acting together can determine how different anthropogenic impacts interact, which is crucial in light of projected climate change and increased pollution levels. Comparative studies on the characteristics of birds affected by noise might also isolate the traits that make birds susceptible, making it possible to predict how noise will affect birds. This is especially useful for rare or threatened birds, which are hard to study. The cumulative impact of noise effects determines how a bird is affected, and most birds respond negatively. Differences in susceptibility to noise might drive homogenization, where a few species benefit from decreased abundance of other birds. Such differences might also give us insight into which birds are most vulnerable to anthropogenic noise and where we should allocate special conservation efforts. After all, we don't want our cacophony to silence the song of birds.

Kingfisher: Lina Westermann

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Photo: Sven Emil Hinderaker

Reptiles:
Climate Change and Adaptations

Reptiles: Climate Change and Adaptations

Sven Emil Hinderaker

Wildlife is under immense pressure from anthropogenic activities. In particular, global warming is expected to result in larger fluctuations in temperature. An average rise in temperature between 1.5 – 4 °C may threaten between 8.5% and 16% of all species (Stouffer & Wetherald, 2007; Urban, 2015). An estimated 15-36% of reptile species are already considered threatened (Böhm et al., 2013). Rising temperatures can further endanger ectotherm non-avian reptiles (hereafter reptiles) which are vulnerable to overheating. Reptiles depend on external sources of heat, such as ambient air temperature, solar radiation, and ground temperature to alter their body temperature in a process called thermoregulation. In order to maintain a favourable body temperature, reptiles thermoregulate by either actively heating up, by basking, or seeking shelter in burrows or rock-crevices to avoid dangerously high temperatures (Sunday et al., 2014).

Elevated temperatures can also affect population dynamics by creating skewed sex ratios, since some taxa of reptiles depend on temperature for sex-determination (Holleley, Sarre, O'Meally, & Georges, 2016). Temperature-dependent sex determination (TSD) allows the nesting temperature to determine the sex of offspring, and occurs in many taxa of reptiles (Holleley et al., 2015). For many reptiles, a specific temperature acts as a pivotal point, and even a change in temperature of 1°C can completely change the outcome of sex ratios (Sarre et al., 2004).

While some species with TSD have sex chromosomes, temperature can override the default sex determining effect of these during embryonic development which results in sex-reversed individuals (Holleley et al., 2015). Rapidly rising temperatures could prove to become a problem for species with TSD, as the sex ratio of their offspring could be highly skewed towards only one sex (Holleley et al., 2016).

In order to survive the heat stress and skewed sex ratios in increasingly warmer and more variable temperatures, reptiles will need to alter their behaviour (Refsnider & Janzen, 2012). This article will therefore explore the effects of increasing temperatures and thermal fluctuations on reptiles, and how reptiles are seen to mitigate the effects of climate change by altering their behaviour.

Effects of increased temperatures on reptiles at different latitudes

Thermoregulation, the process of maintaining a favourable temperature is essential for reptiles. Low temperatures slow down metabolism and internal processes of reptiles, making them less competitive (Sunday et al., 2014). High temperatures can lead to heat stress, which can cause life-threatening damage to the animals' cells (Licht, 1968). Heat stress combined with dehydration can also shut down metabolism, and eventually the nervous system in reptiles (Bradshaw, 1988). If an animal is unable to retreat to a shaded habitat or burrow, heat stress and dehydration could lead to death from overheating (Sunday et al., 2014). Increasing temperatures have already been related to reptile populations going extinct, and others are expected to be eliminated by only a slight warming (Sinervo et al., 2010).

Reptiles in temperate regions are mainly restricted by low temperatures and scarce amounts of sunlight (Kearney, Shine, & Porter, 2009). With increasing temperatures in temperate regions, the activity periods of reptiles could increase, while the risk of overheating remains small (Chamaillé-Jammes, Massot, Aragon, & Clobert, 2006). This has been observed in some species, such as the Montpellier snake (*Malpolon monspessulanus*) and the common lizard, (*Lacerta vivipara*) which has shown an increase in activity periods and growth (Chamaillé-Jammes et al., 2006; Moreno-Rueda, Pleguezuelos, & Alaminos, 2009). With longer activity periods, reptiles have more time to forage,

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which may be why the common lizard experienced a 28% growth in size and increased clutch sizes (Chamaillé-Jammes et al., 2006). However, higher temperatures also increase the metabolic rate in reptiles, and hence their energy requirements (Huey et al., 2012). Fortunately, lizards in temperate regions can compensate for a higher metabolic rate by increasing their activity period and hence foraging opportunities (Kearney et al., 2009).

Although reptiles in temperate regions could adapt to, and even benefit from modest increases in mean temperatures, reptiles living at mid latitudes, between temperate and tropical environments, could be threatened by higher variation in temperature (Sinclair et al., 2016). A higher thermal variance would result in a higher probability of temperature extremes exceeding species thermal maximum, potentially leading to death (Kingsolver, Diamond, & Buckley, 2013). The thermal variance induced by climate change could therefore pose a threat to mid-latitude species (Kingsolver et al., 2013).

The most severe effects are expected in the tropics, where reptile diversity is also highest (Deutsch et al., 2008). The challenge for reptiles in the tropics is not to heat up, but rather stay cool in order to avoid overheating (Kearney et al., 2009). Reptiles within the tropics therefore need a high amount of tree cover or other forms of shade, in addition to burrows or caves in their habitats, in order to maintain their regular activity without overheating (Kearney et al., 2009).

Increasing temperatures will force reptiles to spend more time cooling down, rather than foraging (Kearney et al., 2009). Some reptiles will therefore need to compensate for reduced activity periods and high metabolic rates by foraging more efficiently (Kearney et al., 2009), or altering their active periods (Barrows, 2011). If temperatures rise and reptiles are unable to adjust their behaviour, some species will become less competitive as they will be less efficient in exploiting the resources in their habitat (Buckley, Ehrenberger, & Angilletta, 2015). This can lead species to migrate, in an attempt to discover more favourable habitats, if their ability to disperse allows for it (Sinervo et al., 2010). However, migrating reptiles could outcompete native species, thereby driving them to extinction (Sinervo et al., 2010). Reptiles migrating into new environments could therefore result in a few species outcompeting other species and decreasing diversity. Increasing temperatures can have adverse effects on reptiles' survival and behaviour, depending on latitude and environment. In addition, increasing temperatures can also affect population dynamics of reptiles by skewing offspring sex ratios and morphology.

Temperature-dependent sex determination

Temperature-dependent sex determination (TSD) in reptiles allows the incubation temperature of eggs to affect sex determining processes during embryo development (Holleley et al., 2016). The temperature range that produces both sexes in some reptiles is narrow, with higher and lower temperatures only producing one sex (Sarre et al., 2004). A change in

temperature as small as 1°C is in some species enough to alter the sex ratio of hatchlings (Mainwaring et al., 2017). Some reptiles also exhibit a system where temperature can override the genetic sex determination during embryonic development and produce sex-reversed individuals (Holleley et al., 2015). With more frequent temperature anomalies, this can lead to highly skewed sex ratios. The skewed sex ratios could lead to one sex becoming vastly more common than the other, which could negatively affect the viability of populations and species.

The effect of global warming on reptiles with TSD depends on what temperatures produce which sex. A skewed ratio towards females could be less severe than a skewed ratio towards males. If males are rare, a small number of males could still mate with

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several females in species where promiscuity is widespread and the need for parental care is limited. The opportunity of a few males fertilising several females all depends on the mating system of the particular species. For species where promiscuity is common, this trait could help maintain population sizes despite skewed sex ratios (Uller & Olsson, 2008). However, even populations skewed towards females will result in fewer individuals participating in reproduction, resulting in loss of genetic diversity in entire populations.

A skewed sex-ratio towards males is more severe because any given number of females can only produce a (fairly) limited number of offspring. A population with skewed sex ratios towards males will therefore be limited by the number of females. The number of offspring can thus decrease in each generation, as increased temperatures skew sex ratios towards males. This can happen until only a few males are left, at which point a population, or species, is in practical terms extinct.

Changing sex-ratios in populations is not only a theoretical possibility, but a reality among several species, including that of turtles and lizards. Green sea turtles and loggerhead turtles are currently producing 90% females in their clutches, and are projected to produce 100% females with a further increase in temperature of 1°C (Mainwaring et al., 2017).

Increasing temperatures and fluctuations might push reptile species with both GSD and TSD towards a system of solely depending on TSD for sex determination. Bearded dragons (Pogona spp.) are in a special category in relation to TSD and increased temperatures, as they exhibit both genetic- and TSD. In bearded dragons, temperature can override the genetic sex-determination and induce female development in embryos with male chromosomes (Holleley et al., 2015). Exposure to high temperatures can create highly skewed sex ratios towards males in a population, which would then only carry the male determining chromosomes. The nesting temperature will then determine the proportion of females developing, with increasing frequency at temperatures beyond 30°C, (Holleley et al., 2015). In this way, a population could lose the sex determining chromosome for female development. This has been done artificially by incubating eggs at higher temperatures, successfully eliminating the sex determining chromosomes and making the captive population depend solely on TSD (Holleley et al., 2015). In the wild, global warming could result in bearded dragon populations with highly skewed female biased sex ratios, which could pose a threat to local populations, and survival of the species (Holleley et al., 2015).

Sex reversed individuals of the bearded dragon are genetic males who have developed into females due to elevated temperatures during embryonic development (Holleley et al., 2015). The sex reversed males produces bolder offspring than regular females which more resemble genetic males (Li, Holleley, Elphick, Georges, & Shine, 2016). If the bolder behaviour increases feeding rates without increasing mortality by predation, elevated temperatures could favour sex-reversed males (Li et al., 2016). This can rapidly push populations towards solely depending on temperature for sex determination because the sex determining chromosome which produces genetic females is absent in the sex-reversed males (Li et al., 2016). The genetic material of the population will therefore by default produce only males, unless the temperature threshold for sex reversal is breached, and female development is stimulated during embryonic development. This loss of the sex determining chromosome may be further reinforced by increased temperatures. This will then make them fully dependent on temperature for sex-determination, and elevated temperatures could hence expose them to the risk of completely skewed sex ratios, which could ultimately lead to extinction if only one sex is produced (Holleley et al., 2015). Increasing temperatures will therefore require both behavioural and genetic changes for many reptile species to survive the changes ahead.

However, Holleley et al (2015) also found heritable variation in sex reversal thresholds. Holleley et al. (2015) therefore notes that thermal sensitivities to incubation temperatures could in theory evolve and TSD could evolve into producing balanced sex-ratios. The severity of species transitioning from genetic sex determination to TSD is difficult to assess, but the transition could become an adaption in itself.

Elevated and fluctuating temperatures will become an increasing stressor and threat for many reptiles at mid- and low-latitudes, and temperature dependent sex-determination could pose a threat to reptile populations. Adaptive behaviour compensating for increasing temperature and fluctuations is therefore an important way to survive these changes.

Behavioural adaptation

Behavioural adaptation in reptiles could play an important role in response to climate change. For reptiles living close to their thermal limits, changing their activity periods could be important in order to adapt to global warming (Kearney et al., 2009). This has been observed in various groups of reptiles. Desert reptiles have shown an ability to shift their activity periods towards the cooler, earlier mornings and staying active longer during previously inactive parts of the year (Barrows, 2011). Some crocodiles and turtles have shifted breeding and nesting seasons in response to elevated temperatures (Escobedo-Galván, González-Salazar, López-Alcaide, Arroyo-Peña, & Martínez-Meyer, 2011). Studies of thermal preferences in lizards have found that behavioural thermoregulation can help species tolerate climatic changes in the short term (Buckley et al., 2015).

Unfortunately, adaptation through behavioural thermoregulation has been found to weaken the selective pressure needed to evolve a genetic tolerance to increasing temperatures (Buckley et al., 2015). The short-term benefit of behavioural thermoregulation could therefore in the long term inhibit reptiles from developing a higher heat tolerance (Buckley et al., 2015). A species could appear to be coping well to increased temperatures as it behaviourally adapts to minor temperature changes, before suddenly experiencing a rapid decline in numbers when temperatures reach a critical point where the species can no longer compensate any further with behavioural thermoregulation.

Overall, there is considerable uncertainty regarding the role of behavioural adaptation and how this can inhibit the development of a genetic resistance to higher temperatures. Studies of thermal preferences in lizards suggest that lizards could evolve a higher thermal tolerance if the selective pressure from global warming increases (Buckley et al., 2015). However, whether reptiles can adapt to the unprecedented pace of climatic change is difficult to tell.

Controlling nest temperature

Survival of a species in a broad biologic sense does not depend on an individual's survival, but upon its ability to produce viable offspring. In order to avoid highly skewed sex-ratios, reptiles need to behaviourally adjust their nesting to compensate for elevated temperatures. The ability of reptiles to adapt their nesting behaviour in order to maintain stable nest temperatures appears to vary between species. In order to avoid highly skewed sex-ratios, reptiles with TSD will have to change their nesting behaviour by choosing nesting sites providing optimal temperatures. This can be done by altering nesting time, nest site, or the nest depth (Mainwaring et al., 2017). Some species, like the Australian water dragon (*Physignathus lesueurii*), the Painted turtle (Chrysemys picta), the Mugger crocodile (Crocodylus palustris) and the Snapping turtle (Chelydra serpentina) show signs of actively controlling the nest temperature (Doody et al., 2006; Escobedo-Galván et al., 2011; Refsnider, Bodensteiner, Reneker, & Janzen, 2013). By evaluating canopy cover and solar radiation, they ensure stable and favourable nesting temperatures

(Doody et al., 2006; Escobedo-Galván et al., 2011; Refsnider et al., 2013). However, both the Water dragon and the Painted turtle appear unable to adjust nesting temperature by nest depth, and are therefore critically dependent on suitable habitats with tree cover for successful nesting (Doody et al., 2006; Refsnider et al., 2013). The Eastern three-lined skink (*Bassiana duperreyi*) on the other hand, appears to adjust both its nest depth and seasonal timing of nesting in response to higher temperatures (Telemeco, Elphick, Shine, & Eski, 2009). Its nest depth has almost doubled, while its nesting period has been skewed earlier by almost a month (Telemeco et al., 2009). How these shifts in timing and locations of nesting affects predation rates or hatchling success remains unknown. It is therefore important to investigate the behavioural responses, or lack thereof, in both the Eastern three-lined skink, and other reptiles, in order to assess their future vulnerability to rising temperatures.

Conservation implications

The challenges reptiles are facing with increased temperatures make it important to limit global warming, as each small increase in temperature could be the tipping point of a species. However, habitat loss is still a major driver of extinctions, and protecting habitats which provide sufficient opportunities to cool down by thermoregulating is essential (Sunday et al., 2014). This is particularly important in lowland tropical areas where such habitats are especially threatened (Sunday et al., 2014). Without appropriate habitats providing the necessary shade, reptiles might suffer from heat stress, and sex ratios could become heavily skewed.

Protecting key habitats with enough shade and shelters will therefore be particularly important for species with unknown or limited adaptive capabilities.

Conclusion

Increasing temperatures will affect most reptiles, both in temperate, mid-latitude, and low-latitude (within tropics) regions. Reptiles in temperate regions could increase their activity periods and benefit from elevated temperatures in respect to growth. However, high thermal variation could lead to death from heat stress in mid latitudes. Species living at lower latitudes risk overheating from elevated temperatures, as many already live close to their thermal limits. Habitats which provide sufficient opportunities to cool down, like trees, caves and burrows will therefore be essential for reptiles' ability to adapt to rising temperatures.

Increasing temperatures can create highly skewed sex ratios in reptiles with temperature- dependent sex determination. This can result in declining populations and hence threaten entire species. Whereas some species appear to be fully able to mitigate the effect of global warming by altering the time, location, or depth of nesting, others seem unable to alter their behaviour enough to avoid highly skewed sex ratios. Behavioural adaptation will therefore play an important role in mitigating the extinction risk of reptiles in the face of climate change. However, without the necessary protection of key habitats, many reptiles will be unable to compensate for the expected changes to come.

Further research on species-specific responses to increasing temperatures, both on behavioural adaptation and control of nesting temperatures, will be important in order to monitor and assess reptiles' abilities to survive climate change.

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Frost flowers:
Formation and Environmental Impact

Frost flowers: Formation and Environmental Impact

Andrea Heitmann

FORMATION

In order to understand frost flower formation we require a basic understanding of the relevant processes that occur during sea ice formation. As new sea ice forms, the salt components of seawater do not fit into the ice crystal structure and are consequently expelled. These rejected elements of seawater form a highly saline liquid called brine, which accumulates in brine channels within the ice. As the ice grows and constricts, this liquid can be pushed to the ice surface creating a brine skim layer on top of the ice. This process usually initiates when the sea ice reaches a thickness of 1-2 cm [*Rankin et al.*, 2002], and the resulting skim layer is generally 1-2 mm thick [Perovich et al., 1994]. The brine skim is relatively warm compared to air temperature, which triggers the liquid to evaporate. This results in a super-saturated moisture layer in the air just above the surface [*Barber et al.*, 2014]. The stage is now set for frost flower formation, but there are two remaining criteria: it must be very cold with very little wind. If the air temperature is below -20°C with wind conditions below 5 meters per second, small ice crystals can start to nucleate on the imperfections of the ice surface [*Perovich et al.*, 1994]. These crystals will continue to grow by vapor deposition and become frost flowers. Calm weather is crucial for frost flower formation as they depend on a persisting supersaturated layer to remain a source for vapor deposition. As the frost flowers are standing in brine skim, the brine will travel up the crystal structure through capillary action and the flower will eventually become covered in it. There is a strong correlation between frost flower salinities and the salinities of the brine layer they form in [*Perovich et al.*, 1994]. During frost flower formation the saturated brine layer becomes slush and increases in thickness to 2-4 mm [*Rankin et al.*, 2002].

Perovich et. al. [1994] explain how the expelled brine creates a rough surface topology critical for frost flower formation. The brine is not excreted uniformly from the ice, but rather "erupts" at specific points where the brine channels meet the ice-air interface. Some of this expelled brine freezes at the ice surface, so the surface skim consists of both liquid brine and ice crystals. Using the calculation methods of *Cox and Weeks* [1983], Perovich et al. [1994] deduce that the surface slush layer consists of 40% brine and 60% ice, with a skim salinity of 100 ppt (in contrast to seawater, which averages 35 ppt), surface temperature of -15°C, and an ice density of 0.920 g cm^{-3}. The ice crystals tend to congregate around the mouth of the brine channels and create small bumps in the skim layer. These bumps function as growth platforms for frost flowers, as they cannot nucleate directly on the liquid brine [*Perovich et al.*, 1994].

The crystal structure of a frost flower depends on the temperature. They grow in a clump-like fashion with a roughly circular shape. We can observe two main types of crystal formations; stellar dendrites and needles. The dendrites are extremely thin, plate-like crystals with branches and side branches. They develop at air temperatures of around -16°C and grow up to 2.5 cm tall and 1.5 cm wide. Needle crystals form at lower air temperatures, around -22°C [*Perovich et al.*, 1994]. Domine et al. [2005] used photo- and electro-micrographs and found that the crystal structures are hollow, indicative for rapid forming ice crystals. They also concluded that being covered by brine inhibits further growth. Frost flowers are highly fragile, due to their hollow crystals, and they will ultimately either be buried by snow or eroded by wind [*Perovich et al.*, 1994].

CHEMICAL COMPOSITION

In order to understand how frost flowers may impact their environment, we need to take a look at their chemistry. The chemical composition of frost flowers relies on their growth conditions, such as air and ice temperatures, chemical composition of the water and

Photo: Alejandro Herrera-Cano

brine skim, relative humidity, and the changes of these factors during their short lifetime [*Hobbard et al.*, 2009].

Salinity

Rankin et al. [2002] studied and compared the salinity levels of frost flowers, brine, ice and seawater near Mertz glacier, Antarctica. Frost flowers typically have salinity levels three times higher than seawater [*Rankin et al.*, 2002, *Perovich et al.*, 1994, *Douglas et al.*, 2005]. Salinity levels of frost flowers range between 80-110 ppt while the mean seawater salinity value is 35 ppt. *Alvarez-Aviles et al.* [2008] studied the bulk salinity of surface brine and frost flowers in Barrow, Alaska. They found that the brine layer on top of 1 cm thick sea ice has a salinity of about 36 ppt, and as the ice thickened to 4 cm, the brine salinity increased to about 75 ppt. They found the average bulk salinity level of young frost flowers also tends to be 75 ppt. The bulk salinity of mature frost flowers showed great variation, with an average of 62 ppt. The tips of the frost flowers showed the lowest salinity levels of 16 ppt, which is lower than seawater. This can be expected as frost flowers grow from vapor deposition, and it takes time for the saline brine to travel up the crystal skeleton [*Alvarez-Aviles et al.*, 2008].

Sodium and sulphate

Sodium and sulphate are important elements in the brine skim. Na_2SO_4 begins to crystallize, which means it becomes solid in a liquid solution, at -8°C, forming mirabilite ($Na_2SO_4 \cdot 10H_2O$). This crystallization process can deplete most of the sulphate and up to 13% of the sodium from the brine liquid [*Rankin et al.*, 2002]. Dendritic frost flowers tend to grow at ice surface temperatures between -12°C and -16°C [*Martin et al.*, 1996]. At these temperatures most of the mirabilite will be precipitated from the brine skim, and as a result frost flowers are generally depleted in Na2SO4. NaCl, on the other hand, requires much colder ice temperatures, at least -22°C, before it starts to precipitate, and such ice surface temperatures are rarely seen in first-year ice. Therefore, we expect to find high NaCl-concentrations in brine-covered frost flowers [*Rankin et al.*, 2002].

Bromine and ozone depletion events

Calcium carbonate ($CaCO_3 \cdot 6H_2O$) starts to crystallize at -2°C, which is significant because the removal of carbonate may reduce the pH of the residual brine. Low pH is a key factor in the heterogeneous reactions of HOBr (hypobromous acid) with bromide, which is connected to ozone destruction [*Sampson et al.*, 2007]. Bromine ions are common in seawater due to long-term leaching of the ocean floor. Bromide (Br^-) is expelled when seawater transitions to ice and accumulates in the brine. During heterogeneous reactions with HOBr, Br^--ions transition to gas-phase bromine (Br_2) and becomes activated, which means it is now more receptive to undergo other specific chemical reactions [*Sampson et al.*, 2007]. Alvarez-Aviles et al. [2008] suggest that frost flowers could serve as possible reaction sites for Br^- and HOBr. This process produces Br_2, rendering the frost flowers into small bromine pumps that release the gas into the troposphere. *Sampson et al.* [2007] measured the pH of melted frost flowers and found levels too alkaline to support this chemical process. However, they do point out that they measured melted frost flowers and that the true pH level of frost flowers in their natural state remains unknown, therefore they cannot rule out frost flowers as potential bromine activation sites. They also suggest that the aerosol (small air-borne particles) released from frost flowers could carry Br- ions into the atmosphere where they become activated and produce Br_2. This is still an active question of research. Regardless of activation site, Br_2 in the atmosphere is highly efficient at destroying ozone (O_3) and can cause tropospheric ozone depletion events (ODE's). The concentration of bromide in frost flowers is so high that a release of only 0,5% could be enough to cause an ODE [*Alvarez-Aviles et al.*, 2008]. When Br_2 in the atmosphere is subjected to sunlight (photons) it will separate through photolysis and produce two bromine atoms. Atomic bromine reacts with O_3, producing BrO and O2 [*Alvarez-Aviles et al.*, 2008]. *Kaleschke et al.* [2004] matched satellite images of air masses rich in BrO and potential frost flower production sites. They also state that the highest BrO concentrations have been found over the sea ice during the polar sunrise. New sea ice forms continuously throughout the winter season, as do frost flowers, and bromine concentrations build up in the atmosphere. When sunlight returns in the spring vast amounts of Br_2 is photolyzed and reduced to atomic bromine, which reduces ozone to oxygen, thereby depleting tropospheric ozone. This is called the "bromine explosion". Atomic Br can also react with itself, reforming Br_2, which can be photolyzed again [*Kaleschke et al.* 2004]. Tropospheric ozone is an effective greenhouse gas that can trap Earth's longwave radiation in the troposphere. Frost flowers releasing bromine can therefore cause an indirect cooling effect. However, ODE's can affect the atmospheric hydroxyl radical (OH) chemistry and

change the air's oxidative capacity [*Moore et al*. 2014]. This is significant because OH is the main sink for the highly effective greenhouse gas methane. OH reacts with methane and produces new molecules, thereby removing methane from the atmosphere and keeping its concentrations in check. The oxidation of OH inhibits its ability to react with methane, leading to methane accumulating in the atmosphere and causing a warming effect. Frost flowers can therefore, through this complex chain of events, increase methane levels in the atmosphere.

Mercury

During mercury depletion events (MDE's) gaseous elemental mercury (GEM) undergoes a series of photochemical reactions in the atmosphere and becomes potentially bioavailable reactive gaseous mercury (RGM). This triggers a chain of reactions where mercury (Hg) is depleted from the atmosphere and deposited on Earth's surface [*Douglas et al.*, 2005]. *Douglas et al.* [2005] studied the mercury levels in snow and frost flowers on the new ice forming in Arctic leads. Leads are fractures formed when an when an ice floe breaks apart. New ice may start forming over the exposed water, and this can trigger frost flower growth. In their study, *Douglas et al.* [2005] measured the mercury concentrations of both young (<4 hours old) and older frost flowers (>8 hours old). The younger flowers yielded mercury levels of 181 ± 8 ng/L, while the older ones had levels ranging from 154 ± 17 to 185 ± 32 ng/L. This was on the ice forming over a 200-meter-wide lead.They explain that the mercury concentration of just four-hour-old frost flowers is almost double of what is expected for mercury deposition to snow on land during MDE's. These high mercury values were found only in the vicinity of leads that had convective plumes over the water, a phenomenon which can occur as the warmer water is exposed to the much colder air. Two mechanisms could explain the link between convective plumes of leads and mercury deposition. Firstly, if the convective processes near leads promote the transfer of halogens from sea ice or frost flowers to the atmosphere, it could enrich mercury concentrations and enhance the GEM-to-RGM process in and around the plume due to the abundance of reactive halogens. As mentioned, frost flowers are possibly a significant source of atmospheric bromine. GEM-to-RGM reactions only occur when halides, such as Br^-, become activated and create halogens (Br_2) and halogen oxide radicals (BrO). Second, the scavenging of mercury from the air could be more efficient in the vicinity of supersaturated plumes due to the diamond dust that is often

Reindeer: Lina Westermann

observed here. Frost flowers, with their large surface area, are efficient collectors of diamond dust that is mercury-enriched [*Douglas et al.*, 2005]. *Moore et al.* [2014] explored the atmospheric mixing that occurs when leads open up. They suggest that the mixing is strong enough to bring mercury from a higher layer in the atmosphere down to surface level, where the it is deposited on the surface. Should mercury-covered frost flowers be buried by snow, mercury can leak into the water column during the melt season [*Moore et al.*, 2014]. *Sampson et al.* [2007] show us the bigger picture by connecting bromine, mercury and ozone depletion events (ODE's). As bromine is released in the atmosphere from sources such as frost flowers, it undergoes oxidation reactions with ozone, depleting ozone and producing BrO radicals. These radicals act as catalysts for the GEM-to-RGM reactions. When strong oxidation events occur, it causes RGM in the atmosphere to be almost completely depleted and deposited in the polar ecosystem [*Simpson et al.*, 2007, *Douglas et al.* 2005]. Mercury deposition in the Arctic has increased 3-fold since the industrial revolution. It is a dangerous neurotoxic pollutant and can have detrimental impacts on wildlife through biomagnification [*Agnan et al.*, 2018].

AEROSOL

Aerosol is an umbrella term for any type of fine particles or liquid droplets suspended in the atmosphere. Aerosols contribute to global warming as they reflect and trap heat in the atmosphere. Due to their large surface area

and sail-like crystal structure, frost flowers have high aerodynamic drag and they play an important role in the air-sea chemical exchange [*Rankin et al.*, 2002]. *Rankin et al.* [2002] state that frost flowers may be a more significant supplier of sea salt aerosols than open seawater during winter. In order to determine whether frost flowers were the source of such aerosols, they compared the chemical composition of frost flowers and aerosol collections. As mentioned, mirabilite ($Na_2SO_4 \cdot 10H_2O$) starts to precipitate at -8°C. Frost flowers grow in conditions much colder than this, therefore we would expect to find little mirabilite in their chemical composition. Thus, frost flowers and the aerosols they release would share the characteristic of being strongly sulfate depleted relative to sodium [*Rankin et al.*, 2000, *Alvarez-Aviles et al.*, 2008]. We would also expect this kind of aerosol to show relatively high values of sodium chloride (NaCl), which, as mentioned, requires much lower temperatures in order to precipitate out of the brine skim [*Rankin et al.*, 2002]. *Alvarez-Aviles et al.* [2008] state that "the primary evidence that brine and/or frost flowers are a source of sea-salt aerosol is that aerosol SO_4^{2-} is depleted with respect to Cl^- in comparison to seawater" due to the different precipitation temperatures of these chemicals. Therefore, most observations of aerosol showing these chemical characteristics are discussed in connection to frost flowers [*Simpson et al.*, 2007]. *Rankin and Wolff* [2003] conducted a year-long study of size-segregated aerosol compositions in Antarctica. By matching the chemical composition of the aerosols with frost flowers, they concluded that surface brine and frost flowers were the source of at least 60% of the total sea salt aerosol arriving at their study site, Halley Research Station.

ALBEDO

Albedo is a metric for how reflective a surface is. Lighter surfaces will reflect more light than darker surfaces and therefore have higher albedo. The Arctic and Antarctic can be viewed as part of Earth's cooling

Photo: Sven Emil Hindaker

system, as their extensive white ice and snow surfaces reflect light and heat away from Earth. The presence of frost flowers is generally thought to increase the surface albedo; they have a much lighter color than the thin ice they grow upon. *Pinto et al.* [2003] studied five different springtime leads in the Arctic Ocean, and frost flowers were observed on the new ice growing in all of these leads. They measured the albedo for newly formed ice, with and without the presence of frost flowers and by this, showed the importance of including the impact of frost flowers when estimating surface albedo [*Pinto et al.*, 2003]. It is, however, important to note that some of the data points also represent somewhat thicker ice, and albedo increases in general with ice thickness.

MICROBIAL FLORA

Bacteria, similarly to salts and particles, accumulate in the brine channels during ice formation and growth. It is therefore logical to speculate whether frost flowers could serve as microbial habitats. *Bowman and Deming* [2010] explored this hypothesis and found that frost flowers contain up to 3.46 million bacteria per milliliter. They also found that bacteria abundance was strongly correlated with the flowers' salinity level. In addition, they found corresponding levels of cryoprotectant exopolymers which are produced by the bacteria, enabling them to remain metabolically active at temperatures as low as -35°C. These are cryophilic (cold-loving) and halophilic (salt-loving) bacteria that thrive in this extreme environment. If the frost flowers become buried by snow, the bacterial communities are insulated and may become more dynamic. With the insulating effect of snow, the bacteria can infiltrate the underlying sea ice and influence its biology and chemistry. If the frost flowers are eroded by wind the bacteria can become biogenic aerosols, subjected to long-range wind transport. They can also serve as condensation nuclei in regard to cloud formation [*Bowman and Deming*, 2010]. Increased cloud formation could have a warming effect in the Arctic winters and increase precipitation. *Bowman and Deming* [2010] also briefly mention the presence of viruses in frost flowers, which requires further study. Studying the microbes living in the extremely cold and saline environment offered by frost flowers could possibly help us understand life on ice-covered distant planets or moons.

THE BIGGER PICTURE – CLIMATE CHANGE

The polar regions are changing, and the Arctic is warming twice as fast as the rest of the world. This results in historical records of multi-year ice melting in summer. During winter, we now see an increase in first-year ice being formed instead of multi-year ice bulking up. The existing multi-year ice is becoming thinner, making it more prone to fracturing and opening up leads where new ice can grow [*Stroeve et al.*, 2018]. As this paper has discussed, frost flower formation occurs on thin, new ice, and this type of ice is increasingly replacing the thicker, older ice. Due to climate change frost flowers now have a larger growth platform. Frost flowers can potentially trigger ozone depletion events, mercury depletion events and the accumulation of methane in the atmosphere. Warmer polar regions can increase frost flower numbers, which in turn can accelerate warming, thereby forming a positive feedback loop. More empirical evidence is needed in this field to avoid a possible underestimation of frost flowers' impact on the polar environments and the climatic feedback loops.

CONCLUSION

Frost flowers represent a chemical concentration of the environment they are formed in. The flowers grow on the ice surface and perform as a springboard for these chemicals and particles to become airborne and influence the atmosphere. This paper has discussed the possible effects of frost flower activity and shown the chain of events linking the flowers to a number of potentially drastic environmental developments in the polar regions. Frost flowers become covered by brine containing chemical compounds from ocean water, where they are exposed to the extreme polar temperatures. The frost flower structures, and the temperature of their environment, can cause the release of bromine into the atmosphere. Atmospheric bromine oxidizes by destroying ozone, a reaction where halogen radicals are formed. Such radicals are linked to mercury depletion events, where large amounts of mercury are deposited in the polar regions. Frost flowers can therefore have indirect, devastating effects on wildlife through the biomagnification of mercury across the trophic levels. The reduction in tropospheric ozone, caused by bromine released from frost flowers, can also impact the hydroxyl radical chemistry in the atmosphere. Hydroxyl radicals are important in regard to keeping the powerful greenhouse gas methane in check. A reduction in hydroxyl radicals, caused indirectly by frost flowers, could lead to methane accumulating in the atmosphere, which would accelerate the warming trends. We still lack quantitative assessments on this, and there are many open questions regarding the role of frost flowers in the big, polar picture. A frost flower may be small, fragile, and short-lived, but their strength lies in their vast numbers.

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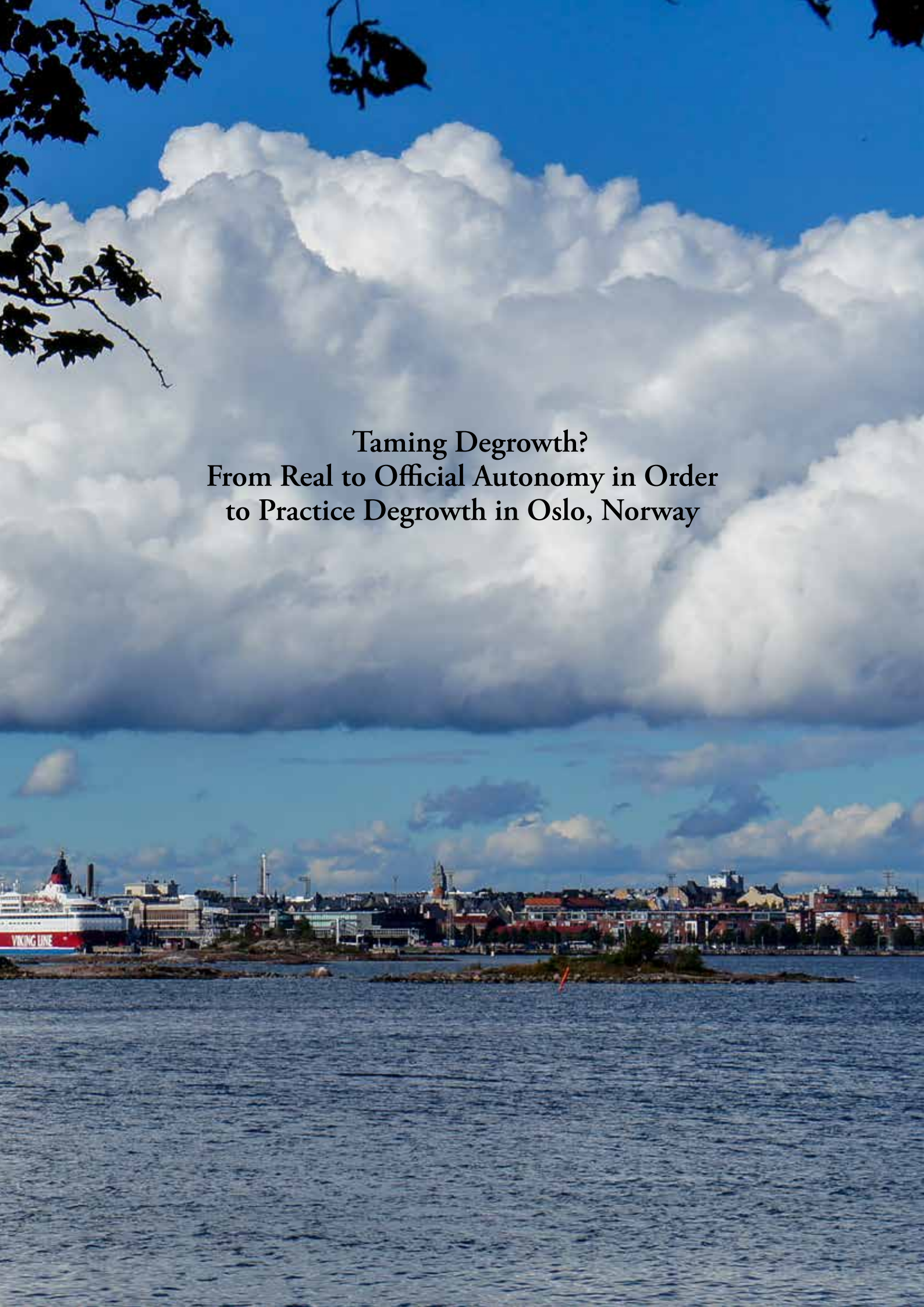
Taming Degrowth?
From Real to Official Autonomy in Order to Practice Degrowth in Oslo, Norway



Taming Degrowth? From Real to Official Autonomy in Order to Practice Degrowth in Oslo, Norway

Elena Sabina Salmansperger

Degrowth is a movement that advocates a democratically-led shrinking of production and consumption to achieve social justice and ecological sustainability (D'Alisa, Demaria, & Kallis, 2015). It is a framework connecting a radical critique of capitalism, economic growth, and GDP as a measure of human well-being to constructive ideas that originate from various disciplines and perspectives (ibid.). In 2019, the theme of the Oslo Architecture Triennale (OAT) was "Enough: The Architecture of Degrowth". As in previous years, the biggest architecture festival in the Nordic region sought to address global challenges like climate change and social division. With contributions from Vestbredden Vel Vel living and working collective (Vestbredden), a former autonomous housing project ('squat') in Oslo's center, the OAT connected architecture with one of

Operahuset i Oslo : Riche Rwahim Latiff

degrowth's pathways: *Autonomy* or, simply, self-rule. By combining architecture and degrowth, the OAT 2019 implies a public interest in future city development that is more just and sustainable through autonomous housing projects like Vestbredden. Despite hosting such an event, **Oslo municipality has barely opened space for projects that create inclusive spaces; and thus alternatives to growth-oriented architecture. This papers argues that Oslo municipality has tamed autonomy and with it degrowth, by transforming real autonomous housing projects into official ones and eradicating autonomy altogether in order to fit degrowth into the current capitalist system**. The analysis is based on the two empirical cases of Vestbredden and Brakkebygrenda, two squats located in Oslo's city center.

Autonomy and Squats in Oslo: Vestbredden and Brakkebygrenda

The transformation of real autonomous projects to official ones is best illustrated by considering the constraints put on Vestbredden, now officially recognized as a city-ecological housing project. Where this transformation was not possible, Oslo municipality eradicated real autonomous housing projects, like Brakkebygrenda in 2014. In September 1999, a group of artists and home-seeking individuals occupied the two buildings of Hausmannsgate 40 (H40) and Brenneriveien 1 (B1) in the then state owned Hauskvartalet (an area of multiple plots and buildings, located in Elvebakke, Hausmannsgate and Brenneriveien in Oslo). Alongside the other buildings of Hauskvartalet, both H40 and B1 had been out of use for several years before the artists occupied them and organized as Vestbredden Vel Vel living and working collective (Vestbredden Vel Vel, 2018a). In 2000, shortly after Hauskvartalet's occupation, a group of activists built a caravan park in St. Halvardsgate 27, a property near Oslo's central station. Much like the occupied buildings in Hauskvartalet, the property has been unused for decades, notwithstanding the increasing pressures of gentrification (Dragland & Eggesvik, 2014). The activists created a city ecological housing project with the name Brakkebygrenda, also called Brækkers (see Appendix 3). By transforming or eradicating autonomous housing projects, Oslo municipality interfered with the work of two Degrowth initiatives.

Broadly speaking, squatters occupy unused spaces, often in or around cities such as Oslo, which are subject to gentrification. Gentrification is a process which pushes lower income individuals out of the city due to ever-rising housing prices created through speculation with and privatization of property. Autonomy is central to many squatter movements, as residents of such projects often reject dependency on the market or the state and capitalism (Kothari, Salleh, Escobar, Demaria, & Acosta, 2019). Squats aim to achieve autonomy through various mechanisms, such as radical democracy and convivial (understandable, manageable, and controllable by its users) tools like urban gardens (D'Alisa et al., 2015). Radical democracy, as opposed to liberal or representative democracy, is based on consensus of affected individuals and a horizontal structure in order to allow each individual to participate in government (ibid., Kothari et al., 2019). It is worth noting that defining squatters as occupants rather than residents has a negative connotation. Chiefly, doing so implies that squatters take away something from society and it ultimately denies them the right to a place. Considering that they create precious spaces that are inclusive and sustainable and that inspire for a needed system and value change as advocated by degrowth, it is more appropriate to refer to people living in squats as residents.

Squats respond differently to authorities' interferences in their autonomy. The first part of my analysis focuses on how Oslo municipality slowly formalized Vestbredden's project and transformed their real autonomy into an official one. This process was enabled by Vestbredden's pragmatism, but it subjugated them to certain rules and values, and greatly restricted their autonomy. The second part of my analysis describes the processes that led to the final eviction of Brakkebygrenda in 2014 and why Oslo municipality did not transform Brakkebygrenda's autonomy into an official autonomy. These examples illustrate how Oslo municipality has tamed degrowth initiatives. In order to analyse the process of taming degrowth through transforming autonomy, a differentiation between real and official autonomy is required.

From Real to Official Autonomy

Real and official Autonomy can be differentiated by referring to the recent statement by two sub comandantes of the Zapatistas, an autonomous movement from Mexico influential for squats around the world:

[...]Official autonomy is recognized by law, and this is its logic: "If you have an autonomous system and I legally recognize it, then your autonomy begins to depend on my law and not on your actual autonomous practices. When election season rolls around, you'll have to support us, voting and promoting the vote for our party, because if another party takes office they'll undo that law that protects you." […] The struggle for freedom is in effect transformed into a struggle for the legal recognition of struggle.

Moisés & Galeano (2018)

Even if a squat is tolerated or ignored, it is dependent on decisions made by the respective government or

property owner. According to Castoriadis, autonomy is both interconnected and in tension with social institutions (as cited in D'Alisa et al., 2015). For real autonomy to exist, the government and private owners must tolerate the squatters without negotiations that seriously restrict their ability to define and live autonomously. If this is not given, does real autonomy turn into official autonomy out of necessity if its aim is to persist in a system based on different values? And if so, what are the compromises and dependencies individuals are subjected to? Boundaries between both kinds of autonomy are blurred and difficult to define, especially as an outsider. Therefore, it is not possible to declare certain events as tipping points that mark the shift from real to official autonomy. Whether, and in which periods of their existence, a movement perceives itself as an official or real autonomy differs from case to case and individual to individual, even within the same case. Still it is possible to recognize some incidents that indicate the process of transforming an autonomy.

Taming Vestbredden's Autonomy

Before taming it, Oslo municipality initially allowed Vestbredden to define and live their autonomy by tolerating their squat. In 2004, the municipality bought the entire Hauskvartalet off the state with the aim to maintain its cultural value and to protect it from private investment (Pedersen, 2016a). In this way Vestbredden could create an important alternative to Oslo's housing market for individuals with financial instability, whether due to unemployment, low wages or voluntary lifestyle choices. Rather than less of the same, degrowth emphasizes a *different* way of living: simpler and as a community. Autonomous movements implement this concept by adopting new norms and values that are not dictated by the paradigm of economic growth, finance or techno-science. This means that residents of squats do not have to subjugate to imposed lifestyles like consumerism and capitalism. Practicing radical democracy on the principles of consensus and horizontality can enable them achieve these freedoms (Kothari et al., & Acosta, 2019, D'Alisa et al., 2015). Vestbredden practiced radical democracy through regular meetings, which every resident could attend and where everybody above the age of 16 years had a vote (Vestbredden Vel Vel, 2018b). Therefore, Vestbredden created a communal space in which individuals are able to participate in governance.

Under these principles and with mostly supporters' and their own resources, Vestbredden turned the abandoned buildings into liveable places. They fixed the roof, as well as electricity and sewage systems (Vestbredden Vel Vel, 2015b & 2018a), and created rare spaces for inclusive and affordable housing based on non-commercial values. Alongside next door Kulturhuset Hausmania they turned Hauskvartalet into an alternative social and cultural space, offering ateliers for artists, concerts and other events based on non-commercial values (ibid., see Appendix 1). Against the backdrop of blurred and hard to define boundaries between real and official autonomy, Oslo municipality initially opened space for autonomy as a degrowth initiative, as Vestbredden was able to autonomously create an urban ecological housing project for the first 9 years of its existence. This shows how autonomy can enrich city development and address central aims of degrowth: social justice and sustainability.

However, a few years after buying the area from the state, Oslo municipality began taming Vestbredden's autonomy with a new regulation plan for the area which aimed to facilitate the development of a lively communal space. In 2008 the city council defined Hauskvartalet as a "byøkologisk kulturkvartal" (urban-ecological cultural area) that emphasized development under active participation of the area's users (Oslo Kommune, 2008). Oslo municipality thus officially recognized Vestbredden as a stakeholder in the decision-making process around Hauskvartalet, their efforts to offer a more inclusive social and cultural space and the area's cultural value. The regulation plan further defined H42, which was occupied in 2005, as conservation-worthy (Vestbredden Vel Vel, 2016a, & 2019). Yet the plan also restricts the autonomy of Vestbredden, as it officially determines certain values for the area's development. Those values (participation, sustainability, alternative living) do overlap with Vestbredden's, the methods for reaching them and desired results are different (Vestbredden Vel Vel, 2016a). In fact, this regulation plan might have opened the possibility of sale to a private investor that has, in the eyes of Oslo's city council, better resources than Vestbredden to fulfill the plan's goals (Vestbredden Vel Vel, 2016a). With formalizing Vestbredden's project through the new regulation plan Oslo municipality began to tame Vestbredden's autonomy. In order to persist, Vestbredden had to accept those compromises and adjust their degrowth project to a framework constructed by Oslo municipality.

The municipality further tamed Vestbredden's autonomy by prioritizing the privatization of the area. Discussions about selling parts of Hauskvartalet began as early as 2009 without including Vestbredden (Vestbredden Vel Vel, 2015a). As the surrounding area experienced significant rise in land prices due to gentrification, Hauskvartalet became more appealing for private investors (Vestbredden Vel Vel, 2016a, Pedersen, 2016a). Additionally, increased interest in

sustainable or alternative housing projects made Vestbredden as an urban-ecological cultural area an attractive project to invest into (Sørgjerd, 2016a). In May 2016 Oslo municipality sold parts of Hauskvartalet (H40, H42, B1, and the empty lot Sirkustomten) to private real estate and urban planning company, Urbanium AS, without Vestbredden's consent, contrary to the 2008 regulation plan's emphasis on participation (Sørgjerd, 2016b, see Appendix 2). By selling parts of Hauskvartalet without the consent of Vestbreddens members that inhabited them, Oslo municipally denied Vestbredden the right to participation in the decision-making process around Hauskvartalet.

Through the sale Oslo municipality prioritized the area's economic value to a private investor over Vestbredden's divergent ways of earning rights to a place: taking care of it for 16 years by putting effort and personal resources into it and creating a sustainable and inclusive space. Instead, Oslo municipality subjugated Vestbredden to the paradigm of economic growth and capitalism, and restricted them from creating a living based on different values. According to the newly elected socialist city council Hauskvartalet was in a disastrous state. Therefore, they called the sale a necessary decision in order to cover the costs for achieving the desired development of Hauskvartalet. Urbanium's 'desired' development was, however, in conflict with Vestbredden's ambitions (Arkitektnytt, 2015, Pedersen, 2016b). The discrepancy between Vestbredden and Urbanium/Oslo municipality was shaped by entirely different perceptions of the buildings' conditions. This highlights the gap in expectations, norms, and values between the respective actors. Vestbredden's perceptions mirror degrowth's goal of a value shift beyond capitalism and materialism, and the willingness to give up the status quo (D'Alisa et al., 2015). The municipality's perception on the other hand focuses on the buildings' material features, which they require to have a certain (higher) standard. Oslo municipality transformed Vestbredden's autonomy into an official autonomy by selling Hauskvartalet to a private investor because of economic incentives instead of allowing Vestbredden to carry on with their city-ecological project. The sale forced Vestbredden to accept great restrictions on their degrowth initiative.

Selling Hauskvartalet to Urbanium AS made Oslo municipality indirectly responsible for the exclusion Vestbredden experienced from decision making concerning H42, B1, and a project, named Vega Scene in Sirkustomten. In collaboration with the 2008 regulation plan, Urbanium aspired to implement a project called 'Habitat Haus' with supposedly city-ecological features in H42 and B1 (Øverdahl, n. d.). Realizing this project would have required tearing down H42, which was contradictory to Vestbreddens ambitions and ignored the 2008 regulation plan's declaration of H42 as preservation worthy. As recent as December 2019, the city council re-regulated H42, allowing its demolition and the implementation of the 'Habitat-Haus' project, now under Bonava AB, a Swedish real estate developer who bought Urbanium earlier in 2019 (Årdal, 2019b). Since the sales contract tolerated the 'occupants' in H40, a rental contract seemed to be the best solution. In April 2019, the parties agreed on a rental contract for H40 (Vestbredden Vel Vel, 2019). Urbanium AS and most recently Bonava AB made Vestbredden go through many negotiations concerning plans for H42 and B1. This limited their autonomy as they had to fight for compromises, instead of independently deciding how they want to create the area they live in.

As well as being widely excluded from decision-making concerning H42 and B1, Vestbredden was also excluded from the Vega Scene project in Sirkustomten. Plans to create an independent cinema there had existed prior to the sale of Hauskvartalet, and Urbanium was obliged to implement them (Sørgjerd, 2016a). The cinema opened in 2018, causing Vestbredden to protest as Vega Scene was built on the foundations that they created but without their participation or acknowledgment of their efforts (Vestbredden Vel Vel, 2018c). Interference like this destroyed Hauskvartalet's social and cultural environment which developed over time and cannot be physically rebuilt or replaced (Sletten & Marciniak, 2019). Both 'Habitat Haus' and the Vega scene project also foster gentrification by making the area more attractive, effectively resulting in the opposite of Hauskvartalet's original aim to create a just and sustainable alternative. Whilst rather being a symbol for the exclusion and oppression Vestbredden experienced, Vega Scene received the City of Oslo Architecture Award 2019. Oslo municipality enabled the private real estate investors to decide over the area's development without Vestbredden's consent, thus greatly intervening in their degrowth initiative.

Aside from the 2008 regulation plan and the exclusion from discussions about selling Hauskvartalet, Oslo municipality restricted Vestbredden's housing project through several violent evictions. In 2010 the authorities used poor fire protection measures as a reason to evict Hausmannsgate 42 (H42). This limits Vestbredden's autonomy through imposing a required standard on the building in which they live (Pedersen, 2016a, Sørgjerd, 2014). The sale of Hauskvartalet to Urbanium AS provoked protest, including the re-occupations of H42 and B1, which in turn caused violent police evictions, arrests, and fines, as the sales

contract only tolerated 'occupants' of H40 (Sørgjerd, 2016b, Vestbredden Vel Vel, 2016b). With evicting Vestbredden several times, especially from the corner building H42, Oslo municipality spatially limits their degrowth initiative by tolerating them only in a certain area (H40).

This spatial limitation was manifested through the rental contract Vestbredden received in 2019. As a result of selling Hauskvartalet, Oslo municipality was indirectly responsible for restriction of Vestbredden's autonomy. The contract over 10 years gave Vestbredden an official status in the case of Hauskvartalet, implying their right to participation. The relatively low rent of 23 000 Kr/ month recognizes their efforts and resources put into the buildings (Årdal, 2019a, Boger & Velle, 2019). Nevertheless, during the process of taming their autonomy, their 'participation' was narrowed down to decisions about H40 only, whilst before they were able to create almost the entire Hauskvartalet. The participation Vestbredden gained through the rental contract with Urbanium is superficial at best, as it gives them less autonomy than they had before Hauskvartalet was privatized. The 2008 regulation plan which opened for selling Hauskvartalet to Urbanium AS which in turn opened for the rental contract that reduced their participation rights to H40 imposed great restrictions on Vestbredden. According to Moisés and Galeano's definition of real and official autonomy, Oslo municipality transformed Vestbredden's real autonomy into an official autonomy by making their project dependent on decisions made by the government and/or the private property owners. This transformation implies how Oslo municipality only allows spaces for degrowth initiatives like autonomy if those projects are formalized.

Eradicating Brakkebygrenda

The second case the analysis focuses on is Brakkebygrenda, a squat in St. Halvardsgate 27 in Oslo's city center. Oslo municipality began dismantling Brakkebygrenda's autonomous housing project by not recognizing its residents as stakeholders in discussions about plans for the plot. Unlike the recognition provided by Vestbredden's 2008 regulation plan, Brakkebygrenda's city ecological project was never perceived as an option for the empty plot, not even during the planning periods. Oslo municipality did not enable negotiations,

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although Brakkebygrenda's residents were the only ones using and taking care of the property for decades (Brakkebygrenda, 2014a). They built infrastructure including a common kitchen, toilet, and compost, as well as urban gardening projects and open events like bike fixings or concerts (Brakkebygrenda, 2013b). Such actions present alternative, non-monetary ways of earning the right to a residence, especially one that has been (and still is) abandoned for decades, while individuals are struggling to find affordable housing. Rather than acknowledging Brakkebygrenda's efforts as a degrowth initiative, Oslo municipality denied them any participatory right in the discussions around future plans for St. Halvardsgate 27.

As they did not recognize Brakkebygrenda as stakeholders, Oslo municipality encountered Brakkebygrenda's attempts of maintaining their city-ecological project with exclusive communication. The owner of St. Halvardsgate 27, Chow Ho, was not available for most of the time, as she was absent from the country due to ongoing accusations of involvement with slavery (Dragland & Eggesvik, 2014, Haug & Brandvold, 2008). Firstly, Oslo municipality decided to prioritize difficult communication with an absent owner over communicating with the present and affected residents of Brakkebygrenda. As a result, plans for St. Halvardsgate 27 went back and forth between the city's wish for building a kindergarten, the owners' ambitions to build a housing complex, and the temporary solution of a parking lot (Sigurjonsdottir, 2015, Eggesvik, 2014, Braaten, 2010). Secondly, Oslo municipality based the discourse on technical jargon, which made negotiations inaccessible for people without a certain education and slowed down discussions by bureaucratic measures. Brakkebygrenda's residents perceived the little existing dialogue with Oslo municipality as superficial and ineffective (Hillestad, "Brakkebygrenda", 2017). In March 2014 Brakkebygrenda's second resident group attempted to receive recognition by bringing their case into court against Oslo's planning and building department. Again, bureaucracy impeded the process and finally their attempt was without success as Brakkebygrenda was evicted before their case was recognized (Hillestad, "Brakkebygrenda", 2017). By minimizing and hampering the dialogue with its residents, Oslo municipality started dismantling Brakkebygrenda's Degrowth initiative

Oslo municipality further dismantled Brakkebygrenda's autonomous housing project by prioritizing private interests (those of property owners) over public ones (those of Brakkebygrenda's residents, neighbors and citizens). They prioritized communication with Chow Ho despite her obvious lack of interest in the property, therefore opening for speculation. Even five years after the first eviction in 2008 she showed no interest in investing in the property or building the anticipated kindergarten (Hillestad, "Brakkebygrenda", 2017). Brakkebygrenda in contrast created an affordable and inclusive social space in response to gentrification. Additionally, Oslo municipality acted on the complaints of two owners of neighboring buildings. In 2013 they urged Chow Ho on behalf of these owners to arrange the final eviction of Brakkebygrenda. The complaints were officially based on lacking fire security and sanitation measures which limits Brakkebygrenda's autonomy (Sørgjerd, 2014). However, considering that the eviction deadline, the 15th of January 2014, overlapped with new residents moving into the aforementioned buildings, it appears that the owners' complaints had personal motives: Brakkebygrenda's alternative appearance was perceived as "unsightly"and would cause surrounding buildings to lose economic value. If the plot was turned into a parking lot or kindergarten instead, those buildings would gain value, which would foster higher rents and gentrification (Brakkebygrenda, 2013a, Sørgjerd, 2014). By prioritizing the rights of two-house owners, Oslo municipality not only ignored the losses of around 15 residents, but also ignored the complaints and ambitions of actual neighbors and citizens who showed their solidarity with Brakkebygrenda (Hillestad, "Brakkebygrenda", 2017). On top of that, the municipality was more willing to pay 8 Million Kroners of public funds for implementing Brakkebygrenda's final eviction, than to keep the alternative housing project, which did not cost the city anything during its 12-year existence (Brakkebygrenda, 2014b). Oslo municipality thus dismantled Brakkebygrenda's autonomy as a degrowth initiative through prioritizing speculative private interests over the ambitions of the Brakkebygrenda's residents, actual neighbors, and other citizens.

In contrast to Vestbredden, Oslo municipality eradicated Brakkebygrenda by violently evicting them twice, instead of formalizing their autonomous housing project. This is likely due to Brakkebygrenda's radical view towards land ownership and the rejection of involved private owners. First, it is unlikely that Brakkebygrenda would have obeyed private property rights and accept a deal such as Vestbredden's rental contract with Urbanium AS. Brakkebygrenda showed interest in an alternative rental contract with Oslo municipality, where their rent consists of creating and running a cultural space, thereby contributing to a sustainable city development (Braaten, 2008). Oslo municipality never owned St. Halvardsgate 27 and because a rental contract in this form is rather

uninteresting for a private investor, it never happened. A member of Brakkebygrenda's second occupant group, who I interviewed as background for this article, again emphasized their radical opposition towards private land ownership. Second, the private owners involved in the case did not, other than Urbanium AS, show any interest in a sustainable development project on or next to their property. The combined effect of intolerance, disinterested property owners, and Brakkebygrenda's unwillingness to subjugate made it impossible for them to persist. Instead, Oslo municipality was confronted with disinterest by Chow Ho and complaints by the owners of surrounding properties.

Recent history shows a pattern of evicting Brakkebygrenda's residents from St. Halvardsgate 27. In 2008 the police violently evicted Brakkebygrenda for the first time under the pretext of plans to build a kindergarten. The residents had to give up their homes, even though St. Halvardsgate 27 remained an empty and unused plot for the following three years (Fröhlich, 2014, Hillestad, "Brakkebygrenda", 2017). In 2010 a second group of activists recreated the city ecological housing project with the aim of reduced consumption, independence of wage labor, and creating an inclusive social space (Brakkebygrenda, 2013b). In June 2014 the police again evicted Brakkebygrenda's second city ecological project although no plans for an alternative land-use existed (Brakkebygrenda, 2014c, Wilden & Jensen, 2014, Sørgjerd, 2014). St. Halvardsgate 27 remains an empty and unused plot up until today, almost 6 years later. As Oslo municipality stayed within its old values, priorities, and legal system, it could not officially recognize Brakkebygrenda as a city ecological project like Vestbredden, due to contrasting views towards land ownership and disinterest of the involved private owners. Therefore, Oslo municipality prevented Brakkebygrenda from creating an alternative social space in the empty lot of St. Halvardsgate 27 through violently evicting them twice and thus limiting autonomy as a degrowth initiative in Oslo.

Conclusion

Despite eradicating autonomous housing projects like Brakkebygrenda, Oslo still practices degrowth to some degree by opening spaces for official autonomy like Vestbredden. Nevertheless, it certainly limits the effects degrowth initiatives could have to attack the growth paradigm as a root cause of social inequality and environmental degradation. Real autonomous initiatives are tamed in order to fit into the current value and belief system or eradicated, like Brakkebygrenda, if they do not fit. Here, Oslo municipality sticks to old and capitalistic values. It prioritizes private property rights and land ownership principles over common property rights and allows further gentrification and speculation to determine the city's development. Hosting an event like the OAT 2019 under the theme of degrowth and including an official autonomous project like Vestbredden, can be seen as a step in the right direction towards actually practicing degrowth alternatives. On the other hand, considering Oslo's recent engagement with autonomous movements like Vestbredden and Brakkebygrenda, it could also be viewed as somewhat hypocritical by just following the green trend, thereby keeping Oslo's 2019 title of the Green European Capital, further fostering gentrification in the city. Future research on Oslo municipality's approach to practicing degrowth through autonomy could consider the engagement of the municipality with other squats in the city. As degrowth is a framework providing various pathways, one could also consider Oslo municipality's openness for degrowth's other approaches like urban farming or community currencies. Regarding autonomy as an approach to degrowth, Oslo municipality should open up for the emphasized value shift and engage in more and better participation of residents of squats in the development of their projects.

Appendix

Vestbredden in H40 (left) and part of Kulturhuset Hausmania in H34 (right) (Randen, 2019)

Map of Hauskvartalet highlighting the parts sold to Urbanium AS in 2016 (Sørgjerd, July 2016)

Brakkebygrenda before its eviction in 2014 (Hillestad, n. d.)

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Philanthro-capitalism in Global Health Governance
A Case Study of the Bill and Melinda Gates Foundation

Philanthro-capitalism in Global Health Governance A Case Study of the Bill and Melinda Gates Foundation

Kulsum Abbasi

1. Introduction and Background

"It costs no more than four dollars to take a truck from their village to our clinic," writes Paul Farmer (2000, p. 94) as he regrets how a man died needlessly of cutaneous anthrax during the 1996 epidemic in Haiti because he didn't have the money to get to the hospital. Two other patients who had arrived at the hospital and received penicillin, recovered. Farmer also talks about how "exceedingly rare" death from another treatable disease, tuberculosis, is in central Haiti, "but for those beyond the boundaries of our project, TB remains the scourge it has been for centuries" (ibid., p. 95). Indeed, boundaries of various types exist globally, restricting access to healthy lives for millions of people, and divide health statuses and mortality rates both between countries and within them (Schrecker, 2017).

These figurative boundaries manifest in stark and persisting global health inequalities. Life expectancies in Japan and Sierra Leone, for example, differ by a gaping 48 years (Marmot, 2005). Some explanations of these inequalities focus on wealth and development levels - poor countries tend to have less healthy populations and poorer people within all countries, rich and poor, tend to be less healthy (ibid., p. 383). Inequalities may be seen as mere differences which are expected to flatten out as states ameliorate poverty through economic participation and growth. Efforts towards this end have resulted in global spending of billions of US dollars, largely in the form of Development Assistance for Health (DAH) initiatives (Schrecker 2017, p. 395).

Another perspective, one that is increasingly embraced by the World Health Organization (WHO), explains these inequalities by considering the many social determinants of health. The WHO defines these determinants as "conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels" (WHO, 2019). They include (but are not limited to) employment conditions, social exclusion, public health systems, gender equity, globalization processes, and environmental effects (ibid.). It is these factors that will: a) prevent people from having access to existing health services and technologies, and b) result in causing certain kinds of diseases among people. This multi-dimensional understanding acknowledges the power asymmetries that exist in the world. Importantly, it recognizes the inequalities as inequities: avoidable and unjust.

Marmot (2005) points out that far from an "inevitability" to polarities in life expectancies or other health indicators, there is "burgeoning research that identifies social factors as the root of much of these inequalities in health" (Marmot, 2005, p. 1103). The imperative is to understand how these social determinants interact, and more importantly, turn this knowledge into "political action" (ibid., p. 1099). Political processes are seen to have an immense obligation and relevance to address this issue. There is, however, a particularly influential force that stands out in glaring defiance to this social determinants understanding of health inequalities: corporate-backed private philanthropy, dubbed *philanthro-capitalism* (Butler, 2019, p. 2). This influence can be understood as neoliberal in nature as it is a promotion of privatization and internationalization of health systems.

There are approximately 60,000 registered philanthropic foundations (Moran & Stevenson, 2013, p. 121) and they are by no means a new notion. Among these, the Bill and Melinda Gates Foundation (BMGF) stands out as arguably "the current era's most influential global health agenda-setter" (Birn, 2014, p. 1). An endowment of over USD 36 billion (Moran & Stevenson, 2013, p. 117) and an "equal partner status" (ibid., p. 118) in health-focused international organizations including the WHO, the World Bank, and the GAVI Alliance, speaks volumes about the Foundation's scale of influence. Its global

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health budget has far overshadowed that of the WHO for several years (Birn, 2014, p. 9). Given the colossal prominence of this force in global health governance, a compelling concern is: *what are the implications for health inequalities?* This paper offers critical reflections on the impact and implications of philanthro-capitalism for health, concluding with a broader critique of how a neoliberal, private corporation-backed, top-down influence in global health governance is likely to continue to exacerbate inequalities.

2. *The impatient optimists* - scale, scope and strategies of the BMGF

In its own words, the BMGF is a foundation consisting of "impatient optimists working to reduce inequity" (BMGF, 2019). *The attribute of impatience and please italicise the word impatience can be recognized as a reference to their business-model approach focused on "harnessing the innovative capacity of firms" (Moran & Stevenson, 2013, p. 118). There is pride in efficiency and a denigration of the bureaucracy and perceived lack of vigor of the public sector. The BMGF is "emblematic

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of an overall trend towards for-profit style management, leadership training, and goal-setting, as well as the privatizing of public health activities," notes Birn (2014, p. 2).

The relevance of the state is sidelined in favor of private approaches, and a role for the state exists only in its partnership with the private sector. In advancing this stance, the BMGF is "the largest donor for many of the public-private partnerships (PPPs)" (Moran & Stevenson, 2013, p. 118) working in global health. Programs have "narrowly defined goals (and) short-term achievements" (Birn, 2014, p. 10), particularly suited to its technology-centric approach, discussed shortly. This approach ties in neatly with the neoliberal economic world in which the parent corporations of philanthro-capitalism thrive. This prevailing ideology that helped the BMGF become a behemoth also rationalizes its prevalent strategies.

The Foundation's self-attributed *optimism* likely refers to confidence in technology and expertise, predominantly focused on the promise of vaccines, as a solution to health problems. Vaccine development has been the most prominent of the BMGF's global health

efforts: "in 2010, it committed USD 10 billion over 10 years to vaccine research, development and delivery" (Birn, 2014, p. 11). The rationale is to make science useful to the poor and marginalized by pioneering and delivering treatment and prevention technologies; treatment "via diagnostic tools and drug development partnerships" (ibid., p. 9) and prevention "through vaccines and microbicides" (ibid.).

The BMGF's claims of working towards reducing inequities is open to debate and is critiqued in the following section. For now, the Foundation's fund matching strategy is worth mentioning. The appeal of the Foundation is such that it is able to attract ten times more resources from bilateral donors compared to its own contributions (ibid., p. 10). Aptly called "the pied piper of global health" (ibid., p. 11), the BMGF capitalises on the sheer magnitude of its donations and harnesses wide-reaching collaboration which includes the World Bank, the WHO, universities, businesses and NGOs. The idea is to invigorate active recipient participation and commitment, but the result is a monopolisation of budgets and resources of other donors and recipient organisations.

Overall, the scale of the Foundation's activity in global health is substantial. The scope is largely to do with pioneering and developing technological and expertise-driven solutions; the strategy to deliver their intervention is a top-down, donor-driven, privatized approach, where matching funds incentives are given.

3. BMGF - impacts and implications for health inequalities

There is no doubt that the Foundation has achieved some incredible innovations which may not have been possible without capital. As Birn (2014) acknowledges, "global health PPPs have helped spur research and development and enabled better diffusion of pharmaceuticals" (p. 13). Progress in rotavirus and Meningitis A vaccines, for example, is to be acknowledged (Butler, 2019, p. 10). There has additionally been substantial and arguably unprecedented encouragement of funding for "neglected diseases" (Birn, 2014, p. 13) through Product Development Partnerships.

However, the BMGF approach is arguably problematic in several specific aspects. To start with, such unchallenged and substantially large-scale influence risks becoming authoritarian. The decisions and activities of the Foundation have little to no accountability, lending it a unique mandate and an unethically unequal global position. Such incredible capital-backed influence is uncomfortable from the lens of egalitarianism. Additionally, several facets of it threaten to exacerbate inequalities in health. The following sub-sections review some of these facets as listed by Butler (2019).

3.1 Technological solutions trump social interventions

The BMGF practices little balance when favoring technological solutions over social ones (Butler, 2019). A preference or aptitude for technology seems to motivate this partiality rather than evidence that technology-based solutions are always more suitable. The magic bullet of antibiotics, for example, is favored to prevent maternal deaths even in the face of compelling evidence and insistence from specialists linking strong health systems with reduced maternal mortality (ibid.). Similarly, the focus on technological intervention, to the extent of dismissal of the social, "directly contradicts an abundance of public health and demographic research" (Birn, 2014, p. 11). Historically, health improvements were significantly a result of better living and working conditions, and were only later (during WWII) supplemented by medical technologies (ibid.).

Essentially, the solution is peddled before the problem is sufficiently understood. Poor health in the developing world is seen as a technical rather than social problem. A focus however is placed "on the supply side of the innovation system" (Brooks et al., 2009, p. 13). With respect to the receiving end, there remains little understanding of the "ecological, political, socio-economic and cultural conditions" (ibid.). These realities combine with poor state institutions and systems and compromise the success of the intervention.

3.2 The problem with vertical approaches over horizontal

Both vertical (disease-focused) and horizontal (health-systems focused) approaches are useful, but the BMGF is "disproportionately supportive of vertical health programs" (Butler, 2019, p. 8), i.e. on dealing with individual diseases rather than on improving health systems. Butler (2019) disaggregates the USD 4.6 billion spent in 2016 by BMGF and concludes that "it is hard to find anything clearly targeted at strengthening health systems, although $114 million is for 'integrated' development and delivery" (ibid.). There is a clear neglect of any complementing intervention in addressing any social determinants of health.

The BMGF's focus on diseases stems from its optimism in vaccines, an optimism that amounts to the assumption that a vaccinated and immunized population will pull itself out of poverty through more capable economic participation. Moreover, in a privatized system people are even expected to pay the bill. The problem has many further dimensions: in the absence of a focus on health systems, the delivery of the vaccines becomes ineffective. A substantial amount of grants go towards vaccine production but the delivery of the vaccines is a sluggish process, slowed by high costs of trials and commercially

inviable settings (Butler, 2019, p. 10). So the access problem persists, alluding to the kinds of boundaries this essay started with. Moreover, vaccines will prevent a certain disease or two in populations that successfully benefit from them, but these gains are very likely to be offset by diseases that are borne from inadequate living and working conditions (Birn, 2004).

3.3 The problem with 'top-down'

A related issue with the vertical and technology-driven approach is that it is essentially a 'top-down' intervention, which brings with it "imposition of outside agendas, poor harmonization with stakeholders and national governments, and vilification of the public sector" (Birn, 2014, p. 14). Importantly, it restricts "integrated approaches" (ibid.) and in doing so, overlooks the opportunities of learning and iteration. As Brooks et al. (2009) explain, lower-cost and perhaps more holistic solutions may be being elbowed out. Children's health, for example, can be addressed with a focus on vaccine interventions, but if the same objective is achieved through "initiatives that build preventative health systems and enable parents to access them" (Brooks, et al., 2009, p. 7), not only are the effects longer-term but are also likely to have wider outreach.

These alternatives may arrive at similar targets, but "along the way, they carry very different implications for ongoing development pathways, and who gains, loses, or is empowered or disempowered through them" (ibid.). Indeed, power dynamics are affected significantly by differential gains and losses, a phenomenon that is evident in Pakistan where vaccinations are vehemently contested in various regions of the country, to the extent that fatal conflicts ensue. How power dynamics are affected as a result of top-down approaches is a consequential field of study that deserves further investigation. Additionally, a paternalism to the top-down approach "robs local people of the freedom to shape their economics and lives themselves" (Unmüssig, 2017) - an inequity concern that remains uncontested.

3.4 How metrics and measurement obscure inequalities

Another important problem with the BMGF approach is its emphasis on metrics and measurement. Prof. Jerven of NMBU has emphasized the dangers of using partial or unreliable data to understand social reality or guide policy. This becomes a bigger problem when the metrics are designed by the Foundation itself, with no external accountability (Butler, 2019, p. 10). These metrics evaluate and often laud the efficiency of the business approach, but have little relevance to gauging social consequences. The problem with this is that while successes on the supply side are highlighted, the wider problems and inequalities remain hidden. The vaccine strategy is particularly suited to this measurement-driven approach, as "vaccines appear to exemplify, par excellence, a technical, universally-applicable solution to disease problems" (Brooks et al., 2009, p. 5). It is a check-list oriented, measurable and scalable approach that accounts "percentages of children immunized, (and) diseases eradicated" (ibid.), but uses a short-sighted lens which is, more often than not, rose-tinted.

Brooks et al. (2009) further point out that this is essentially a redefining of the notion of development where the goals of "poverty reduction, universal education, and maternal and child health" (ibid., p. 7) remain isolated targets. Consequently, the solutions are isolated in nature and their success revolves around their "universality and scalability" (ibid.). In this framework, what is ignored are the processes of feedback and change, and the value of local participation. The questions asked are: *"how much, how fast* and *when"* (ibid.) while "crucial questions about *which way, why, for whom* and *who says"* (ibid.) are conveniently ignored.

3.5 The issue with dependence on the private sector

Dependence on private-sector philanthropy introduces another kind of vulnerability for its beneficiaries - that of dependency on an entity they lack any claim over. For instance, the BMGF could unpredictably pull out of an intervention or withdraw its capital. One of the Foundation's interventions in another sector, education, provides an example. In 2005, the Foundation invested USD 2 billion in "new, smaller schools for nearly 800,000 pupils" (Beckett, 2015) in order to revamp the traditional US high school system only to abruptly stop the funding three years later, leaving the beneficiaries in limbo. For the Foundation, this may have been an investment resulting in a sunk cost, but for the other side, it was not only significant (co-opted) finance gone to waste, but also a significant educational setback for the students involved.

The lack of "a long-term financing mechanism" (Labonté & Schrecker, 2007, p. 3) also creates vulnerabilities because of the bureaucracy associated with it: grants can only be approved "if the full amount required for the first two years is covered by pledges from donors in the calendar year of the approval" (ibid.). The WHO, which also relies on private funding, is likewise subject to "the whim of private parties (which are) under no obligation to continue their support from one year to the next" (Unmüssig, 2017). Similarly, private-sector influence in health research is also problematic with its disproportionate focus on transmittable diseases (malaria and HIV/AIDS) and an arguable neglect of

non-communicable diseases (pneumonia, diarrhea and malnutrition) "even though they cause 75% of all child mortalities" (ibid.).

A dismissal of the public infrastructure, the norms and networks, and the systems in place for collective action risks weakening the existing social capital. Especially as a result of BMGF's partial funding and fund matching approach, resources are diverted towards the Foundation, therefore undermining the social capital and increasing vulnerability in the population. An "unhealthy competition" (Baru & Mohan, 2018. p. 4) ensues among NGOs as a result of the allure of funding, influences priorities, and distorts the direction of work needed at the social and political level. It is ironic that while the BMGF approach lowers vulnerability to strains of certain viruses, it increases vulnerability to another kind of ill in society: the social determinants that negatively affect health.

3.6 How conflicts of interest entangle social justice objectives

The BMGF allegedly has interests, holdings and investments in corporations that damage the environment, profit from low nutrition intake, and produce pharmaceutical products and genetically modified products. This constitutes a problematic conflict of interest as the actions and products of many of these corporations have direct negative effects on health. Bosworth (2011) notes that the BMGF is "heavily invested in corporations whose industrial pollution in the Niger Delta is harmful to its residents' respiratory health" (Bosworth, 2011, p. 387), and then in an ethically bizarre (but economically sound) logic, supplies these very residents with vaccinations. BMGF has similarly been criticized for owning significant shares in Coca Cola, Unilever, Kraft-Heinz, Mondelez and Tyson Foods, corporations "whose products promote cardio-vascular disease, diabetes, obesity and other chronic illnesses" (Unmüssig, 2017). Similarly, the GAVI Alliance (heavily funded by the BMGF) has strongly advocated for new vaccines, many of them developed by its pharmaceutical partners, even though existing vaccines are known to be effective and accessible (Birn, 2014).

A particular conflict of interest involving property rights was played out in a substantial way in the 1990s. Profiteering by pharmaceutical companies that used patent rights to restrict access to life-saving HIV/AIDS drugs was challenged by a strong transnational movement in low- and middle-income countries (ibid.). However, this movement was thwarted by Gates' promotion of intellectual property rights, resulting in an estimated 330,000 avoidable deaths from AIDS (Sharav, 2018). Essentially, it is a problem of neoliberal marketization which turns what should be the public good (one that is non-excludable and non-rivalrous) of scientific knowledge into a private good through the preeminence of intellectual property rights. This also contributes to those boundaries of exclusion referred to in the beginning - "drivers of inequities in the availability, accessibility, affordability and acceptability of health services" (Baru & Mohan, 2018, p. 7).

4. Discussion and Conclusion

Isolated top-down solutions seem incongruent in an increasingly interconnected world where globalization processes are inevitable, and interdependence inescapable. The very social, political and dynamic nature of disease is dismissed by this approach. The interdependence that exists is ignored. The privatized, technology-centric approach is akin to treating the symptom of the problem while shrugging off any attention to the underlying causes. Moreover, the more entrenched this approach becomes, the weaker become other options, increasing vulnerability to the windfalls of this authority.

A significant problem with the philanthro-capitalist approach, as it is practiced by the BMGF today, is that it offers no empowerment to beneficiaries and donors in terms of accountability, transparency and participation. Neither does there exist any ambition or mechanism towards empowerment. A very rigid equation of supremacy sustains this approach. Recipients are seen as subordinates rather than agents of their own change. The health of those who are currently deprived remains in the hands of the benevolent authority that decides which disease to eradicate next and which technology to pioneer. Moreover, the neoliberal mechanisms that give this authority its power are the very mechanisms that continue to disempower many others. It is this conflict of interest that is the most problematic - that with trust in market forces, which have historically only further alienated the less privileged and contributed to the detrimental social determinants of health.

The current neoliberal development approach to health hints at parallels with James Ferguson's critique of the biases in development discourse, as reasoned in his 1994 book *The Anti-Politics Machine*. When problems are understood solely in a technocratic sense, and solutions are deployed technocratically and apolitically, with minimal pre-study of the background, the interdependence with social determinants and unintended consequences is likely to remain misunderstood. Questions of inequality remain depoliticized in this process. The question then is not whether a certain development project was successful or not; rather, what other less-than-

optimal outcomes were generated. Yet, Unmüssig (2017) aptly points out that the fault does not lie only with the philanthro-capitalist private foundations. It takes two to tango. Even if the private sector offers solutions founded in a certain approach, instead of championing them to evade their own responsibility, governments should prioritize their responsibility of justice and equity to the populations in their mandate.

Social, political and economic influences are not the only determinants of health, but neither will pharmaceuticals alone make populations healthy. What is sure to lead to a sub-optimal outcome however, is a complete dismissal of social influences, a disregard of the social science perspective (Farmer, 1996), and worse, a monopolization and diversion of existing resources into a one-sided approach. The microbicides needed to fight cutaneous anthrax may have been plentiful at Dr. Paul Farmer's clinic in Haiti, but what was just as crucially needed that tragic day when a man died of lack of transport, was a holistic health system that ensured access to at least an ambulance.

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Photo: Carolina Herrera-Cano

The Gender Pay Gap in Colombia
Implications for Women's Human Capabilities

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Implications for Women's Human Capabilities

Carolina Herrera-Cano

Introduction

Ensuring equal economic opportunities for women remains a challenge for global development. Efforts towards gender equality have been effective in providing access to education for women and girls (United Nations, 2015a). However, this success has not been replicated in the case of greater access to political and economic participation. Accordingly, the Sustainable Development Agenda included indicators for the effective participation of women in decision-making positions; such as the number of women in leadership positions. Surprisingly, Colombia is leading the way in the inclusion of women in managerial positions. These types of achievements are especially important because they have the potential to generate impacts on other gender equality indicators, such as the wage gap. However, Colombia, like several countries, has an increasing gender pay gap that restricts the human capabilities of women. The purpose of this text is to explain the reasons for the gender pay gap in Colombia in the context of the rise of female managerial positions and discuss its implications for women's human capabilities.

Global Development:
Managerial Positions and Gender Pay Gap

In 2015, the international community celebrated the successful results of the Millennium Development Goals (MDGs) in terms of gender equality. Chiefly, maternal mortality ratio was reduced by 45% and many developing countries eliminated gender disparity in education (United Nations, 2015a). In addition to the MDGs' focus on developing countries, other critiques regarding their understanding of gender equality emerged. Scholars and liberal feminists alleged that MDGs had a narrow definition of gender equality, limited to health and education indicators. Likewise, the millennium goals ignored complex variables influencing gender inequality, and neglected political and economic rights (Briant Carant, 2017). A reductionist perspective such as this overlooked that women's human rights are "interdependent and indivisible" (Sen & Mukherjee, 2014, p. 188), and that women's human capabilities: "*what people are actually able to do and be*" (Nussbaum, 2000, p. 239).

Dilli, Carmichael, and Rijpma (2019) argue that the main obstacles to gender equality are "economic development and institutional arrangements" (p. 34). Consistent with this scholarship, the indicators used by the United Nations 2030 Development Agenda reaffirm the need to acknowledge gender equality in a broader perspective. Likewise, the Sustainable Development Goals (SDGs) recognize that the progress in women's access to health and education was not sufficient to achieve gender equality. Thus, the SDGs drew attention to economic rights for women. SDG5: Gender equality [1] includes a specific target (5.5) to "*ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life" and uses the "proportion of women in managerial positions*" as its indicator for economic empowerment (United Nations, 2015b, p.22).

Although developed countries lead the way in SDG5 targets such as the elimination of all forms of violence against women, others like the *number of women in decision making positions* lags behind in both the developing and the developed world. Specifically, the Global Gender Gap report states that economic (and political) gender disparities persist (WEF, 2018a). This index, published by the World Economic Forum (WEF), measures imbalances between women and men around the world through four dimensions: *Economic Participation and Opportunity, Educational*

1 "Achieve gender equality and empower all women and girls" (United Nations, 2015b, p.22).

Lavender : Victoria Thomas

Attainment, Health and Survival, and Political Empowerment (WEF, 2018a). The report shows substantial improvements in health and education: the remaining gap is only 4 and 5% respectively. While the economic gap is 41%, it is surpassed only by the political gap of 78%. The economic participation is measured by labour force participation, professional and technical female workers, estimated earned income, women in leadership positions, and wage equality for similar work (WEF, 2018a).

However, a satisfactory number of women in managerial positions and the elimination of the gender pay gap (GPG) are still elusive. Women in leadership positions have diminished globally, from 25% to 24% between 2018 and 2017 (Catalyst, 2018), and the UN reports an "only marginal" improvement in this indicator since the 2030 Development Agenda came into force (United Nations, 2015b). The global GPG, on the other hand, increased from 16% to 19% between 2016 and 2018 (International Labour Organisation [ILO], 2018).

The importance of the number of women in managerial positions is backed by compelling evidence. Several studies on women development (Ruppanner, 2010; Cohen & Huffman, 2007) find that the number of women in managerial positions positively correlated to other indicators of gender economic equality, like equal payment. The correlation may indicate that by promoting the increase of women in leadership roles through development policies, women can gain access to equal economic conditions. In this regard, rather surprisingly, Colombia is leading the way in female managerial positions (target 5.5.2). The WEF, the Inter-American Development Bank (IADB), and the ILO report that Colombia (together with Jamaica and the Bahamas) has the highest number of women in managerial positions (Vaca Trigo, 2019; WEF, 2018a; Ambrus, 2016).

Colombia has successfully achieved equal conditions for women in leadership positions. However, there is a lag in achieving similar success regarding equal economic opportunities for women (WEF, 2018a). This country experienced an increase in its GPG (WEF, 2018a), despite its remarkably high numbers of "women in managerial positions". In fact, according to the Global Gender Gap report, Colombia ranks 110 (out of 149 countries) in "wage equality for similar work" which contrasts with its leading position in female managerial positions. Thus, these contrasting indicators demonstrate the need to analyse the origin of remaining economic inequalities.

The Origin of the Gender Pay Gap

The differences in wages for comparable jobs between men and women, also known as the gender pay gap, date back from the time women entered the workforce. During the 1950s, organisations were allowed to pay less to female employees, and in some cases their wages were about 65% lower than those of

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their male counterparts. This situation changed when the "*Equal pay for equal work*" social movement gained visibility in Europe and the United States. This social movement resulted in a series of legislative reforms worldwide that banned wage discrimination based on sex between the 1960s and 1970s. Nevertheless, wage inequality persisted, but the reasons were not limited to differences in wage rates between men and women (Williams, 2017).

The remaining GPG was explained through the distribution of labour based on demographic characteristics (in this case, gender), known as occupational segregation. Gender-based occupational segregation limited women to working positions with lower remuneration, like care work. The sex division of labour was initially attributed to the lack of human capital available among women due to their restricted access to education. However, occupational segregation was also the result of the traditional gender roles that relegated women to economic activities that were less valued. Furthermore, as women have reached more equal conditions at the workplace and better access to education, the GPG narrowed substantially, from 65% in the 1950s to almost 30% in the 1990s (Williams, 2017). Nonetheless, recently, the trend towards closing the GPG has stagnated.

The ILO estimates that the global GPG rose from 16% to 19% between 2016 and 2018 (ILO, 2018). As evident in the ILO (2018) report, wage inequalities based on gender persist (WEF, 2018). However, in most working environments, the GPG is formally imperceptible because employment contracts rarely allude gender to justify their value (at least not explicitly). For instance, women tend to be hired based on their experience and abilities, while men are frequently hired because of their "potential" (McKinsey-&Company, 2012). This difference relegates women to less valued positions at the beginning of their careers, and hence, income disadvantages accumulate throughout the years (Tharenou, 2013). Different meta-analyses worldwide have found that the reasons for the remaining pay gap are: occupational segregation, previous work experience, and educational level (Piras, 2004).

Some theories suggest that the GPG persists because it is still connected to occupational segregation. According to the WEF (2018c), a total of 104 countries still restrict female labour in certain positions in economic sectors such as construction, transportation and mining, yet the global trend is towards the removal of restrictive regulations, which has already happened in the Republic of Congo and Colombia. Nonetheless, some authors argue that occupational segregation can also be hidden as *occupational choice* (Piras, 2004). In most countries, even those without restrictive regulations, the number of women in careers like engineering, manufacturing, information and technology is small, while sectors like education and healthcare lack male labour (WEF, 2018c). Accordingly, occupational segregation persists on the basis of institutional norms outside formal regulations.

Traditional gender roles endure in work environments through constructed narratives of gender stereotypes. The narrative of women being exclusively responsible for a household's caregiving and domestic needs, reduce their (paid) working hours. The combination of paid (formal employment) and unpaid (domestic responsibilities) jobs that women perform is commonly known as the double burden (Hochschild & Machung, 2012). The *double burden* makes women more prone to interrupt their careers, prefer part-time jobs, and work fewer hours (Judge & Livingston, 2008), which translates to lower income levels and more restricted access to healthcare services and pension funds. Alternatively, studies have found that the stereotype of men as the breadwinners, provide them greater bargaining power regarding their salaries and working conditions (Tharenou, 2013). Similarly, Muench, Sindelar, Busch & Buerhaus (2015) report that when men start participating in traditionally feminized economic activities like working in nursery, average wages for both men and women tend to increase.

Under circumstances of an almost closed Global Gender Gap in educational attainment (5%), theories addressing educational level to explain GPG lose validity (WEF, 2018a). While it is true that some countries still face unequal conditions for women's access to education, like Guinea, the Republic of Congo and Chad (with a remaining *Educational Attainment* gender gap of about 50%), this is not the case for most. On the one hand, even the Republic of Congo and Chad perform better at the wage equality indicator than some countries with higher positions in gender equality (WEF, 2018a). On the other hand, in some regions like Latin America and the Caribbean, most higher education students are women (McKinsey&Company, 2013); yet GPG persists in these regions.

Because social indicators (such as labour conditions and educational attainment) differ around the world, each territory should be examined separately in order to analyse the causes of the GPG. The next section will explore the causes of the GPG in Colombia.

The Gender Pay Gap in Colombia

Colombia currently ranks 40th in global gender equality, according to the Global Gender Gap (WEF,

2018a), which is a drop of four positions since 2017. The country has successfully closed the gender gap in *Health and Survival and Educational Attainment; while Political Empowerment and Economic Participation and Opportunity* are still a concern. In general terms, the WEF highlights Colombia's great achievements in health and education, as well as the number of women in ministerial positions (one of the indicators of *Political Empowerment*). As per the economic opportunity dimension, the report applauds the closed gap for women in managerial positions. The latter puts Colombia as one of the countries with the biggest number of female managers (WEF, 2018). Nonetheless, the great challenge for Colombia in *Economic Participation and Opportunity* is its wage inequality.

The WEF (2018) report calls for action on the increasing GPG, which stunts Colombian women's full economic empowerment, and holds back gender equality. According to the Global Gender Gap, the perceived gap in wage equality for similar work between men and women in the country is 46% (WEF, 2018). Regardless, official statistics from the Colombian National Administrative Department of Statistics (Departamento Nacional de Estadística [DANE], 2019) estimate a 30% GPG. However, DANE explains the importance of considering the characteristics of the Colombian economy before drawing some conclusions about the origin of the national GPG (DANE, 2019).

Gender wage inequality in Colombia varies dramatically between the formal and the informal sector. The GPG in the salaried class in Colombia is only 7% (DANE, 2019), but the gap increases when the entire working population is taken into account. DANE (2019) suggests that measuring the GPG in Colombia is a particularly difficult task because a great part of the working population operates in the informal economy: 43.6% of men, and 48.3% of women. Under informal employment, the GPG is 35.8%, which leads to a GPG weighted average of 30%. To explain this situation, professors Jaime Tenjo Galarza, Rocío Ribero Medina and Luisa Fernanda Bernat Díaz (2004), in alliance with the IADB, undertook a study in Latin America.

The study included Argentina, Brazil, Costa Rica, Honduras, Uruguay, and Colombia on the evolution of the salary differences between men and women in these countries. The analysis concluded that the two main reasons for the persistent GPG in Latin America are unequal income per hour and number of working hours (Tenjo Galarza et al., 2004). For the specific case of Colombia, the authors found that women earn higher incomes per hour than men. Yet, the gap takes place in the amount of women's working hours, which explains the GPG in the country. The study concludes that women in Colombia perform fewer paid working hours than men because women's use of time is divided between unpaid domestic work (such as child and elderly care) and employment (formal or informal) (Tenjo Galarza et al., 2004).

Consequently, the double burden has direct implications for women's economic opportunities, especially over their income. It is less possible for women to work extra hours, attend training programs or go on business trips, because they risk reducing their time for domestic responsibilities, although that would increase their possibilities of moving up in positions and increasing their income. Moreover, in order to attend to

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care work, women tend to prefer informal jobs or temporary contract jobs (United Nations Development Programme [UNDP], 2012), in which the GPG is even wider (Tenjo Galarza, Ribero Medina & Bernat Díaz, 2004; Tenjo Galarza & Idárraga, 2009).

Although the report by Tenjo Galarza et al. (2004) was published fifteen years ago, in terms of the distribution of domestic work in Colombia, the same challenges still remain for women. Colombian women spend on average 4.21 hours a day on home-related responsibilities, while men spend 1.09 on the same activities (United Nations, 2018). This means women carry out about 3.8 times more unpaid domestic work than men. Women in Colombia do not work fewer hours, but fewer *paid* hours, and that is the origin of the gender wage gap.

The existence of a GPG in countries that have reached equality in development indicators such as women in managerial positions, shows the need to understand the imbalances in unpaid domestic work as both a human capabilities and a global development concern.

Unpaid Domestic Work and Women's Human Capabilities

Broadly speaking, the gender pay gap is both a symptom and a cause of gender inequality. On the one hand, it is a symptom because the circumstances under which wage inequalities arise, respond to social dynamics of gender discrimination. On the other hand, it is a cause because it is responsible for the deprivation of women's economic opportunities. As mentioned, the GPG can result in women's reduced income, and access to healthcare and pension services. Moreover, its main cause in Colombia (the unequal distribution of domestic work) pushes women to the informal economy, where labour conditions are especially harsh. Nonetheless, this problem is not exclusive for Colombia.

According to UN Women (2016), women's contribution to domestic responsibilities is 2.5 times larger than that of men. In fact, feminist theories refer to the unequal distribution of the domestic burden (*social reproduction*) as the cause of economic gender inequality in the prevailing economic model since the First Industrial Revolution (Horrell & Humphries, 1995; Goode, 1963). Industrialization thus devalued and hid the role of social reproduction activities like housework and childcare. According to liberal feminists, the resulting economic system successfully integrated women into the labour force (*production*); but was unable to include men in domestic responsibilities. As a consequence , gender inequality increased in terms of economic opportunities at the expense of the expansion of women's political and social empowerment (Dilli et al., 2019). However, the consequences of unpaid domestic work go beyond the labour market; they are a concern for women's human capabilities.

The unbalanced distribution of care work subverts the ability to expand women's capabilities and hinders their well-being because economic gender equality is essential to political and social empowerment (Berik, Rodgers & Seguino, 2009). The burden of social reproduction greatly contributes to women's inequality (Nussbaum, 2000, p. 222) and restricts their fundamental human functions, as women have been treated as providers of human capabilities for others, even without payment and recognition (Robeyns, 2003; Nussbaum, 2000). In this regard, the international community's efforts towards development has not yet recognised unpaid care work or provided guidelines for development policy.

In 1979, the Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW), was subject to criticism due to the absence of indicators recognizing and redistributing unpaid domestic work (between women and men). Moreover, as the MDGs used the CEDAW as the framework for the definition of gender equality, the MDGs also failed to consider aspects beyond health and education (as previously explained) (Sobrino Gonzalez, 2016). In compensation, the 2030 Development Agenda included the target 5.4[2] on the recognition of unpaid care and domestic work. One of the main challenges of the 2030 agenda is the adoption of government policies that, with a context-based approach, promote the achievement of the SDGs. Legislation regarding the distribution of domestic work is a difficult task because it involves changing social dynamics based on traditional gender roles. The indicator (5.4.1[3]) suggested by SDG5, for monitoring progress in the recognition of unpaid work, measures the time women and men spend weekly on these tasks.

2 5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate (United Nations, 2015b, p.22).

3 5.4.1 Proportion of time spent on unpaid domestic and care work, by sex, age and location (United Nations, 2015b, p.22)

Nevertheless, feminist academics have also criticized the lack of detailed strategies on how to influence development policies (O'Manique & Fourie, 2016).This is especially true for the paradox that exists in the case of Colombia: in spite of the successful results in the number of women in managerial positions, the economic system still puts women at a disadvantage in terms of economic opportunities, and therefore, human capabilities. The enormous percentage of women working in informal conditions and the severe unequal distribution of domestic responsibilities hinders their access to basic human needs (Nussbaum, 2000). Although the number of women in leadership positions has been correlated to a narrower GPG, this is not the case for Colombia. A possible explanation for this phenomenon is that those studies were held in countries in which the care work is more equally distributed, as it is the case of European nations (Ruppanner, 2010; Cohen & Huffman, 2007). The benefits of the number of women in managerial positions cannot be reached if there are no structural changes in an economic model that relies on unequal distribution of domestic work and restricts women's human capabilities.

To applaud women's access to leadership positions while other gender equality indicators are deprived is contrary to women's development, which is "synonymous with [the] expansion of capabilities" (Berik et al., 2009, p.2). The capabilities approach considers the protection against all forms of discriminations and the notion of human rights and capabilities as indivisible and interdependent necessary for gender justice (Sen & Mukherjee, 2014; Nussbaum, 2011). Nevertheless, such a scenario is especially challenging when the international development agenda considers women in managerial positions an indicator of gender equality but fails to recognize the redistribution of domestic labour as an essential step towards equality. This approach is inconsistent with the principle of "*leaving no one behind*" promulgated by the Sustainable Development Agenda.

The existence of the GPG in countries that have reached equality in development indicators such as women in managerial positions, shows the need to address the unequal distribution of care work as a global development concern. To celebrate women's access to leadership, such as the Colombian case, while other gender equality indicators continue depriving, is a reminiscent of the criticism of previous international efforts towards gender equality. If the current efforts towards expanding women's capabilities (development) does not recognize and, more importantly, redistribute unpaid domestic work, not only will the gender pay gap continue to widen, gender equality will also continue to be a social debt. To guarantee the achievement of the 2030 Sustainable Development Agenda and gender equality, women's economic opportunities, as human capabilities, should be fully addressed.

Conclusions

The achievements made by Colombia in terms of gender equality, specifically the increase in the number of women in decision-making positions, contrast with its increasing gender pay gap. This takes on heightened significance as previous studies have correlated women in managerial positions with a narrower wage gap. When examining the globally persistent gender pay gap, several explanations emerge: remaining traditional gender roles, discrimination at workplaces, and lower educational attainment. In Colombia, the fact that women perform fewer working hours than men explains the growing pay gap. This phenomenon has arisen as women take on the majority of the unpaid domestic work burden. Consequently, women carry a double burden that reduces their income, possibilities of moving up, and their access to health and pension services. In line with these findings, it is valid to say that women in Colombia do not work fewer hours, but fewer paid hours. More importantly, unpaid domestic work is not only a problem in Colombia, but also worldwide.

Unequal distribution of domestic responsibilities originate in the prevailing economic model, which makes social reproduction invisible. Therefore, the incidence of unpaid care work was discussed not only in terms of the gender pay gap, but also regarding economic gender inequality in a broader sense. This relation was established on the basis of Nussbaum's human capabilities approach that shows how women have been providers of human capabilities of others, at the expense of their own. The expected benefits of the number of women in management positions cannot be exploited when the economic system and the global development agenda fail to recognise and, in particular, redistribute domestic work. It will not be possible to achieve gender equality if the 2030 Development Agenda indicators are not equally considered.

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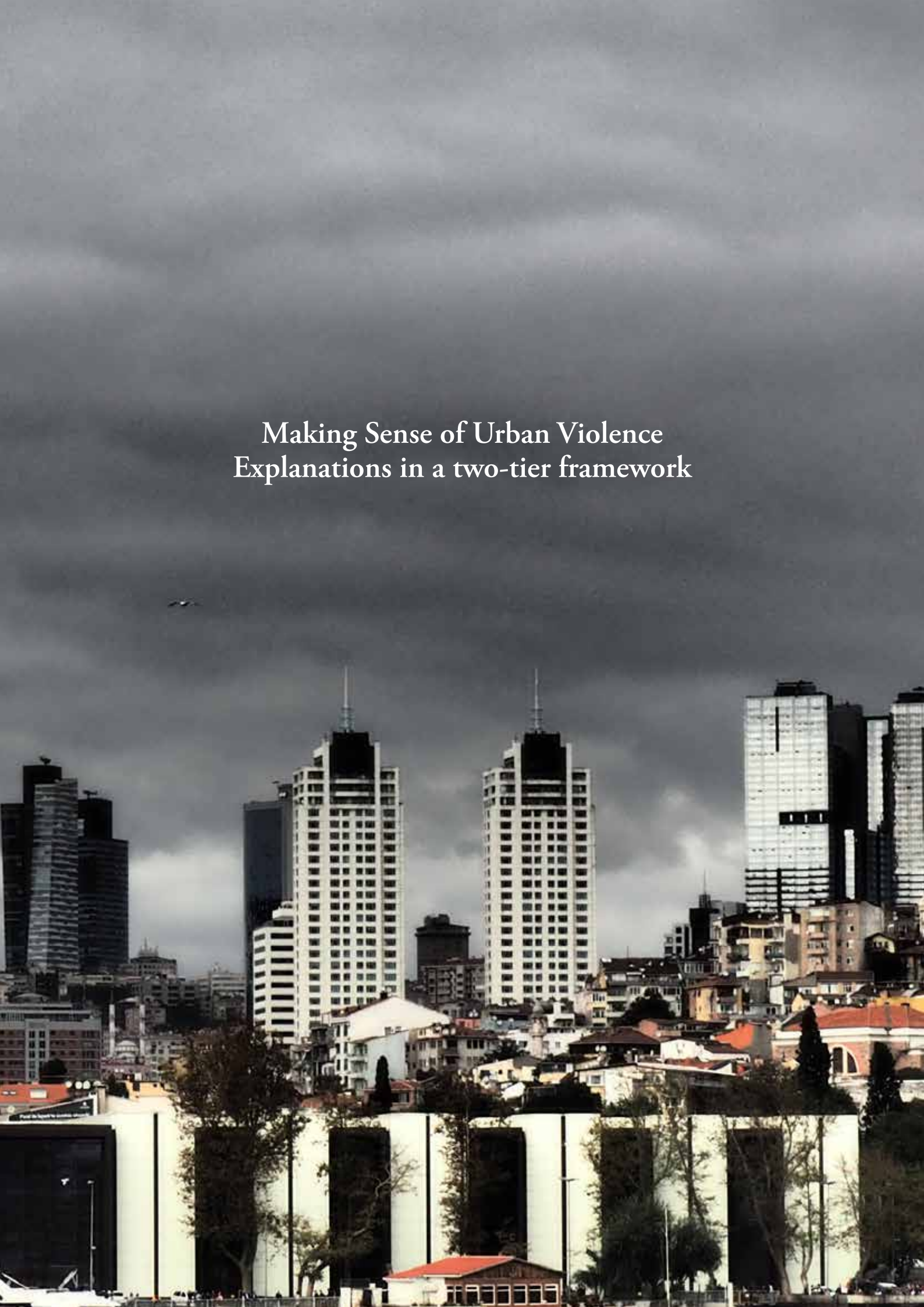
Making Sense of Urban Violence
Explanations in a two-tier framework



Making Sense of Urban Violence Explanations in a two-tier framework

Anna Buckley Cahill

Urban spaces have acted as hotbeds for conflict and violence throughout history. However, despite the enduring existence of urban violence, it is far from a uniform phenomenon. Urban violence takes place within a city's physical socio-spatial setting, which has been shaped by that city's unique geography, history and reaction to global phenomena such as urbanization, globalization and economic liberalization. In other words, violence may exist in every city, but its immediate triggers, performance and effects are unique to each case. Despite its contextually specific manifestations, I argue that modern urban violence, though geographically widespread, can to a great extent be linked to a set of shared causes.

In this paper, I present a framework for consolidating, organizing and understanding some of the complex causes of urban violence that have been proposed in academic literature. In doing so, I devise two levels of explanation that are distinct, but complementary. The top level, which I will call the *primary causes*, point to overarching seismic shifts in global order characterized by globalization, urbanization and economic liberalization. These global transformations drive a bottom level of explanations of urban violence, termed in this paper as *secondary causes*. Secondary causes are comprised of the contextual reactions to primary causes and include social inequality, exclusion and a general urban angst. Though both primary and secondary causes contribute to urban violence, they operate within different scopes, with primary causes exercised on a global scale and secondary causes on a more narrow city-wide scale. A framework that includes both primary and secondary causes thus allows us to understand how the realities of urban violence fit into a larger picture of global transformation.

What is violence?

The study of urban violence and its outcomes are contingent on the operationalized understanding of violence as a phenomenon. The way violence is conceptualized and measured determines its frequency, trends and suspected causes. Thus, one of the greatest challenges to studying urban violence is the fact that there is no consensus on its definition. In fact, theorizing and explaining what constitutes violence has been an enterprise in urban violence studies in and of itself. What was once accepted as violence in medieval and premodern times, namely that which was physical, intentional and punishable, has today been expanded to include both action and inaction: the non-physical, non-intentional, non-culpable and, most notably, the non-exceptional. Considering this wide range of interpretations, many of which are abstract and immeasurable, defining violence in general may be best approached by first familiarizing oneself with its many circumscribed classifications, the most common of which are outlined below.

An early and continually useful classification of violence is the concept of structural violence, which bridges the gap between the non-physical and physical manifestations of violence (Galtung, 1969). Structural violence occurs when structural constraints, such as social inequality, lead to unequal access to the resources required by humans to reach their full potential, including healthcare, education, legal protection and political representation (Malešević, 2017). Structural violence subsequently materializes physically in the form of poor health and early death. Building on this concept is the notion of symbolic violence, which can be thought of as the non-physical processes that legitimize and perpetuate structural violence (Bourdieu, 1991). Such processes include, for example, the popular acceptance of class and gender stratifications. A third approach, which builds on the symbolic violence concept is proposed by Slavoj Žižek, who uses a two-fold conceptualization that highlights both the physical and non-physical manifestations of violence. Its two parts are made up of objective and subjective violence, which are distinct but codependent.

Takeover: Victoria Thomas

Subjective violence aligns more with the traditionally accepted understanding of violence as visible, criminal behavior featuring identifiable actors and victims, while objective violence delineates the more dominant, invisible social reality that upholds the existing social order, a social order characterized by structural violence (as cited in Malešević, 2017). Important in this conception is the understanding that subjective violence is the singular and remarkable while objective violence is its antithesis, the ordinary everyday maintenance of the status quo.

In grappling with these different, interrelated forms of violence, Malešević (2017) proposes an overarching violence definition to be "a scalar social process in which individuals, groups or social organisations find themselves steeped in situations whereby their intentional or unintentional actions generate some substantial coercively imposed behavioural changes or produce physical, mental or emotional damage, injury or death" (p. 15).

With the forms of violence outlined above, certain themes become clear. For example, violence can be organized, institutional, unintentional, unexceptional and unpunishable. I have outlined these violence conceptions not to analyze each specifically, but rather to provide a background understanding of commonly used violence conceptions relevant to urban spaces and to demonstrate that violence is a flexibly defined phenomenon. Throughout this paper, all of these conceptions of violence will be referred to with the understanding that each, though different, is viable and valuable.

Violence in urban space

As the above section shows, the task of thinking about and conceptualizing different forms of violence has received significant academic attention over the last several decades. However, academic focus on the geographies of violence, specifically in urban spaces, is relatively new (Springer & Le Billon, 2016; Fuccaro, 2016). This shift in focus may well reflect a real global shift, one which is characterized by the transformation towards globalization, urbanization and a shared "global urban culture" (Fuccaro, 2016, p. 12). For example, it is now known that over half of the world's population live in urban spaces. Urban spaces additionally provide a particularly illuminating context in which to study violence because they function as both economic hubs and sites of government presence, constituting a unique coexistence bound by close proximity between citizen and state. Within the closed geographic borders of a city, dense populations compete for security, resources and territory (Fuccaro, 2016). In this way, city spaces shape violence.

Violence shapes space as well. The interplay of social patterns and infrastructure create value-laden divisions within the city such as no-go zones for certain citizens, e.g. women or minorities, secure and safe areas, slums and financial districts. According to Fuccaro (2016), the interaction of a city's physical layout of infrastructure and its human, social and capital elements, which together constitute a social order of parts, give rise not only to violence in the city, but indeed violence *of* the city. Seeing the city in this way, as itself a violent actor, "entails recognizing the power of urban locations to form and reproduce social and political relations and experience" (Fuccaro, 2016, p. 10). This further means that violence of the city is not displayed by exceptional occurrences of violent conflict, though these may exist, but rather by the mundane violence woven into everyday life (Springer & Le Billon, 2016). The violence that takes place in the city is therefore never isolated or random.

Primary Causes of Urban Violence

The primary causes of urban violence can be attributed to phenomena that take place far outside a city's borders. Underlying shifts towards globalization, urbanization and economic liberalization are catalysts for a restructuring of the relational roles between the city and the state. This reconfigured relationship in which cities assume a particularly powerful position within states and in relation to the rest of the world is typically accompanied by transitions towards capitalism and an emphasis on individual human rights. In other words, what many think of as *development*. These progressions are what I will term in this paper as primary causes of urban violence. They do not occur in isolation, but instead make up the moving parts of a sweeping transformation in global order. They compose a foundational level of change that sets off a chain reaction, leading to what I term secondary causes of urban violence. Just as shifts in tectonic plates cause acute and violent volcano eruptions, so have seismic shifts in the global order caused eruptions of violence in cities. These shifts are not swift, but rather take place over decades and even centuries.

A seminal contribution to the analysis of the evolution of international order comes from Charles Tilly. Tilly (1992) argues that not only has a shift in international order caused and perpetuated violence, but violence has in itself driven this global order shift. Specifically, the centuries-long course leading to a convergence from many different state forms, including empires and city-states, to the adoption of the national state, in which powerful, centralized governments oversee contiguous regions and their cities, has occurred through the processes and impacts

of war and preparation for war. In this manner, war makes states and states make war (Tilly, 1992). These same processes have also shaped the role of cities. Preparation for war mandates financing war, which places a heavy burden on cities where capital and power are concentrated. The presence of power and the need for accumulation of capital thus lead to cities becoming key sites of coercion. Indeed, as sovereign states grow stronger, their propensity to yield coercion and their capital requirement to maintain sovereignty increase, designating cities as the base for capital-intensive, coercion-intensive activity. Therefore, as modernity has furnished more sovereign states with autonomous structures and ideological power, an increase in the production of collective and organized violence within its borders has followed (Malešević, 2017). This type of violence, wielded by sovereign states in their own cities, leads us to question the inside/outside boundaries of sovereignty with respect to the canonical Western ideation of sovereign states as the foundation for "civilized international order". Instead, we see that sovereign states are fragile and internally violent (Hansen & Stepputat, 2005, p. 18). Sovereign power is thus described as a "tentative and unstable project whose efficacy and legitimacy depend on repeated performances of violence and a 'will to rule'" (Hansen & Stepputat, 2005, p. 3). We can summarize these arguments to conclude that war-driven political transformations toward sovereign national states yielded our current international order, characterized by fragile power repeatedly exercised and enforced primarily in capital-intensive cities. However, war's impact on international political and economic order extended beyond the formation of national states.

Capitalism emerged in Europe as early as the seventeenth century, but the momentous push for today's standard of industrial capitalism began in the nineteenth century. Europe's Industrial Revolution has been pointed to as the catalyst for aftershocks of urbanization far outside the Western world, particularly in Europe's colonies (Fuccaro, 2016; Mishra, 2017). Imperialists looked to their colonies to drive the production of staple crops, outsourcing production and managing wages to maximize profits. Over time, economic liberalization intensified and migrants relocated to places believed to have better job opportunities, wages and working conditions, increasing ethnic and cultural diversity in most major cities. Cities simultaneously became sites for industrialization, housing factories and businesses, functioning as intellectual epicenters, and fostering trade in international networks through railways, seaports and communication lines. Urbanization and increased production thus demanded a global market, and with global supply chains came global interdependence.

Yet commodities and capital were not the only materials to change hands as a result of a global trade market. Ideas from America and Europe spread as well, particularly concerning political urban reform. The establishment of modern policing and municipal administrations principled by representative local government took hold in the Ottoman Empire and North Africa by the end of the 19th century (Fuccaro, 2016). The spread of representative democracy continued throughout the course of the 20th century, resulting in a "democratic revolution of aspiration" strong-armed by global powers and militaries such as the United States (Mishra, 2017). Democracy has steadily increased since the mid-1970s, and the end of the Cold War is often seen as a turning point in global consensus toward Western democratic ideals. Today, democracy is about as prevalent globally as it's been in modern history. Of the 167 countries with populations over 500,000, 57% are democracies of some form while 85% have (at least) some democratic elements (Desilver, 2019).

While democracy spread, the United States' particular brand of liberal capitalism "swept across the world, sparking longings for wealth, status and power, in addition to ordinary desires of stability and contentment, in the most unpromising circumstances" (Mishra, 2017, p. 12). Capitalism, it was believed, did not discriminate, and a system in which anyone could be anything, irrespective of social class, race, ethnicity or heritage, was appealing for many. Of course, democracy and capitalism both operate on the necessity to act (or vote) according to one's own self-interest, and as these two systems took hold, so too did an onset of cultural individualism. This entailed a shift towards individual awareness of discrimination and a fixation on individual rights, as opposed to communal or familial claims (Mishra, 2017).

Global transformations taking place in the last 200 years, including the formation of national states and international order, shifts towards capitalism, increasing urbanization, globalization and individualism, have acted as primary causes of urban violence. These primary causes are the first level of the two-tier framework proposed in this paper and outlined in Figure 1. The next section will show how these processes have led to secondary causes of urban violence within cities.

Secondary Causes of Urban Violence

In this two-level framework, secondary causes of urban violence are defined to be those that take place on a city rather than global level, and therefore have a more direct impact on violence outbreak than primary causes. Secondary causes spawn from primary causes, yet are distinct, consisting of exclusion, inequality

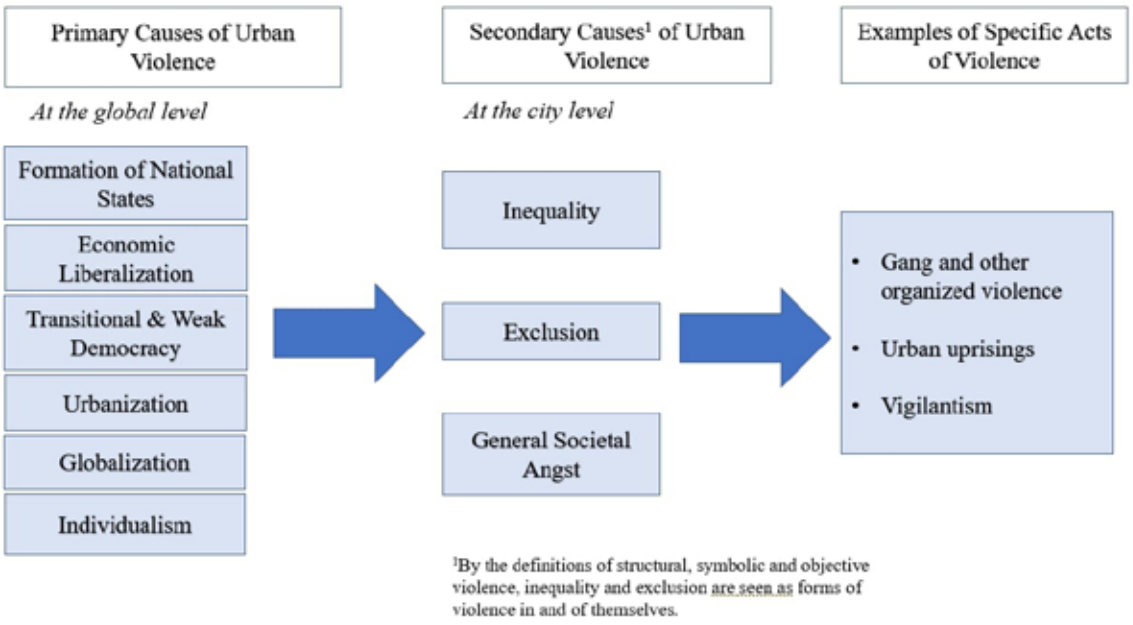


Figure 1. Argument flowchart. This figure outlines the path from primary and secondary causes of urban violence to specific examples of violent acts and activities in urban spaces.

and general societal angst in urban spaces. At the same time, the partition between primary and secondary causes is not perfect, as there is today no sharp distinction between what takes place at a global and city stage. This point is exemplified by the term 'global cities' coined by Saskia Sassen (2005), which describes cities that act as international hubs of capital and commerce, such as London, Tokyo and New York. The term captures the fact that cities within the current global economic order have transcended conventional territorial claims, acting on an international scale as strategic nodes for global flows. Despite this overlap of city, national state and global scales, it is still useful to think of secondary causes of urban violence as those manifesting themselves specifically within cities. Since each city has a unique population make up, history and culture, the specific acts of violence within cities are not universal. However, I will argue that certain phenomena experienced in every city, such as exclusion and inequality, function as triggers for violence. These phenomena are what I have termed secondary causes of urban violence. In this section, I will provide the through line, illustrating how the primary causes discussed above have led to secondary causes and ultimately violence in urban spaces.

Two interconnected primary causes of urban violence, namely urbanization and economic liberalization, have caused rapid changes in the layout of cities, with different areas becoming 'dangerous' or gentrified relatively quickly. For instance, commercial housing projects designed to create revenue for city governments have left long-time urbanites unable to afford their rent and forced to move to less desirable neighborhoods. Additionally, the privatization of once public resources such as water and communal spaces have also hurt the disenfranchised lower classes in a process called 'accumulation by dispossession' (Dikeç, 2018, p. 12). These steps towards economic liberalization result in increased inequalities as the rich grow richer and more geographically segregated in the city. Technology has assisted in this development as cities are typically the hubs for technological progress. Jobs in the service and technology sectors often require higher education and are doling out higher wages than other sectors. With an economy growing less and less reliant on agriculture and manufacturing sectors and instead demanding more and more skilled labor, the uneducated poor are losing their fair chance at jobs that pay the rent. This poverty trap is a positive feedback loop in which low-income urbanites are less able to afford education, healthcare, healthy food and social mobility opportunities for themselves and their families. This chain of events allows global shifts, ie. the primary causes of urban violence, including urbanization and economic liberalization, to generate secondary causes of urban violence, such as inequality and exclusion.

Recalling the previously outlined broad definitions of violence and the distinction between conventional physical, visible and punishable violence and systemic and invisible structural violence, the secondary causes of urban violence become both causes and instances of urban violence. Since structural and symbolic violence are the societal

Black & White: Victoria Thomas

constraints that prevent people from realizing their full potential, such as good health, access to education and financial resources, inequality and exclusion, which are secondary causes of urban violence, are also, by Gatlung's (1969) structural violence definition and Bourdieu's (1991) symbolic violence definition, violent phenomena in and of themselves. In this way, inequality and exclusion function both as secondary causes of urban violence, and instances of urban violence. Poverty, a symptom of inequality, is thus also an example of structural violence.

The expansion of capitalism and democratization from the Western World has also been a global phenomenon with city-level repercussions. After the Cold War, democracy appeared to be the right and *only* way to organize society. However, opportunities for violence expanded as the Western World attempted to exert influence in countries, primarily in the Global South as well as Eastern Europe, to democratize. Transitioning governments, typically moving from authoritarian regimes to democracies, have been found to be the most prone to violent conflict. This has been observed, for example, in former USSR countries where systemic change and the dissolution of the federal state has led to violent insurgencies (Smith, 2004). This is argued to be due to the fact that transitioning governments are often characterized by weak institutions that leave institutional 'empty spaces' in power, inviting gangs, militant groups and other factions to vie for control (Winton, 2004). This control is often territorial, and thus carries a particular spatial element within cities, creating 'no go zones' or dangerous areas. Governments transitioning to democracy can also contribute to structural and symbolic violence when the democratic institutions in place are not fully legitimized. Fragile transitioning democracies may suffer, for example, from untransparent and corrupt election and voting practices that stifle political participation and civil liberties (Democracy Index 2019, n.d.). The result of undemocratic elections is the exclusion of populations from access to political representation. Similarly, corruption in weak democratic institutions will most likely favor the powerful and rich, compounding societal inequalities. In summary, just like the inequality and exclusion that stemmed from urbanization and economic liberalization, the inequality and exclusion that result from (weak) transitional democratic political structures are both secondary causes of urban violence and instances of systemic and symbolic violence. This is because weak democratic institutions that stifle political participation and representation prevent people from reaching their full potential.

While Galtung emphasized that structural violence has physical ramifications in the form of poor health and consequences from lack of legal protection, there is another connection between inequality, exclusion and physical urban violence. Exclusion and inequality can induce "reactive violence" among its victims (Winton, 2004, p. 167). Using Zizek's subjective/objective violence definition, the objective violence caused by weak democratic political structures triggers subjective violence in reactive retaliation. Reactive violence can take the form of criminal violence or revolutionary violence. Criminal violence, such as vigilantism or gang activity, is a direct result of exclusion. Excluded youth may perceive having few options other than joining gangs, where they are able to earn money and find

community. Additionally, one must resort to vigilantism when they are excluded from representation and decision-making and thus not sufficiently protected by the political and legal institutions in place.

Inequality and exclusion are especially well facilitated by urban spaces, which highlight not just the relative lack of resources, but a physical separation in dwelling, employment and recreational areas apart from areas of the city occupied by the privileged and upper classes. Those in excluded dwellings, often in the form of slums or favelas, may take it upon themselves to provide their own security in the form of gangs, keeping 'their own' safe and discouraging official police from entering. However, without sufficient legal and political rights and the public perception of living in 'violent areas', favela and slum dwellers are especially vulnerable to excessive police surveilling, police brutality and even extrajudicial killings (Winton, 2004). In such a scenario, everyone, including citizens, police officers and state institutions, has the capability to inflict violence on anyone else, resulting in violent behavior rationalized by self-defense.

Photo: Sven Emil Hinderaker

Another consequence of exclusion and the concentrated nature of urban space is that the underprivileged are constantly reminded of their exclusion and relative lack (Dikeç, 2018). In the current international climate where globalization and economic liberalization have bred a culture of individualism, people are hyper-aware of their mistreatment and their failure to exercise certain rights. Discontent and mistrust of the government ensues, and people feel removed from government decisions. This in turn generates a societal angst caused by a sense of outrage among the excluded who feel entitled to the privileges not being granted. The ultimate consequence of this can be an urban uprising, defined by Dikeç (2018) as "insurrections motivated by grievances of the everyday lives of urbanites" and usually triggered by a specific tragic incident (p. 3). In this context, urban uprisings are seen not as random behavioral irregularities, but rather as events that "expose patterns, dynamics and structures of exclusion and oppression that have become normalized" (Dikeç, 2018, p. 7). This normalization of violence is thus a form of Bourdieu's symbolic violence, which serves to legitimize the structural violence that is exclusion and social inequality.

Conclusion

In this paper, I have presented a two-level framework for organizing and understanding some of the manifold causes of urban violence. I argue that it would be short-sighted to assess urban violence without viewing it in the context of larger global transformations transpiring over the last 200+ years, which is why this framework consists of two levels. On the top level are primary causes of urban violence, including urbanization, globalization, economic liberalization and individualism taking place on a global scale. The lower, arguably more conventional, level of the framework focuses on intra-city dynamics and encompasses what I refer to as secondary causes of urban violence. These causes are more directly associated with violence and include social inequality, exclusion and a resulting societal angst in urban spaces. Though different, I have shown that secondary and primary causes are closely related, with combinations of economic privatization, urbanization, globalization, individualism and political transitions interacting to create and perpetuate inequalities, exclusion and urban angst. Secondary causes of urban violence such as exclusion and inequality can themselves constitute violence in the form of structural and symbolic violence. They can also lead to physical manifestations of violence including criminal activity, organized violence and urban uprisings.

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Betydningen av oppdrettsforhold for fiskevelferden hos Atlantisk laks (*Salmo salar* L.)

The importance of environmental conditions on salmon welfare

Julie Elise Trovaag

Siamese fighting fish: Lina Westermann

Teksten er revidert etter en gradsoppgave som ble skrevet i tilknytning til FHF-prosjektet *«Mørke flekker i laksefilet: Årsak til dannelse og tiltak som hemmer utvikling (EX-spot)»* (FHF, 2018). For spørsmål eller fullversjon av oppgaven, kontakt Julie Elise Trovaag, julie.elise.trovaag@nmbu.no

Innledning

Verdens befolkning er beregnet til å øke med over to milliarder mennesker innen 2050 (UN, 2019). Dette fører til et økt behov for mat. Til tross for dette behovet, og det faktum at jordkloden består av 70 % hav, er kun 2 % av maten vi spiser fra havet (Skretting, 2019). Akvakultur vil spille en sentral rolle i fremtiden ved å løse denne økte etterspørselen, samtidig som det beskytter ville bestander fra overfiske. Bare i Norge produseres det i dag omtrent 1,3 millioner tonn matfisk årlig - et volum som er forventet å femdobles innen 2050 (SSB, 2019). I lys av antatt produksjonsøkning, er det viktig å sørge for at fisken vi spiser får oppfylt sine velferdsbehov ved å tilrettelegge for et oppdrettsmiljø den trives i. Dette er også av interesse for konsumenter. En studie fra 2010 viser at norske forbrukere er villige til å betale ekstra for laks der produsenten lover tiltak for bedre velferd i sin produksjon (Olesen et al., 2010). Den såkalte "bambieffekten", gjør imidlertid at vi har mindre sympati for fisk sammenliknet med mange andre husdyr. Denne artikkelen presenterer forskning gjort på undersøkelser av velferdsindikatorer hos laks i sjø og på land, og sammenligner forskjellene mellom dem.

Teori

Dyrevelferd

En mye brukt definisjon for dyrevelferd ble utarbeidet av faggruppen for etologi ved NMBU i 2004. Denne beskriver dyrevelferd som *«(...) individets subjektive opplevelse av sin mentale og fysiske tilstand som følge av dets forsøk på å mestre sitt miljø.»* (Animalpickings, 2014). For å møte dette velferdsbehovet hos fisk i norsk oppdrettsnæring er blant annet Atlantisk laks beskyttet av dyrevelferdsloven (Lovdata, 2009) samt Forskriften om drift av akvakulturanlegg. Sistnevnte påpeker følgende ved jf. § 5: *«(…) Driften skal være helsemessig og fiskevelferdsmessig forsvarlig.»* (Lovdata, 2008).

Velferdsindikatorer

For å møte dette velferdsbehovet, og gjøre det enklere for oppdrettere å vurdere fiskens velferd, startet Fiskeri- og Havbruksnæringens forskningsfinansiering (FHF) i 2015 opp kunnskapssammenstillingen FISH-WELL. Dette prosjektet ble drevet av forskningsmiljøer med Nofima i spissen, og hadde som mål å lage en lett tilgjengelig oversikt over hvordan man kan vurdere såkalte velferdsindikatorer; VI-er (FHF, 2015). VI-er brukes for å få en oppfatning om velferd hos en fiskegruppe (Noble et al., 2018). Man kan vurdere VI-er basert på oppdrettsmiljø eller dyret selv. Denne artikkelen fokuserer på VI-er knyttet til dyret selv, altså antatte forskjeller i velferd hos laks, med fokus på forskjeller mellom sjø- og landbasert oppdrett.

Sjøbasert oppdrett

Atlantisk laks er en anadrom art (SNL, 2018), hvilket gir den muligheter til osmotisk regulering under produksjonsforhold både i sjø og ferskvann. Norges naturgitte forhold, med sin langstrakte kyst og kalde vanntemperatur gjør det gunstig å drive oppdrett av laks i sjø. Det har ført til at vi i Norge i dag har godt over 1000 matfisklokaliteter. En kontinuerlig vanntilførsel gir et naturlig vannmiljø med oksygenrikt vann inn til merdene, samtidig som det fjerner avfallsstoffer (Noble et al., 2018). Imidlertid kan sjøanlegg ha problemer med rømming, lus og algeoppblomstring, men hvor alvorlig disse problemene er avhenger av produksjonsforhold.

Landbasert oppdrett

Ved landbasert oppdrett i ferskvann kan en del av problemene ved sjøanlegg elimineres, og oppdretteren kan til en viss grad bestemme ønskede nivåer av miljøindikatorer. Tradisjonelle gjennomstrømnings-anlegg og RAS-anlegg (Resirculating Aquaculture Systems) er eksempler på landbaserte produksjons-anlegg. Fordelen med RAS i forhold til gjennom-strømningsanlegg er at vannet resirkuleres og reduserer vannforbruket. Dog er det også risiko med denne produksjonsformen (RAS), og den er omdiskutert på grunn av sin lite kostnadseffektive ressursutnyttelse (Badiola et al., 2018). På grunn av den økonomiske ulempen knyttet til vannbehandling ved å ha fisken i lukkede anlegg, er det potensielt nødvendig med høyere fisketetthet der kontra åpne anlegg i sjø (Terjesen et al., 2013). Likevel er ikke nødvendigvis høy tetthet det optimale for fiskens velferd (Thorarensen & Farrell, 2011). Tetthet over 22 kg/m3 har vist seg å kunne gi lavere velferdsskårer (Turnbull et al., 2005). Samlet sett, vil det derfor være både fordeler og ulemper knyttet til miljø innenfor begge produksjonsmetoder.

Materiale og metoder

Denne studien har tatt utgangspunkt i data samlet fra postsmolt av Atlantisk laks (*Salmo salar* L) fra to ulike lokaliteter, hvorav en på land og en konvensjonell i sjø (Figur 1). Fisken fra begge lokalitetene var fra samme smoltgruppe (Belsvik, Lerøy), og fikk lik behandling før smoltifisering (tilpasning til sjøvann). I forkant av datainnsamlingen hadde fisken blitt fôret med lik diett med et konvensjonelt fôr.

Figur 1: For å undersøke effekter av oppdrettsmiljø ble fisk fra lik smoltgruppe og startmiljø flyttet til kar på land eller i merder i sjø når de var klare for sjøvann. Dette gav et svært ulikt utseende, som også påvirket velferdsindikatorer.

Sjø

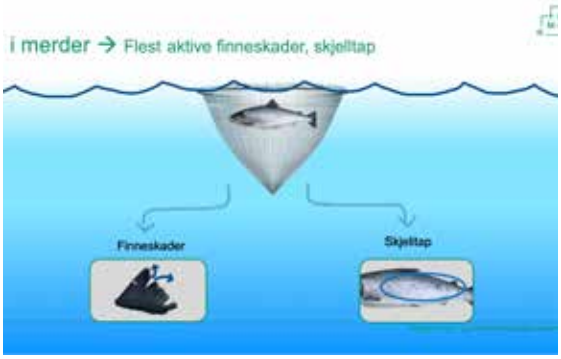
Fisken i sjø ble hentet fra matfisklokaliteten Naustneset i Tingvollfjorden i Møre og Romsdal. Her ble det brukt 82 fisk, likt fordelt over to merder. Ingen av merdene hadde vært gjennom noen form for behandling i løpet av tiden i sjø (BarentsWatch, 2019a) (BarentsWatch, 2019b). Fisketettheten i disse merdene var på 25 kg/m^3, og gjennomsnittsvekten på 1,2 kg. Begge merdene ble manuelt fôret etter appetitt ved hjelp av under- og overvannskamera frem til datainnsamlingen.

Land

Fisken på land ble hentet fra Nofimas Forskningsstasjon for bærekraftig utvikling, i Sunndal kommune, Møre og Romsdal. Det ble brukt 30 fisk, likt fordelt over tre tanker med sjøvann. Hver tank hadde et volum på 3300 L, og fisken hadde en gjennomsnittsvekt på 0,8 kg. Det gav en gjennomsnittlig tetthet i tankene på 33 kg/m3. Fisken ble fôret automatisk etter appetitt fra foregående dag. Fôrrester ble veid opp hver dag, slik at hver tank fikk 10% mer enn hva den spiste dagen før. Temperaturen i tankene var blitt holdt på 10°C, og fisken fikk kontinuerlig lystilgang (24:0 timer).

VI-er og resultater

Det ble funnet signifikante forskjeller mellom oppdrettsmiljøer i land og sjø ved ni velferdsindikatorer: aktiv ryggfinneskade, helbredet ryggfinneskade, ryggradsdeformitet, overkjevedeformitet, snuteblødning, haleblødning, utstående øye, øyeblødning og skjelltap. Lokaliteten i sjø kom dårligst ut på aktiv ryggfinneskade og skjelltap (Figur 2), mens lokaliteten på land kom dårligst ut på de resterende syv velferdsindikatorene med signifikant forskjell (Figur 3). Høyt velferdskår i denne oppgaven indikerer lav velferd for en gitt indikator, og motsatt.

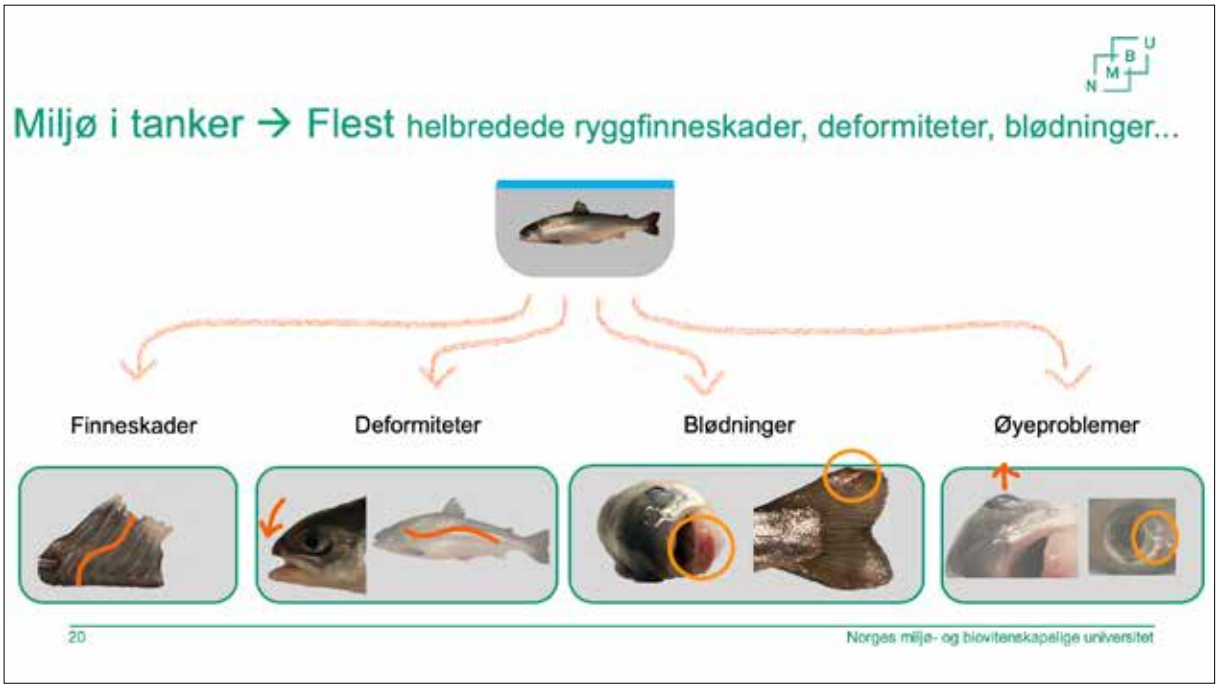


Figur 2: Miljøet i kommersielle merder i sjø gav høyest forekomst av aktive finneskader og skjelltap.

Ryggfinneskader

Litteratur om ryggfinneskader, knytter problemet primært til **aggresjon** (MacLean et al., 2000), ofte i sammenheng med **fôringsatferd**. Tidvis fravær av fôr har ført til aggressiv atferd mot artsfrender, og det er funnet en positiv korrelasjon mellom ryggfinneskader og aggresjon og finnebiting hos postsmolt (Jones et al., 2010). Forsøk gjort på regnbueørret viser at økende rasjonering svekker styrken til sosiale hierarki (Moutou et al., 1998). Fôringsregime vil dermed kunne ha indirekte betydning for grad av finneskader (Noble et al., 2007a). Apetittfôring kan redusere konkurranse, og dermed også finneskader (Noble et al., 2007b).

Til tross for at apetittfôring kan redusere finneskader, kan det oppleves utfordrende å fôre med høy intensitet selv ved god appetitt dersom man opplever driftstekniske problemer. Det kan være at det er vanskelig for å finne rett treffpunkt (med underflatekamera), eller problemer med tomme fôrsiloer, lyslengde og/eller høyt trykk i fôrslanger. Man har ikke oversikt over hvordan fôrstyringen i sjø har vært i dette forsøket, og vet dermed ikke om lokaliteten i sjø kom dårlig ut på grunn av fôringen. På den andre siden, kan fôringen på land føre til over- og underfôring. En studie har vist at matlyst fra dag til dag kan variere mer enn 15% (Noble et al., 2018). Imidlertid stemmer ikke dette overens med variasjonen i matlyst som karmiljøet på land er begrenset til. Problemer med ryggfinneskader understreker dermed en dyrevelferdsmessig side av optimal fôring, med god spredning og høy nok intensitet. Selv om finneskade primært skyldes aggresjon, kan faktorer som **håndtering**,



Figur 3: Miljøet i tanker på land gav høyest forekomst av helbredede ryggfinneskader, deformiteter, blødninger og øyeproblemer.

vannkvalitet- og temperatur, sykdom og **fôrinnhold** også spille inn (Suzuki et al., 2008).

Resultat: ryggfinneskader

Resultatene fra dette forsøket viser at fisken i sjø hadde høyest velferdsskår for aktiv ryggfinneskade. Fisken på land hadde derimot høyest velferdsskår for helbredet ryggfinneskade, hvilket er et senere resultat av aktiv skade. Selv om lokaliteten på land hadde en høyere skår på helbredet enn aktiv ryggfinneskade, regnes tilfellet i sjø som mest alvorlig. Det er fordi aktiv ryggfinneskade gir tilfelle av åpent vev (Noble et al., 2018), som gjør det mer mottakelig for blant annet patogene mikroorganismer.

Deformiteter

Deformiteter hos laks kan gi utslag i mange ulike virvelskader og morfologske forskjeller, der eksempler er «korthaler», «mopsehode» eller «papegøye» (Havforskningsinstituttet, 2003). Avhengig av alvorlighetsgrad, truer de fiskens velferd ved at de kan forårsake redusert ytelse, nedsatt robusthet ved håndtering samt sub-optimale svømmeferdigheter (Noble et al., 2018). Likevel kan man forvente at det vil være en viss grad av deformiteter i en populasjon ettersom det også forekommer hos villaks (Havforskningsinstituttet, 2003).

Ryggradsdeformiteter

Deformiteter kan skyldes en eller flere samvirkende faktorer under laksens livsstadier (Havforskningsinstituttet, 2003). Forskning har vist at **forhøyede temperaturer,** samt **fotoperiodemanipulering** (lysstyring) sannsynligvis er de viktigste miljøfaktorene som kan gi deformiteter (Fjelldal et al., 2012). Temperaturer over 12°C i ferskvann øker sannsynligheten for ryggradsdeformiterer, og høye temperaturer kan være en utfordring i resirkuleringsanlegg (Noble et al., 2018). Fisken på land i dette forsøket ble hverken holdt i temperaturer over 12^0C, i ferskvann, eller i resirkuleringsanlegg, og man kan utelukke dette som årsaker til forekomsten.

Noen studier peker dessuten på **ernæring**smessige årsaker til deformiteter og beinhelse (Bæverfjord, 2004) (Fjelldal et al., 2010). Fisken i dette forsøket fikk likt fôr, og derfor kan man i utgangspunktet eliminere denne årsaken i dette tilfellet. Men; postsmolt som har kontinuerlig lystilgang bør få fosfor som et supplement i dietten (Fjelldal et al., 2012). Kontinuerlig lystilgang var tilfelle for fisken på land selv om den fikk identisk diett med fisken i sjø. Kanskje dette kan være en forklaring på deformitetene på land. En annen abiotisk årsak kan være **sterk vannstrøm**. Yngel av abbor har vist seg å kunne få deformiteter av dette (Divanach et al., 1997), men det er usikkert om dette resultatet kan overføres til Atlantisk laks.

Overkjevedeformiteter

Overkjevedeformiteter kan medføre redusert fôropptak og økt energiforbruk. I motsetning til vertebrale

deformiteter (ryggradsdeformiteter), er det gjort svært lite forskning på overkjevedeformiteter. Likevel kan det se ut til at kjevedeformiteter ofte skyldes de samme årsakene som ryggradsdeformiteter. Det har imidlertid blitt gjort svært interessante funn som knytter kjevemisdannelser til **farge på karvegger**, hvor fargede tanker har ført til flere «walling behaviours» hos larver av Stripete trompetfisk (*Latris lineata*) (Cobcroft & Battaglene, 2009). Studien gir ingen entydig grunn til forekomsten, men peker på mekaniske skader og dårlig ernæring som medvirkende årsaker til at «walling» skjer. Veggene i karene i dette forsøket var grønne, og man kan derfor vurdere om farge på karvegg er en medvirkende årsak til over-kjevedeformitetene på land.

Resultat: deformiteter
Fisken på land kom signifikant dårligst ut på både ryggradsdeformitet og overkjevedeformitet. Resultatene utgjør enkelte ryggradsdeformiteter, og en svært høy andel overkjevedeformiteter. Ved begge oppdrettsmiljø var øvrige skårer for deformiteter tilnærmet lik null. Imidlertid kan lette deformiteter være vanskelige å oppdage.

Snuteblødning
Snuteskade er en overfladisk skade som kan skyldes pressing mot not- eller karvegg (Noble et al., 2018). Atferdsmessige årsaker til at fisk motiveres til å utføre denne handlingen er ukjent. Likevel er karveggen på land trolig hardere å møte enn notveggen i sjø. Forsøk har vist at hoppeaktivitiet i merder har ført til at fisken treffer notveggen i omtrent 6% av tilfellene, og vanligvis lander på siden (Furevik et al., 1993). Det kan dermed antas at fisken da også kan treffe med snuten i karveggen i enkelte tilfeller. Fishwell sin bok påpeker dessuten at munn- og kjeveskader oppstår nettopp grunnet kontakt i møtet mellom fisk og not- eller karvegg, men det kan også oppstå i forbindelse med **håndteringer** (Noble et al., 2018). Håndteringer ble imidlertid ikke utført av fisken på land i forkant av datainnsamlingen, og derfor ses ikke dette på som en årsak til snuteskader. Uansett årsaker til at snuteskader forekommer, vil de kunne oppleves smertefulle for fisken. Det kommer av at snuten er et område med høy tetthet av nociseptorer (smertereseptorer) (Braithwaite & Boulcott, 2007).

Resultat: snuteblødning
Forekomsten av snuteblødning i dette forsøket var høyere på land enn i sjø, selv om forekomsten i sjø også var forholdsvis høy.

Haleblødning
Haleblødning ble laget som en egen VI i dette forsøket, på grunn av at det ble observert i svært stort omfang hos fisken på land. Dog er det ikke funnet noen klare årsakssammenhenger, og det er dessuten usikkert om tilfellene gjelder mekaniske eller bakterielle sår. Likevel vet man at det kan være problemer knyttet til høy fisketetthet og sårheling, ettersom høy tetthet forsinker vevsreparasjon (Sveen et al., 2018). Dermed har lokaliteten på land dårligst utgangspunkt for sårheling dersom uhellet først skulle være ute, ettersom det var høyest tetthet der. Det er ikke antatt at blødninger på halefinnen kommer av samme årsaker som ryggfinneskader, siden det ikke ble observert tilfelle av splittinger mellom finnestråler eller åpne sår.

Resultat: Haleblødning
Haleblødning utgjør den VI-en med gjennomsnittlig høyest skår av alle VI-er som ble testet. Fisken på land hadde høyest skår for haleblødning. I sjø ble ikke haleblødninger observert, og det er dermed tydelig at forskjellene skyldes miljøet.

Utstående øye
Utstående øyne (eskoftalmus) medfører en risiko for blindhet, og er et sykdomstegn som bør følges opp (Hargis Jr, 1991) (Noble et al., 2018). Forekomsten kan relateres til ulike årsaker, der det vanlige er kolonisering av mikroorganismer bak øyet, sirkulasjonsforstyrrelser eller gassblæresyke (Noble et al., 2018).

Resultat: Utstående øye
Forekomsten av utstående øyne var høyere på land enn i sjø. Det er usikkert hvilke faktorer ved miljøet på land som har ført til denne forekomsten. VI-en burde undersøkes mer grundig for å finne mulige årsaker.

Øyeblødning
Laksens øyne er spesielt sårbare siden de hverken har øyelokk eller tåreväske (Noble et al., 2018). Det medfører risiko for ulike komplikasjoner og velferds-utfordringer, deriblant øyeblødning. Øyeblødning (haemorrhage) er antatt smertefullt, og kan ofte skyldes **mekaniske skader** (Noble et al., 2018). Det viser igjen hvor forsiktig man bør være under håndtering av laks, spesielt siden uttørking også er en risiko. Øyeblødninger kan også skyldes parasitten *Paravicapsula pseudobranchicola* (Noble et al., 2018). Denne kan smitte via sjøvann (Karlsbakk et al., 2010), og man kan derfor ikke utelukke dette helt som årsak til blødning i dette forsøket. Likevel ville et tilfelle av denne parasitten kunne gi andre symptomer slik som svært lav kondisjonsfaktor (Noble et al., 2018). Dette ble ikke observert. Likevel vil fisken på land være spesielt sårbar for øyeblødninger på grunn

av at øynene i utgangspunktet er noe **utstående** (Noble et al., 2018). Man har altså ingen entydig forklaring på hva denne forskjellen skyldes, men fisken på land hadde et utgangspunkt som gjorde den mer utsatt for øyeblødninger.

Resultat: øyeblødning
Forekomsten av øyeblødning var høyere på land enn i sjø. Selv om det gir en signifikant forskjell, er forekomsten på land forholdsvis lav.

Skjelltap
Laksens hud fungerer som fiskens første forsvar mot det ytre miljøet. Den består av epidermis, basalmembran og dermis, samt skjell og skjell-lommer (Takle et al., 2015). Skjelltap vil dermed føre til ødeleggelse av viktige komponenter i det medfødte immunsystemet, som gjør fisken spesielt sårbar for sekundære infeksjoner. Laksen er spesielt utsatt for skjelltap ved sjøutsett siden **smoltifiserings**prosessen (tilpasning til sjøvann) medfører løse skjell og en sårbar osmotisk balanse for opprettholdelse av homeostase (Takle et al., 2015). I tillegg til dette, vil **håndtering** og **skarpe kanter** være utslagsgivende i forhold til skjelltap. Disse faktorene bør derfor unngås så langt det lar seg gjøre.

I dette forsøket kan skjelltap i forbindelse med smoltifisering (ved utsett i sjø) antas utelukket, på grunn av at regenereringstiden for skjell på 3 måneder ble oversteget i forkant av datainnsamlingen. Likevel vil denne tiden kunne påvirkes av mange faktorer (Schmidt et al., 2013). Når det gjelder håndtering, vil fisken i sjø kreve noe ekstra av dette i forbindelse med lus. Først og fremst gjelder det den ukentlige lusetellingen, selv om dette vil berøre svært få fisk. Senere ved utsett vil dessuten fisken i sjø være ekstra utsatt for lusepåslag, samt risiko for eventuell(e) avlusing(er) når temperaturen i vannet stiger (Samsing et al., 2016). Mekanisk avlusning fører til en signifikant økning i skjelltap (Veterinærinstituttet, 2017), og det kan dermed antas at fisken hadde tatt seg enda dårligere ut etter en eventuell avlusning.

Resultat: skjelltap
Fisken i sjø hadde høyest skår for skjelltap, sammenliknet med fisken på land. Det tilsvarer en høyst signifikant forskjell, og VI-en som kom dårligst ut hos fisken i sjø.

Totalvurdering/konklusjon
Oppdrettsmiljø ser ut til å ha stor betydning for antatt velferd hos postsmolt av Atlantisk laks. Resultatene viste at miljøet i sjøanlegg gav økt skjelltap, mens resultatene med laks oppdrettet i små kar på land gav problemer med overkjeve- og ryggradsdeformiteter, hale-, øye- og snuteblødning og utstående øye. Ryggfinneskader kan være et problem ved begge miljø. For flere av velferds-indikatorene var det imidlertid vanskelig å fastslå hva i oppdrettsmiljøet som forårsaket de observerte forskjellene. Mer forskning trengs for å gi kunnskap om hvilke tiltak som kan gjøres innen ulike miljø for å sikre god fiskevelferd.

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The Effects of Maternal Care on Social Behaviors and Interactions on Juvenile *Metriaclima zebra* Cichlids

Sheyda Shapouri, Kevin Parsons, & Tiffany Armstrong

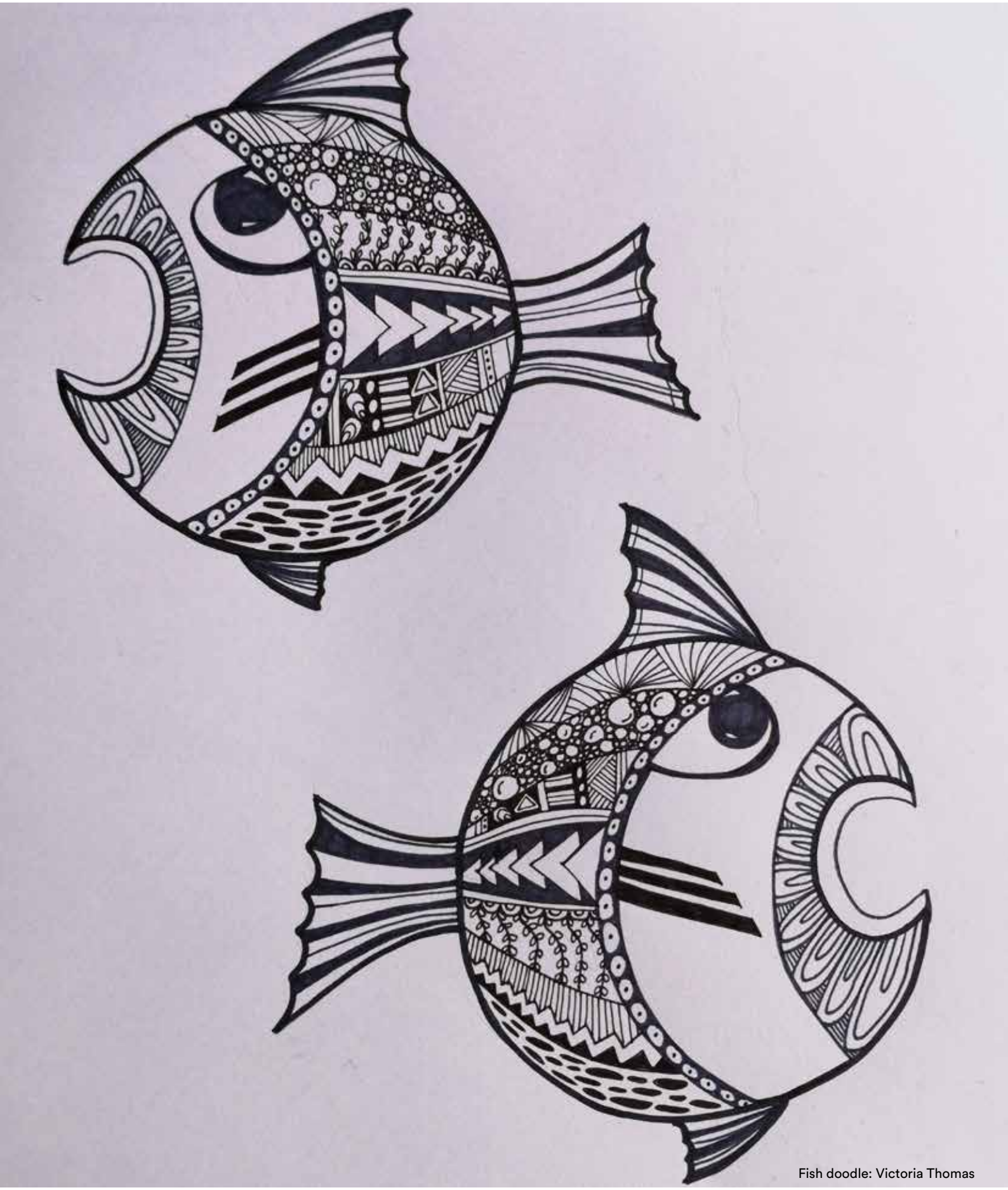
Introduction

Parental care is vital to the success and well-being of young across animal populations. By ensuring the survival and health of their offspring, parents safeguard and increase the probability of continuing their genetic lines. In the 1960s, professor George Williams proposed an idea which came to be known as Williams's Principle (Gross, 2005). Williams theorized that reproduction is both beneficial and costly to the overall fitness of organisms, and that there is a balance of risk and payoff (1966). Ensuring the survival of a brood, or family of young, through parental care behaviors can increase the payoff of continuation of genetic lines considerably through broods of young reliably surviving into adulthood and their own reproductive phases. Adequate parental care is essential to normal development and social behaviors later in life, and disruptions to these patterns in an animal's early life history stages can present difficulties in future interactions.

Reducing levels of parental care can be damaging and disruptive to young animals' interactions with their environment and other members of the species, with the potential to fundamentally change the way future social interactions and behaviors are approached (Arnold & Taborsky, 2010).Parental care behaviors are often found in mammals, with rats having complex interactions between adults and young that when altered, can have lasting effects on behavior (Starr-Phillips & Beery, 2013). Additionally, primates such as rhesus macaques benefit from instrumental parental care during infancy and adolescence, with removal of parental care and isolated upbringing causing artificially raised females to attack, injure, or even kill their own infants in adulthood ((Harlow, Harlow, Dodsworth, & Arling, 1966, McCormack, Sanchez, Bardi, & Maestripieri, 2006). Abnormal parental care behaviors do not solely affect a single generation of offspring, they can cause multigenerational changes to how future offspring are conceived and cared for. Many fish species provide dedicated parental care to their offspring as well, in a variety of different forms with varying physiological costs to the parents providing it. While parental care behaviors are not as common in fish as they are in mammals or birds, around 25% of fish species have evolved maternal or paternal care behaviors such as guarding, egg hiding, or body cavity brooding such as keeping eggs and young in the mouth (Balshine & Earn, 1998).

The costs of these behaviors are varied. The simple pits dug by female salmonids are relatively low-cost, while discus cichlids engage in the high-cost behavior of feeding their young with skin secretions (Balshine & Earn, 1998). In fish, dedicated parental care results in reduced body size in parents, a potential risk and drawback for future broods due to the increased risk of predation and reduced brood size in smaller fish (Gross, 2005). However, this is a potential cost to fitness that many fish species undergo, due to the benefits parental care offers.

Cichlids are known for a particular method of protecting their young known as mouthbrooding. Mouthbrooding fish immediately transfer their eggs to the mouth after fertilization to prevent fungus growth and deter predation; once hatched, these young mouthbrooded fish occasionally return to the mouth to avoid perceived dangers. Mouthbrooding is found in other species of fish, such as some species in the genus Betta, and has evolved independently in cichlid species from Africa and South America (Rüber, Britz, Tan, Ng, & Zardoya, 2004). The ancestral form of parental care for cichlids is substrate brooding, which is still observed in many cichlid species. Mouthbrooding evolved from substrate brooding as a mobile alternative



Fish doodle: Victoria Thomas

to sedentary substrate brooding depending on the type of predators and risks present in different sections of the different rift lakes (Goodwin, Balshine-Earn, & Reynolds, 1998).

This experiments study species, mouthbrooding fish called *Metriaclima zebra* are cichlids found in Lake Malawi, a large freshwater lake in East Africa surrounded by Malawi, Mozambique, and Tanzania. These fish occur in rocky habitats wherein the males defend cave territories used for spawning. When the eggs are fertilized, females mouthbrood for roughly three weeks, holding the fry in their mouths for protection from predators (IUCN). For these fish, the cost of labor-intensive mouthbrooding is high. Females holding eggs or fry experience overall reduced growth, larger pauses between broods (Smith & Wootton, 1994), and extended recovery times for gonads (Balshine-Earn, 1995), mostly due to the lack of nutrition a mouthbrooding female receives (Sefc, 2011). Evolutionary ancestors of rift lake cichlids were originally substrate breeders, with mouthbrooding behavior originating in occasional transport of the young by mouth to different sites (Sefc, 2011). The benefits of mouthbrooding are highlighted by the "safe harbor" hypothesis that observes egg size evolving in relation to the amount of parental care and the increased survival of eggs that amount entails (Shine, 1978). Larger eggs are selected for when the egg stage of development can be considered a "safe harbor" due to the effort of parents providing care such as mouthbrooding. Therefore, while mouthbrooding results in certain costs, such as a lessening in fertility rates and reduced growth, the added protection the young receive gives rise to larger eggs and an increased survival rate for fry (Rüber, Britz, Tan, Ng, and Zardoya, R., 2004). However, depriving young of mouthbrooding from a parent entirely could potentially affect their future contact with conspecifics and the way they interact with the environment around them.

In this study, M. zebra cichlids developed in two environments: maternally raised with the benefits of mouthbrooding, and artificially raised from eggs to the free-swimming stage without the mother present. These fish were then placed into an unfamiliar environment with another fish from the same or different developmental treatment to observe the differences in behavior and interaction. Based on previous studies on various species regarding parental care and the lack thereof, I hypothesize that M. zebra juveniles that experienced less maternal care will be less interactive and display more independence in comparison to juveniles that have received parental care and have witnessed defensive and protective behaviors from their mother.

Methods/Materials

Prior to data collection

To test the hypothesis that parental care behaviors including mouthbrooding have an effect on the social behaviors of juvenile fish, Metriaclima zebra, a mouthbrooding cichlid from Lake Malawi was utilized in this study. Females mouthbrood both their fertilized eggs and hatched fry for a period of time. Three days post observed fertilization, one M. zebra female that was holding eggs was left to provide parental care to half of the brood, while the other half was removed and placed in a container underwater with a constant flow of bubbles agitating them to simulate the aeration and movement they would receive inside their mother's mouth. After both broods reached approximately 10 days post hatching, the data collection process began with 10 artificially raised fish and 10 maternally raised fish.

Experimental design

To examine the influence of maternal care on activity and interaction with conspecifics, we placed fish pairs in a 20x45cm rectangular tank, with a built in glass divider, that was inside a large plastic box to reduce influence from external stimuli. The solid glass divider allowed for no olfactory or chemical stimuli from the opposite fish, however, provided visual stimuli from the other side. Initially, a sheet of laminated paper was placed along the divider, preventing the fish from seeing each other. Each pair was given one minute to acclimatize to the new environment before filming began. Filming started with the opaque barrier in place to establish a baseline for behavior, and continued once the barrier had been removed, revealing the transparent glass and allowing both fish to see and interact with one another. The fish were held in water taken from the tank they were being kept in, and water from this same tank system was used to fill the divided tank to avoid shock to their bodies caused by water of varying temperature or chemistry. The entire environment used for recording was used in the same temperature controlled room the fish were kept in. Above the tank, a Logitech C310 HD webcam on a stand provided footage of the entire tank space from above. After the one minute acclimatization period, the pairs were filmed for five minutes with the divider in place. Upon the mark, the divider was removed and the fish were given full view of each other for an additional five minutes. During this time, disturbances were minimized as much as possible to ensure the only external stimuli the juveniles were receiving were from each other.

Three different trials were run in this experiment. First, maternally (MR) and artificially raised (AR)

fish were paired with fish from the same maternal treatment, resulting in 5 runs of each treatment. Second, fish from opposite treatments were paired, resulting in 10 runs of MR/AR interaction. In total, 20 videos were recorded, with 5 AR/AR, 5 MR/MR, and 10 MR/AR.

Data collection

To accurately calculate distances and patterns, the path each fish took in the recordings was tracked using MtrackJ, a plugin of ImageJ (Rasband, 1997) that provides a framework to overlay tracks on the frames of each video. To prepare the videos for tracking, the frame rate of the videos was decimated by 10, resulting in image sequences 60-65 frames long. After these image sequences were imported into ImageJ, the tracking plugin was used to locate the fish frame by frame. Doing this for both fish results in a clear line showing their path throughout the trial time as well as producing a spreadsheet of information such as distance traveled and location on x/y axes. After converting the total distance traveled from pixels to centimeters using a known distance on each video to set a conversion factor, the distance traveled by each fish before and after the removal of the divider was calculated.

To compare behavior before and after the removal of the divider further, total distance traveled and the average distance from the midline of the tank were used for each fish both before and after the opaque divider was removed. Measuring the distance traveled allows us to visualize each fish's level of activity. Activity levels were raised by behaviors such as fish mirroring each other from across the divider, or attempting to group together cohesively for protection in numbers.

Statistical analysis

Three different statistical tests were utilized to determine the difference in observed behaviors between MR and AR individuals: ANOVA tests, a Spearman Rank correlation, and Wilcoxon rank sum tests. Statistical analysis and figures were completed using base R 3.2.3 (R Development Core Team, 2006). Each spreadsheet was converted and loaded on to R-Studio for analysis. The data were analyzed with Spearman Rank Correlation tests, Wilcoxon rank sum tests, and analysis of variance. In these tests, maternal treatment, companion treatment, distance traveled, and distance from the midpoint were compared to each other both before and after the removal of the opaque divider to determine if maternal care or the presence of another juvenile fish affected behavior. Because the transparent divider at the midline of the tank is the only location in which interaction between the two individuals can occur, measuring distance from the midline and comparing each fish on either side of this divider is the most effective measure of social behavior in this experiment.

ANOVA tests

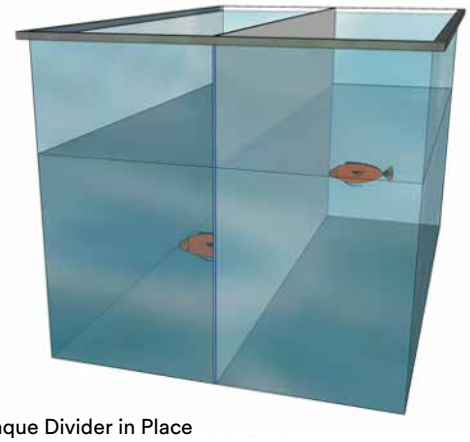
Using Treatment, Companion Treatment, and Before/After Divider as explanatory variables, two Analysis of variance (ANOVA) tests were conducted: one measuring the average distance from the midline of the tank as a response variable, and another measuring total distance traveled.

Spearman Rank Correlation

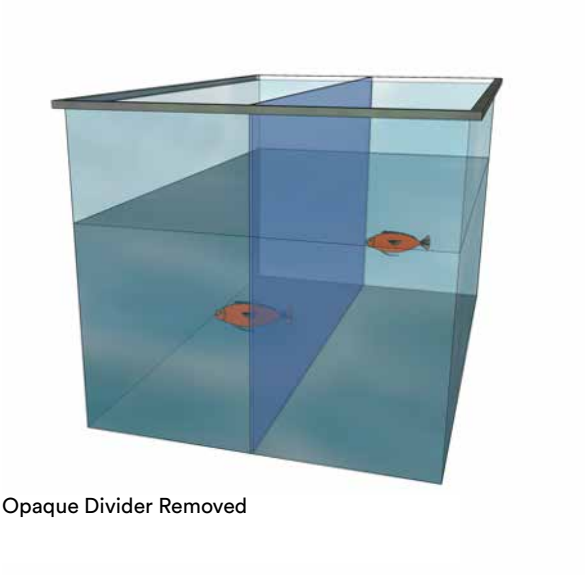
To analyze the effect of the different treatments on total distance and average midline distance individually, the correlation between these treatments and the individual results was completed using a Spearman Rank correlation test. Total distance traveled and average midline distances were analyzed separately for each maternal treatment to compare the effects on the overall behavior of these fish.

Wilcoxon rank sum tests

To compare individual treatments to each other while also taking into account other explanatory variables, a Wilcoxon rank sum test was utilized. First, paired tests were used to determine the differences in total distance traveled before and after the removal of the divider for each treatment separately. A paired test was also used to determine if there was a difference in distance to the midline before and after the divider was removed for each treatment. Second, a non-paired test was used to determine the difference in total distance traveled before the divider was removed for between treatments. This was then performed again for distance traveled after the removal of the divider. A non-paired test was also used to determine the difference between treatments, before the divider was removed, in average distance from the midline. This was also done again for average distance from the midline after the divider was removed, again between treatments.



Opaque Divider in Place



Opaque Divider Removed

Results

Total Distance Traveled

To determine the influence of maternal care and the effect of the presence of a member of the same species with a different maternal care treatment on the activity levels of the juvenile fish, we investigated the total distance each fish traveled in the new environment they were placed in: the experimental tank, both before and after the removal of the opaque divider. In an ANOVA test run on the results focusing on total distance traveled, it was determined that maternal treatment, the presence of a companion fish, and the relationship between treatment and companion treatment were significant in their influence on the activity levels of the offspring (Table 1). Additionally, we determined that maternally raised fish were influenced by the presence of a companion fish in their activity levels (Table 3). In the mixed trials, the total distance traveled after the removal of the divider was significant, while the distance traveled while the divider was present was not (Table 3). Finally, we found no significance in correlation for the distance traveled before and after the divider removal for separate MR and AR trials (Table 4). Both maternally raised and artificially raised fish decreased their amount of movement significantly after the opaque divider was removed (Figure 1). While maternally raised fish had larger total distances both before and after divider removal, the distance decreased after the divider removal is still significant for both groups.

To determine whether or not a fish's treatment or companion treatment affected its behavior, both before and after the removal of the opaque divider, an ANOVA was performed. This test determined that both treatment and the presence of another fish were significant in their effect on the total distance each fish traveled ($p=0.000871$, $p<0.0001$; Table 1; Fig.1), while companion treatment was not significant ($p>0.05$; Table 1; Fig.1). When measuring for the effect of these variables on each fish's average distance from the midline, there was no significance among any of the variables.

To compare distances and average distances from the midline, both to mixed and same-treatment trials, eight Wilcoxon rank sum tests were performed, each

	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	F Value	P Value
Treatment	1	145182	14582	12.30	**0.000871**
Companion Treatment	1	1999	1999	0.166	0.685183
Before/After Divider	1	321708	321708	26.657	**<0.0001**
Treatment:Companion Treatment	1	267192	267192	267192	**<0.0001**
Residuals	75	905129	12068		

Table 1: ANOVA explaining the effect of the listed explanatory variables on distance traveled by all fish in the trial. Statistically significant values are bolded. This table shows that the treatment each fish received (either maternally or artificially raised) and the treatment of the companion fish on the opposing side had a significant effect on the distance traveled by fish.

	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	F Value	P Value
Treatment	1	21785	21785	1.456	0.231
Companion Treatment	1	1447	1447	0.097	0.757
Before/After Divider	1	1764	1764	0.118	0.732
Residuals	75	1122471	14966		

Table 2: ANOVA explaining the effect of the listed explanatory variables on the average distance from the midline for each fish. Statistically significant values are bolded. Because there are no significant values here, this table shows that while treatment was perhaps trending towards significance, there are no statistically significant effects affecting distance from the midline.

	Degrees of Freedom	W Value	P Value
Distance Before vs Distance After (MR)	9	170	**0.01362**
Distance Before vs Distance After (AR)	9	38	0.3223
Midline Before vs Midline After (MR)	9	132	0.33
Midline Before vs Midline After (AR)	9	35	0.4922
Distance Before (MR vs AR)	19	75	0.06301
Distance After (MR vs AR)	19	81	**0.01854**
Midline Before (MR vs AR)	19	72	0.1051
Midline After (MR vs AR)	19	73	0.08921

Table 3: Results of a series of Wilcoxon rank sum tests comparing fish from the two different treatments (MR and AR) and the respective effects these treatments had on both distance traveled and distance from the midline. Significant values are bolded.

MR

	Distance Before	Distance After	Midline Before	Midline After
Distance Before		P=0.2123	P=0.4031	
		R=0.4321	R=-0.2979	
Distance After				P=0.8228
				R=-0.0815
Midline Before				**P<0.0001** R=0.9623
Midline After				

Table 4: Correlations of behaviors comparing distance traveled and distance from midline to each other and to themselves both before and after the removal of the opaque divider. These values are divided for MR and AR fish. Both p-values and correlation values are shown. Significant values are bolded.

AR

	Distance Before	Distance After	Midline Before	Midline After
Distance Before		P=0.2091	P=0.3133	
		R=0.4348	R=-0.3556	
Distance After				P=0.9876
				R=0.0056
Midline Before				**P<0.0001**
				R=0.9789
Midline After				

comparing a different facet of the data. Here, maternally raised (MR) fish had a significant difference in distance traveled before and after the divider was removed (p=0.01362; Table 3). Mixed-trial fish also showed a significant difference in their movement post-divider (p=0.01854; Table 3). Additionally, the pre-divider removal results for the mixed trials showed a trend towards significance (p=0.06301). However, none of the results from this test showed any significance in any trial for average distance from the midline, apart from the mixed trial test for after the removal of the divider, which was trending towards significance (p=0.08921). This means that while the presence or absence of parental care had no statistically significant impact on the distance fish kept from the midline of the tank except the mixed

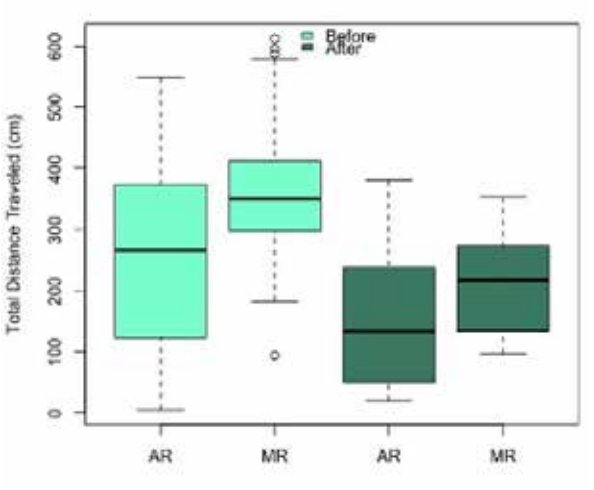


Figure 1: Total distance traveled in centimeters by both MR and AR fish presented before and after the removal of the opaque divider. The upper and lower edges of each box represent the upper and lower quartiles (25% and 75%) respectively. The bold line going through each box represents the median value for that particular section of the data, and the whiskers represent the maximum and minimum values. The lighter color represents data from before divider removal, while the darker color is after. This table shows maternally raised fish traveling more of a distance overall both before and after the removal of the divider.

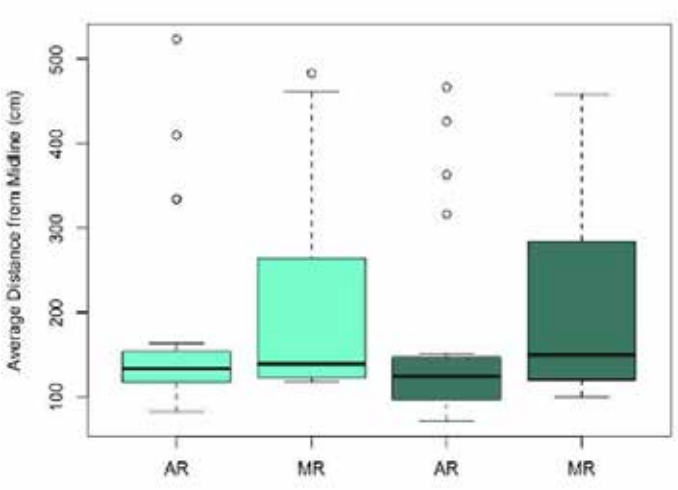


Figure 2: Average distance from the midline of the tank before and after divider removal for both treatments of fish. The upper and lower edges of each box represent the upper and lower quartiles (25% and 75%) respectively. The bold line going through each box represents the median value for that particular section of the data, and the whiskers represent the maximum and minimum values. The lighter color represents data from before divider removal, while the darker color is after. This shows that maternally raised fish spent considerably more time close to the midline in comparison to artificially raised fish, as a result of social mirroring behavior and attempting to school with the other fish. Meanwhile, artificially raised fish were apathetic to schooling or grouping and did not seek out the center divider.

trial (maternally raised vs. artificially raised) which was trending towards significance after the divider was removed. Essentially, a maternally raised fish encountering an artificially raised one once the divider was removed after the initial period had more interest in the fish across the barrier by maternally raised fish (as shown in later tests as well) who then attempted to get closer to this conspecific by approaching the middle divider.

Analysis with Spearman Rank Correlation revealed that maternally raised fish altered their distance from the midline upon seeing another fish, either to attempt schooling behavior or mirroring back and forth from across the glass divider. Meanwhile, artificially raised fish showed no change in their behavior upon removal of the opaque divider, and did not attempt any social behaviors or even to increase their proximity to a conspecific once contact was established.Comparing the two treatments of maternally and artificially raised fish separately allows for more in depth analysis on the different variables excluding treatment and how they present in two different groups of fish, therefore showing what results can be attributed to treatment specifically. In this analysis, the significance of the fish's average distance from the midline is tested, without the added influence of a mixed-trial companion. Both maternally raised and artificially raised fish showed a significant correlation in their average distance from the midline (MR $p<0.0001$, AR $p<0.0001$; Table 4) both before and after the divider was removed, while total distance traveled showed no significant correlation. This means that maternally raised fish showed considerable interest in remaining in proximity to the midline divider, possibly in an attempt to group with and school with the fish on the other side. Artificially raised fish however, were displaying more asocial and avoidant behaviors by remaining solitary away from the center divider.

Average Distance From Midline

To determine the influence of maternal care and the effect of the presence of a conspecific with different maternal care treatment on the offspring's desire to be near a conspecific, we studied the average distance each fish maintained from the midline of the divided tank, an environment new to the fish, both with and without the presence of a companion. In the results of the ANOVA test, we found that maternal treatment was the only significant factor influencing the offspring's distance to the midline (Table 2). Additionally, there was no significance in the distance from the midline in the results of a Wilcoxon rank

sum test for both treatments (Table 3). Finally, we determined that there was a significant correlation for the average distance from the midline before and after the removal of the divider for both maternal treatments (Table 4). In the box plot measuring the average distance from the midline for both groups of fish, it is clear that artificially raised fish spent significantly more time near the divider than maternally raised fish (Figure 2). While the median distances, represented by the black line inside each colored box, are relatively similar, the overall difference in average distances is sizable.

Discussion

The results of this study suggest that maternal treatment, and the lack thereof, has a substantial effect on the behavior of juveniles, causing overly cautious and asocial behavior compared to maternally raised individuals. Individual responses to the sight of conspecifics varied depending on the level of maternal care. When measuring the response toward a conspecific in terms of distance traveled, treatment proved to be highly significant. Maternally raised fish altered their behavior considerably upon the removal of the divider compared to artificially raised fish, and mixed trials showed a significant change in movement after the removal of the divider. This suggests that maternally raised fish are reacting to the presence of another juvenile fish, while artificially raised fish are far less reactive. Prior to the removal of the opaque divider, the results of the mixed-treatment trials were trending towards significance, indicating that further results would have likely shown significance if this trial had been replicated. Since the type and level of intensity of parental care is thought to be highly influential on a juvenile's behavioral development (Stamps, Metcalf, and Krishnan, 1978), the potential implications of artificially raised juveniles' success in navigating social behaviors are clear.

Cichlid fish raised in communal settings exhibit increased social behaviors compared to fish raised in smaller groups of young without adults, which display more aggressive and antisocial behaviors (Fischer, Bessert-Nettelbeck, Kotrschal, and Taborsky, 2015). Maternally raised fish seeking out conspecifics and attempting to mirror their movements is a display of normal social behaviors learned through maternal care and regular close interaction with siblings, while artificially raised fish did not alter their distance upon visual contact with a conspecific. Without maternal care and learned social behaviors, artificially raised fish are less reactive to the presence of a conspecific and do not exhibit mirroring or schooling behaviors, while also traveling and exploring less in total compared to maternally raised fish. While both maternal treatments lessened their total distance traveled after the divider was removed, but maternally raised fish still had a higher distance overall, showing higher levels of both exploratory and mirroring behavior. The artificially raised group's reduced distance showed lessened social behaviors and increased anxiety. In the offspring of cichlids that undergo mouthbrooding, vital anti-predator and social behaviors are imparted to the young by way of maternal care in a vital time window early in life (Stratmann & Taborsky, 2014).

Each fish's average distance from the midline of the tank is an effective measurement of social behavior, due to the fact that the only possible social interaction in this experimental setup is through the divider glass once the opaque divider is removed. Both maternal treatments

Juvenile Metriaclima zebra cichlid: Sheyda Shapouri

altered their behavior after the removal of the divider, meaning that the visual cue of a conspecific causes a change in behavior in regards to average distance from the midline regardless of treatment.

Social individuals swim closer to one another, strengthening already established communal bonds (Jolles Fleetwood-Wilson, Nakayama, Stumpe, Johnstone, and Manica, 2015). Therefore, it can be concluded that maternally raised fish, which already have firmly established familial and community bonds, will make an effort to swim alongside and mirror each other through a divider. Artificially raised fish stayed closer to the midline throughout the entire data collection period, regardless of the presence or absence of the divider, which could suggest heightened anxiety and avoidant behaviors. This is reflective of behaviors displayed in a maternal care study of juvenile rats. Rats deprived of adequate maternal care expressed far more anxious and fearful behaviors in comparison to those that had received adequate amounts of grooming and licking, which explored and interacted with novel environments with little anxiety (Starr-Phillips & Beery, 2013). These experiments show that maternal care, and the lack thereof, is a deciding factor in establishing learned social behaviors. The artificially raised fish, having experienced little to no social interaction between them and their mother, have not learned communal and individual social and exploratory behaviors and therefore do not know how to react in a novel environment or to an unfamiliar conspecific.

Additionally, artificially raised fish spending a significant amount of time close to the midline before the removal of the opaque divider can also be explained by young lacking maternal care being known to exhibit anxious behaviors. These fearful behaviors can be actions such as attempting to hide or avoiding open water. Fish displaying explorative behaviors in a novel environment ventured out into the middle of the space, while fearful juveniles maintained a close distance from the tank walls at all times, including the middle divider prior to it being transparent. This could mean that maternally raised fish maintained a higher average distance from the divider due to their lack of fearful behavior and investigative nature, while artificially raised fish maintained close contact with the divider line as an avoidant behavior. In the mixed-treatment trials, the average distance from the midline after the removal of the divider was trending towards significance,

suggesting that should this study have continued to further trials, a clear distinction in the data could have been made supporting the idea that maternally raised fish attempted more social contact with a conspecific than artificially raised fish did.

The broader implications of these results are significant because affected social behaviors can persist in the form of long lasting multigenerational effects.For example, female rhesus monkeys subjected to maternal abuse early in their lives had considerable difficulty conceiving young of their own. If they managed to produce young, the cycle of maternal abuse continued in most of the females (Harlow, H., Harlow, M., Dodsworth, R., and Arling, G., 1966). While the abnormal parental behaviors in this study were not abusive like the macaques, the potential future effects of an inadequate foundational understanding of social behaviors can be limiting. Seeing as a poor social environment during early life history stages can result in antisocial and violent behaviors in cichlids (Fischer, Bessert-Nettelbeck, Kotrschal, and Taborsky., 2015), social activities such as mating can be constrained for fish that did not receive sufficient experience in developing learned behaviors from a parental figure. Fish that cannot interact normally with others may be selected against in favor of a fish expressing typical behaviors by potential mates. These possible ramifications are not just behavioural, however; physical and mental health in future life history stages could be seriously affected by abnormal or adverse parental care, a possibility that was looked into in detail on young rats (Fish et al., 2006).

Another potential problem faced by cichlids lacking maternal care is the increased risk of predation and high mortality of young. Mouthbrooding is a strategy of protecting eggs and young that has been repeatedly selected for across cichlid populations worldwide due to the increased survival rate and larger egg size it ensures (Klug & Bonsall, 2014; Kidd, Duftner, Koblmüller, Sturmbauer, and Hofmann, 2012). Therefore, not only does mouthbrooding impart essential social and defensive behaviors, it also increases juvenile cichlids' chances of survival and decreases the risk of predation. Additionally, predation risk also increases in solitary fish that do not engage conspecifics. Schooling is a vital group behavior that collectively reduces the risk of predation (Magurran, 1990). Information about possible risks can be relayed through a school without

Photo: Sven Emil Hinderaker

requiring every member to witness it firsthand, as well as benefiting from the overall increased vigilance of the entire group (Magurran, 1990). In this study, artificially raised fish did not exhibit the same mirroring and following behaviors maternally raised fish expressed, which was clearly shown in the artificially raised group's comparatively diminutive total distance traveled. In the wild, this solitary behavior can increase the risk of predation, especially considering the small size of M. zebra juveniles. In populations experiencing a significant threat of predation, schooling behaviors have been shown to greatly reduce individual risk by amplifying individual anti-predator measures and behaviors (Magurran, 1990). Therefore, a solitary fish not expressing schooling behavior due to lack of learned social activity from a parental figure is at a considerably higher risk of predation than a fish exhibiting normal social group behaviors. Considering that adult fish in heavily predated habitats will increase levels of parental care, often to their own personal detriment in order to ensure the survival of their young (Steinhart, 2004), it is clear that parental care in any form is essential in ensuring the survival of young amongst predators and that independent young would not have nearly as high of a survival rate compared to offspring receiving parental care.

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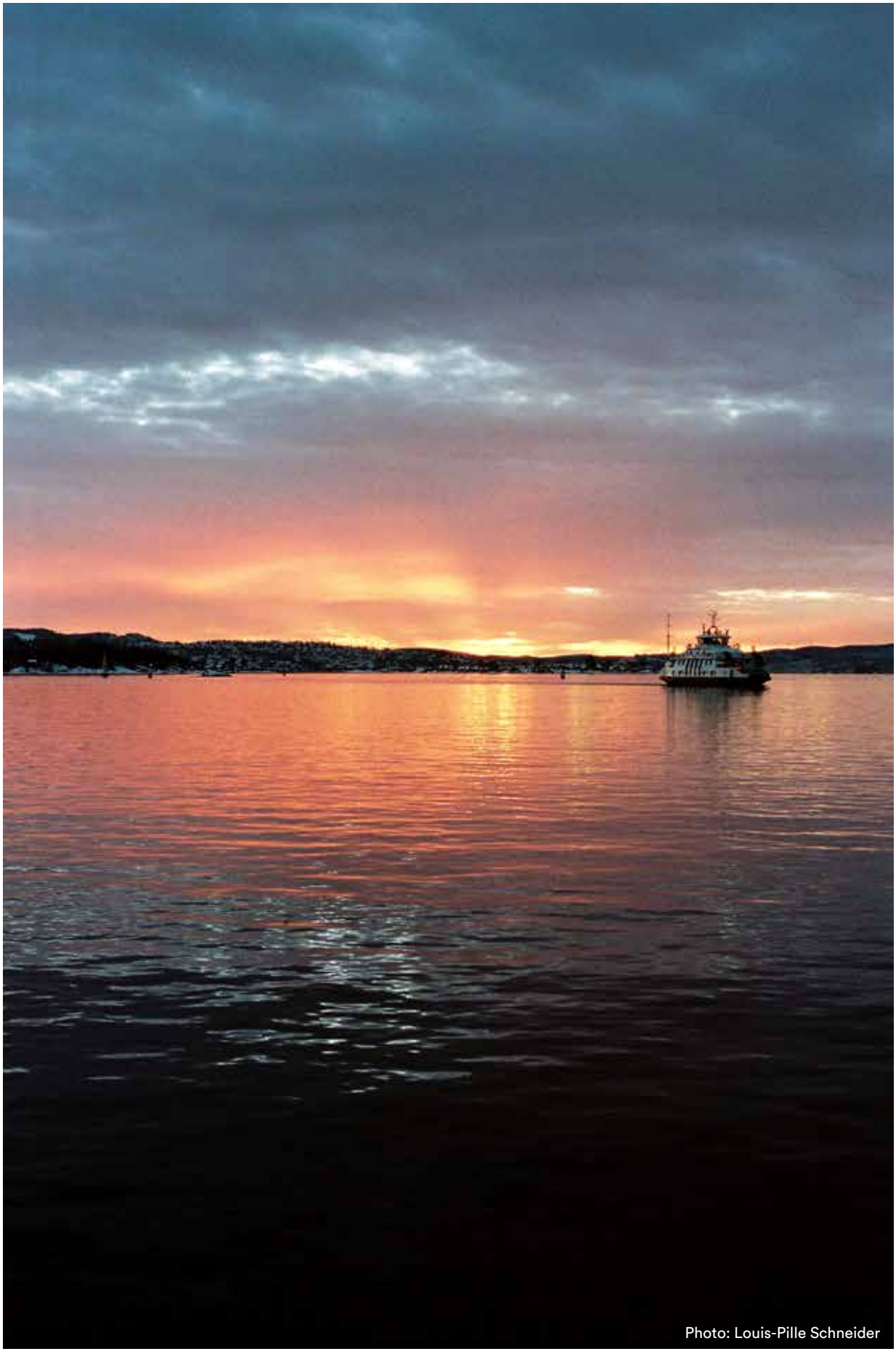

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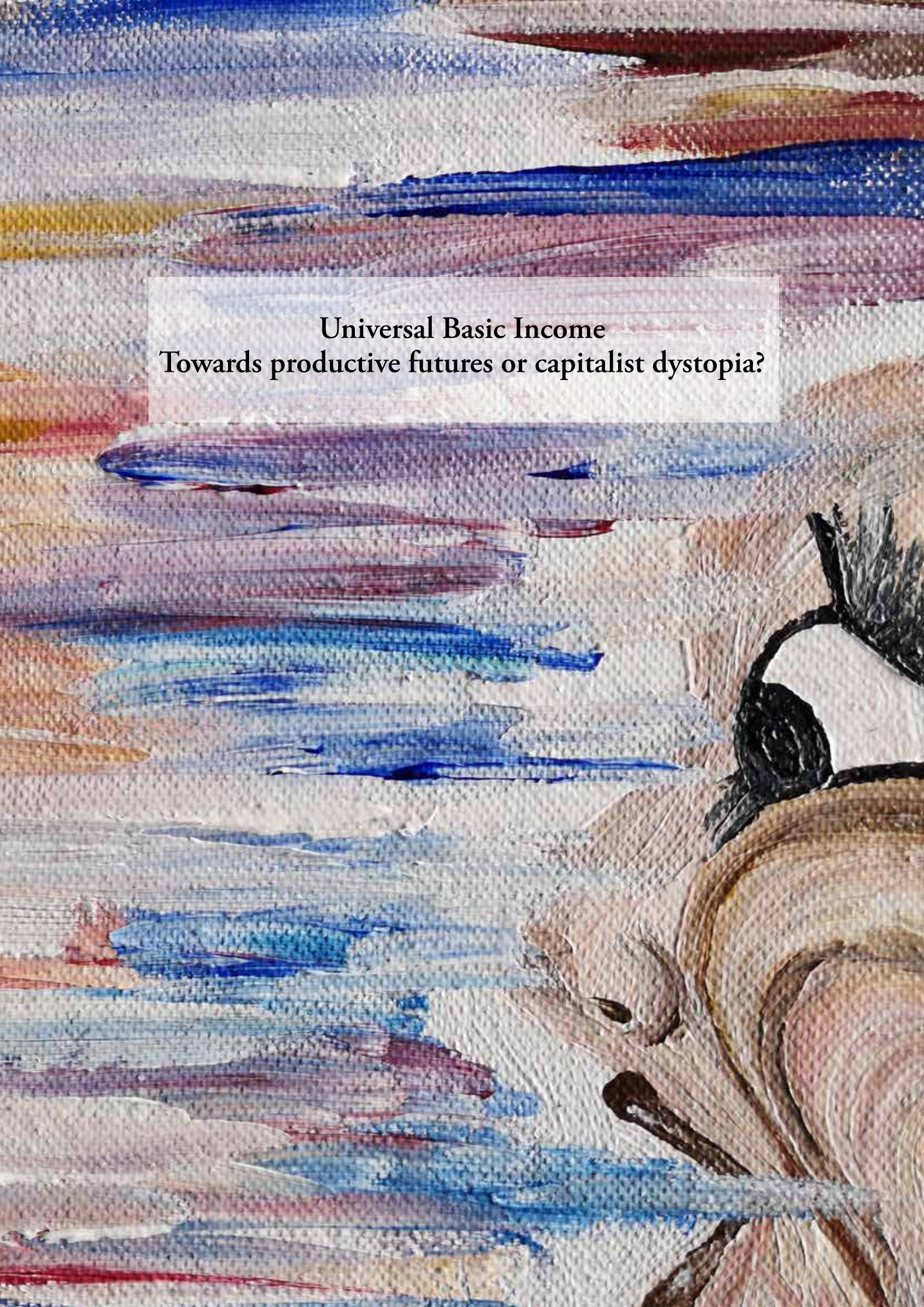

Universal Basic Income
Towards productive futures or capitalist dystopia?

Universal Basic Income
Towards productive futures or capitalist dystopia?

Anna Buckley Cahill

While not a new concept, universal basic income, or UBI, is as hotly debated today as in its conception in the 18th century. Defined as a fixed income distributed universally and unconditionally by the government to all adults (Heller, 2018), UBI is a simple idea with complex implications. Its implementation involves questions of morality, inheritance, freedom and fairness, and depends greatly on context and time. Economists and academics alike have praised UBI as a viable and efficient way to lift the lower class out of poverty and support the middle and working classes by relieving financial strains related to the costs of living. These arguments claim that an income cushion grants recipients the freedom to pass up on low-paying and part-time jobs and invest in skill-building, (re)education and entrepreneurial pursuits, ultimately improving quality of life and adaptability to a changing economy.

Today's changing economy, which is intertwined with what has been called the Fourth Industrial Revolution, is one characterised by labor-saving technology and automation. By some estimates (Zahidi, 2020), nearly one-third of jobs worldwide will be digitized or automated by the end of the decade, requiring large-scale reskilling, particularly for those in construction, transportation and manufacturing sectors. Related is the imminent shift towards a 'gig economy' in which irregular and temporary contracted work becomes the norm (Donovan, Bradley, & Shimabukuru, 2016). Influential voices across political affiliation, profession and income brackets, including conservative political scientist Charles Murray, tech billionaire Elon Musk and former 2020 US democratic candidate Andrew Yang, have championed UBI as the key to executing a graceful transition. However, not all UBI schemes are created equal and those proposed have varying genuine concern for their recipients.

In this paper, I will begin by introducing Thomas Paine's early 'ground rent' proposal and evaluate its relevance in the modern UBI discussion. From there, I will outline some current arguments for UBI as a key to adjusting to labor-saving technology, and compare them to the aforementioned rent-based model. Through this comparison, I will illustrate the pitfalls of the current leading technology-oriented UBI schemes, which are exploitative and counter-productive. This comparison will show that any viable UBI scheme will require strong underlying logic to justify where the money comes from, why it is to be distributed and what the amount will be. Finally, I will present a rent-based model for a technology-related UBI inspired by Thomas Paine's ground rent concept. This model, I argue, offers a fair, philosophically sound way to distribute cash for all.

One of the earliest conceptions of a universal basic income was proposed by American Founding Father Thomas Paine in 1797. In *Agrarian Justice*, Paine identifies two distinct types of property: privately owned artificial property invented by man and natural communal property, which comprises all of Earth's elements that we use but played no part in creating. In the case of the latter, Paine (2004) argued that prior to civilization, the earth was "the common property of the human race" (p. 5). This changed with the eventual consolidation of land ownership and cultivation, which left the vast majority who were born without land unjustly denied their basic right to the common property of mankind. Thus, while land property and cultivation engendered societal advancement and, particularly in Britain and colonial America, accounted for a large share of national income (Lindert, 2008), the landless poor were getting left behind. Indeed, despite a lack of concrete data from this period, it is believed that a surge in both wealth and inequality took root in England and the US during the 19th century alongside the Second Agricultural Revolution (Lindert, 2008; Thompson, 1968). Paine (2004) called this wealthier, advanced society a 'state of civilization', and argued that "every

Photo: Louis Pille-Schneider

person born into the world, after a state of civilization commences, ought not to be worse than if he had been born before that period" (p. 4). In other words, growth should lift everyone, or at least not leave anyone worse off.

Since the societal and economic development enabled by land cultivation cannot be separated from the land itself, all members of a "cultivated state" therefore have a right to compensation from land owners who use and profit individually off what are essentially communal resources, i.e. land (Paine, 2004, p. 4). Paine calls this compensation a "ground rent" meant literally as a rent for using the ground, where rent is defined by Adam Smith as "the price paid for the use of land" (Paine, 2004, p. 4; Smith, 1904, p. 145). With this rent payment, it is important to note the total lack of any moral or ethical judgement; the landless poor are not receiving a ground rent payment because society values the reduction of poverty and inequality. If this were the case, a cut of the revenue from land cultivation and extraction to be redistributed to the poor would likely be more appropriate. Instead, the ground rent is compensation for the right to use land that belongs just as much to anyone else. According to Smith, rent price, as with any other capitalist transaction, is negotiated between the land users and owners in the market, which determines the value of the land to be its competitive equilibrium price (Smith, 1904, p. 145).

Fast forward almost 230 years and economists are still assessing the viability of Paine's initial concept, often in relation to the complex and disharmonious discourse around UBI. Paine's 'ground rents' have resurfaced today as resource rents (cf. Devarajan, 2017; Barnes, 2014), reflecting the current use of land for lucrative natural resource extraction. As opposed to Paine's initial broad conception of the earth owned by the entire human race, modern resource rents have adopted a more state-centric nuance where citizens of a state lay claim to that state's natural resources (Segal, 2011). However, despite the endurance of Paine's ground rent concept in UBI debates and its strong philosophical underpinning, it faces serious implementation barriers, which may be why no such policy exists. First, while the idea of the earth being the common property of humans may be pleasing, we are deeply, probably hopelessly, entrenched in a system of individual, exclusive land ownership. Within this system, coming up with market equilibrium rent prices for land that has already been purchased does not seem possible. Second, state and economic union borders, like that of the EU, pose complications because of the Free Movement of Persons policy, and the fact that not every state is equally endowed with natural resources (Vandenbroucke, 2017). With Free Movement, for example, there is little stopping people from flooding to oil rich countries where resource rent

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payouts would be higher. A third point is that resource revenues will not be a permanent source of UBI funding as natural resources will eventually run out.

However idealistic, I argue that the value of Paine's initial conception of ground rents, and today's conception of resource rents, lies in its strong foundation and coherent rationale for distributing money. This foundation is clearly demonstrated when observing three key features: where the money comes from, why the money is distributed to citizens, and how the amount of money to be distributed is determined. Calling attention to these three features sets up a useful backdrop when unpacking current UBI arguments related to technology. For instance, whereas ground rents are paid by land users at market value to compensate citizens for using land that they, theoretically, share ownership of, the UBI models suggested today for assisting in labor-saving technology are nowhere near as clear-cut. There is no consensus among the economists, politicians, social scientists and entrepreneurs who advocate for a UBI about its exact intended purpose, its source of funding or the amount to be allocated to each citizen. The following comparison of these three points, which are fundamentally interrelated, as they appear in current technology-related UBI proposals and a rent-based model of UBI will illustrate just how inadequate and exploitative current technology-related UBI models are.

Similar to how agricultural innovations in land cultivation advanced society in Thomas Paine's time, technological innovation has transformed life in today's developed regions of the world. Widespread technology such as cellphones, computers, GPS, medical technology, in addition to readily available information at our fingertips, have no doubt made life easier. Many services and products are also cheaper than before as robots and artificial intelligence (AI) take over jobs once performed by humans. While technology has been a vehicle to make societies richer, it has at the same time made them less equal (Greenwood, 1997), and this trend is likely to continue. On the top level, as computer programs, internet platforms, machine learning and automation upend the economy and labor market, all but an elite few "who can innovate and create new products, services, and business models" will be squeezed out, causing the rich to grow richer and fewer (Brynjolfsson, McAfee, & Spence, 2014). On the bottom level, it is unfortunately the poorest labor workers performing low-skill jobs who are the most vulnerable to getting ousted by automation. In 2016, the White House submitted an Economic Report to Congress showing the probability of a job becoming automated according to its median hourly wage. The report predicted that 83% of low-paying jobs (less than 20 USD/hour) would become automated along with 31% of jobs with wages between 20 and 40 USD/hour ("New Opportunities and Challenges," 2016, p. 239). Here we must revisit Thomas Paine's condition that no one should be worse off by a more advanced society. Currently, however, it seems that technological advancement threatens to denigrate the standard of living for the already poor.

UBI has thus been introduced as a possible solution to this highly anticipated crisis, with a spectrum of approaches proposed. On one side of the spectrum are those who recognize the automation of some jobs in service and trucking sectors as a shift in the economy, though not necessarily an earth-shattering shift. UBI advocates in this camp assert that to adjust to such economic and labor market changes, providing resources to retrain people for careers that require different skill sets will be essential ("New Opportunities and Challenges," 2016). This added financial security will also be necessary to "fill the gaps" as employment becomes more precarious and people change jobs more frequently, as required by a gig economy. Since the focus here is on adapting workers to the new demands of the labor market, the amount of money required would not be enough to live off of, but instead a stipend to provide security to carry out a career pivot.

On the other side of the spectrum are those who anticipate labor-saving technology to cast a much wider net on the workforce. This faction argues that the days of working people are numbered, and that eventually, a full income will need to be distributed to all those whose jobs will be performed by technology. It is interesting to note who the bulk of advocates for this strain of UBI are: relatively young, extremely wealthy tech entrepreneurs. For example, venture capitalist Andrew Yang centered his 2020 US presidential campaign on a UBI that he termed a "Freedom Dividend," while in his 2017 commencement address at Harvard University, Mark Zuckerberg urged graduates to consider UBI, "To keep our society moving forward… to not only create new jobs, but create a renewed sense of purpose" ("Mark Zuckerberg's Commencement address at Harvard," 2017; "*What is Universal Basic Income?*," 2019). This renewed sense of purpose, of course, means finding meaning in what might become a post-employment era.

For the most part, these UBI proposals do not offer concrete suggestions about how much money should be distributed or exactly how it should be funded. In fact, these two points of contention are often brought up in arguments of opposition to UBI. Critics claim that actualizing such an intervention would be both prohibitively expensive and politically implausible

for implementing governments (Kesselman, 2013; Cremer & Roeder, 2015), and fear that such an unconditional allowance would disincentivize participation in the labor market for many of its recipients (Horstschräer, Clauss, & Schnabel, 2010). Though increasing taxes to fund the UBI is expected to be an unpopular strategy among citizens, a finger has been pointed at the wealthy elite to contribute. Yang, for instance, proposed a "Value-Added Tax," which would "[make] it much harder for large corporations, who are experts at hiding profits and income, to avoid paying their fair share," while Zuckerberg agrees, "People like me should pay for it" ("*What is Universal Basic Income?*," 2019; "Mark Zuckerberg's Commencement address at Harvard," 2017). While this type of progressive taxing would entail some redistribution of wealth from the nouveau riche tech elite, we also need to be critical of what it means for the average person in terms of their relationship to the money they would be receiving in a UBI. Specifically, how is this relationship, where they receive a cut of revenue, different from when they receive a rent?

The most obvious difference is the matter of ownership. In the case of 18th century ground rents and modern-day resource rents, rent recipients have a legitimate claim of ownership on the means of production, i.e. land. This implies that the UBI received is not charity, but a rightful share, and thus no stigma is attached to receiving it. Receiving a cut of an industry's revenue or a tech elite's income, however, does not imply the same claim to the means of technological production. Recipients aren't *owed* this cut, they are being given it in a charitable gesture, essentially as a consolation prize for not outsmarting a robot. Such a UBI is more humiliating than destigmatizing. A UBI imagined in this way is beneficial to the tech elite because, paradoxically, it relieves a moral duty not to profit solely at the common man's expense, and even more so because it reinforces their position. It seems no coincidence, then, that Silicon Valley, an epicenter of technological capital, is funneling significant funding for UBI pilots both in the US and internationally (Heller, 2018). Tech entrepreneurs have amassed billions of dollars in private capital from AI and automation technology and will profit further if automation grows the way they have predicted. Their envisioned UBI will secure a future in which the masses are satisfied, even grateful, for receiving a relatively small revenue cut from huge tech companies, never questioning their motives for fear of biting the hand that feeds them. This UBI is therefore a mechanism for the rich and powerful to grow more rich and powerful, with the livelihoods of everyone else dependent upon "the crumbs" of their success (Tarnoff, 2016).

This scenario sounds eerily similar to the capitalist dystopia warned about by Karl Marx. Throughout the 19th century, Marx prophesied about a rise and turbulent fall of capitalism distinguished by class struggle and the exploitation of laborers by wealthy capitalists. These capitalists would own the *means of production*, which, during this era, were factories, raw materials and machinery. As the means of production became privatized by the elite, their power would allow them to negotiate unfair terms of trade. As a result, capitalists, whose aim was to produce and profit as much as possible, would keep laborers' wages to a bare minimum (Marx, Fowkes, & Fernbach, 1990). Inevitably, the laborer would be alienated from his labor, the products of his labor and any sense of trade-based identity (Marx & Frederick, 1848). This dystopian alienation of the labor force comes about when laborers no longer own the products they produce. While this paper does not argue for an overhaul of the capitalist system, it does find value in Marx's ideas about class, ownership and profit. With these ideas in mind, the UBI schemes proposed above by tech billionaires fare even worse.

Yet, what would happen if we reimagined these technology UBI schemes through the eyes of the rent models discussed above? The first thing we would have to do is establish ownership. Van Parijs and Vandenbroucke gently hint at this by claiming that today, we have come into a "technological inheritance" (Van Parijs, 1991; Vandenbroucke, 2017). Van Parijs (1991) rightly concludes, however, that in developed societies, most of the technology we use is freely available to all, so, "it would then be pointless to embark on the arduous task of estimating their (counter-factual) competitive value, since they are already given equally to all" (p. 119). While we have inherited technology, which implies some type of ownership, patents do not make this ownership straightforward, and even if it were, it would still be impossible to receive rent on what is already free to everyone.

There is, however, a less obvious resource that we indisputably own and which is used by tech companies to make billions: our data. A wide range of companies use digital tracking and profiling to show consumers customized and targeted ads that make companies a fortune. These digital profiles, which are based on consumers' offline purchases and online behavior, are also used for more ominous purposes, like estimating individuals' credit scores, determining the prices they are offered for online products, tailoring political ads with personalized messaging based on internet activity and selling data profiles to other advertising firms as well as Facebook

and Google (Christl, 2017). The situation mirrors that which Paine wrote about in 1797: people have property being harvested by others to advance society, make money, and disenfranchise the common man, who is not being compensated.

This is essentially the stance taken by Brittany Kaiser, a former director at Cambridge Analytica who coined the hashtag #OwnYourData. While Kaiser argues that the way in which our data are handled is an invasion of privacy, it is also unfair in terms of the role our data, as our property, is playing in money making by the tech industry. Kaiser (n.d.) reports, "They find out what we buy, what we do online, how we live our lives offline. Then they use our own data to sell to us - from pharmaceuticals to political campaigns. We're just now realizing the bad news: we're the product they're selling." Of course, we are not charging anyone to farm our data – we are giving it away, and tech companies claim that by giving away our data, we are consenting to having it used in any way they please. Our IP addresses give websites information about our specific browsing behavior and even location, which they can use to then sell to advertising firms. These advertising companies can also track our web history through browser cookies, helping them build more personalized content. This 'free data' is different from the free technology discussed by Van Parijs, because, I am willing to bet, most people (by design) have no idea how valuable their data is, or how much tech companies would be willing to pay for it. The market for data is not fully informed, and if it were, its sellers would try for, and get, a higher price. Data royalties, which come in many forms, including as percentage payments of revenue derived from a patented product, have generally been the proposed mechanism of compensation. However, tracking one's data and knowing when it is used would be impossible within the internet's seemingly infinite expanse, most of which is unregulated (Alvarez, 2018). Rent, on the other hand, skirts this issue as it is paid periodically, independent of the product's derived revenue or how many times it is used. As such, the distribution of a data rent would essentially be a UBI: a uniform value distributed to every citizen above a certain age in regular time intervals.

Critics would say that it is difficult to conceive of a world where such a rent is implemented, that is a world where the legal and practical structures necessary to mandate companies like Facebook, Amazon and Google to pay its billions of users are in place. Considering today's lack of data privacy regulation in the US, politicians and tech companies seem a long way from ever agreeing to such a deal. Then again, there is reason to believe that politicians and law-makers around the world are now waking up to the last decade's escalating data mistreatment. In May 2018, the European Union (EU) implemented the General Data Protection Regulation (GDPR), which requires that users fully understand and consent to collection of their data. Additionally, users must be able to request their data profile from companies and retract consent at will (Tiku, 2018). While GDPR is aimed to protect EU citizens, its effects are more widespread, requiring systemic changes in companies' policy and protocol that will ultimately benefit users everywhere. American politicians are also showing more interest in the matter, which was displayed when American media design professor David Carroll began fighting to recover his data from Cambridge Analytica in 2018. In his support, both Democratic and Republican senators wrote to Senate judiciary committee chair Chuck Grassley to request that tech CEOs formally answer to accusations of data misuse (Helmore, 2018). In 2018, the US Congress also called in Mark Zuckerberg to testify about Facebook's privacy and data regulations and the company's connection to Cambridge Analytica (Watson, 2018). Assuming this trend in political attention continues, it will not be unthinkable that American politicians, in the near future, may make enforceable decisions about how to keep its citizens' data and privacy protected. When that day comes, deciding to implement a UBI funded through data rents does not sound as outlandish. Such a UBI would present a rights-based foundation with subsequent clarity about why the UBI should exist, where the money should come from and how the amount of money to be distributed is determined. For the UBI to indeed be universal, it would be assumed that all adults have an online presence, and the eligible age to receive the rent may well be earlier than conventional 'adulthood', taking into consideration a country's average age of first internet use. Market-determined prices for personal data could then conceivably be collected from companies using and selling personal data and redistributed to citizens through a state fund. Having this state presence as an intermediary would ideally help hold companies accountable, ensuring that they pay what personal data providers are owed.

Whether a UBI should come into existence depends on the underlying values and mechanisms of the particular UBI scheme proposed. I have shown that for UBIs aimed at assisting in adjustments to labor-saving technology, current proposals made popular by tech elites and the data rent-based proposal inspired by Thomas Paine argued in this

paper, are founded on extremely different values. Although both schemes result in everyone receiving a payment, their differing values beget contrasting implications for UBI recipients in terms of ownership, freedom and fairness, which have been illustrated in the exploitative, pro-inequality, cut-of-revenue schemes currently suggested and piloted in Silicon Valley. Depending on the eventual severity of impact that new technology and automation will have on the labor market, the data rent UBI proposed here may not be enough. It is, however, a philosophically sound way to ensure that people own their means of production, receiving a UBI funded according to competitive market prices; not out of charity, but as fair compensation.

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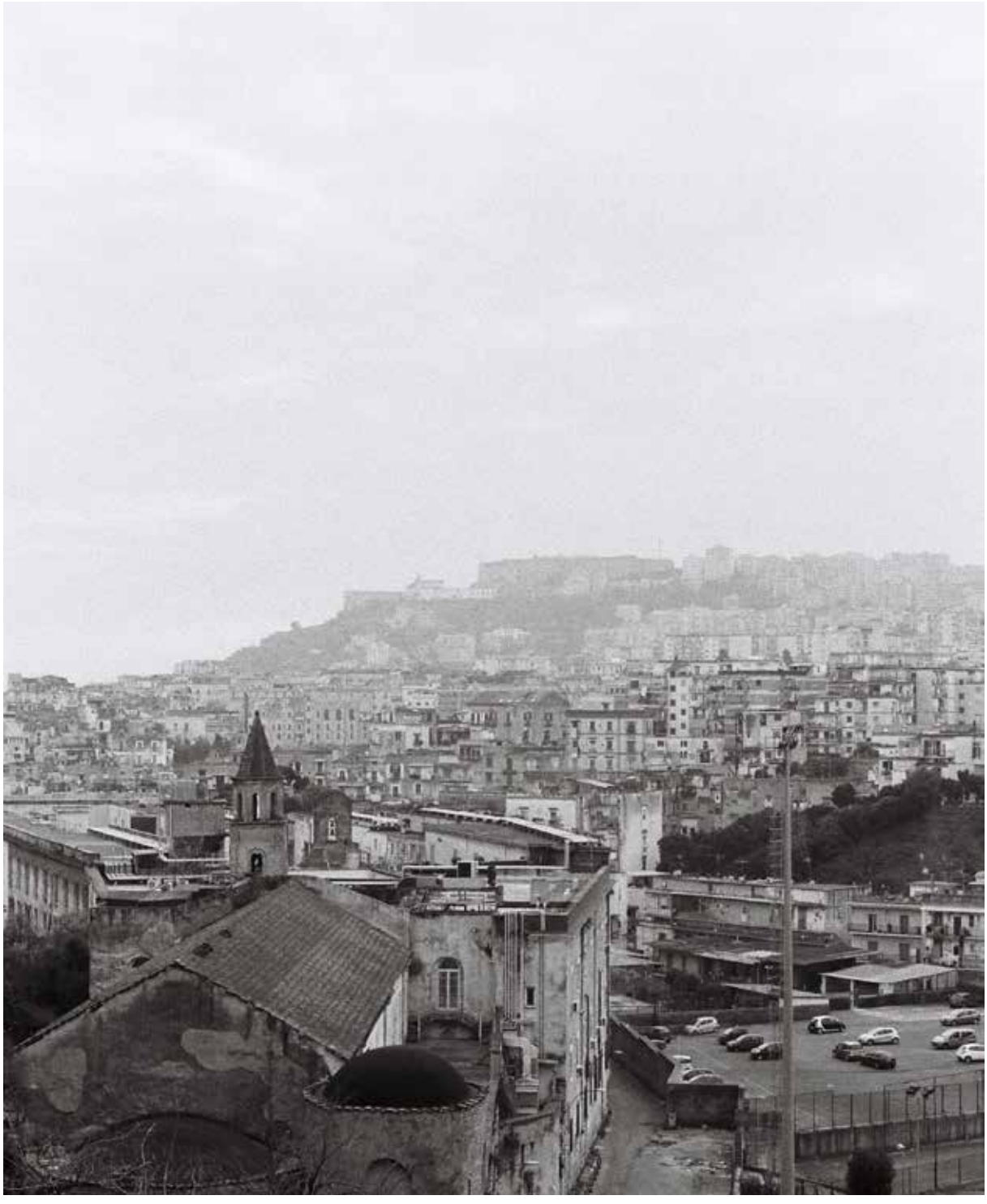

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Duties of an oil rich nation the case of Norway and climate finance

Marie Tangen Olafsen

This article discusses Norway's duties in meeting the goals of the UNFCCC Paris Agreement based on its history as a producer and exporter of oil and gas. It focuses on climate finance, which is provided by developed countries to support developing countries in reducing emissions and adapting to the consequences of climate change. Today's finance is biased towards emissions reductions, ie. mitigation, while the Paris Agreement suggests a balance between funding to mitigation and adaptation (Decision 1/CP.21, 2015, Article 9.4). The article takes a cosmopolitan standpoint by arguing that states have moral obligations outside their borders. When discussing moral obligations in relation to climate change, the focus is on the global relationship, i.e. what we all do to each other. Although it is possible to identify the biggest contributors, climate change is a unique issue in the sense that everyone contributes to it. The question is rather on what scale this contribution is and therefore give states a common but differentiated responsibility (Decision 1/CP.21, 2015). This global aspect of climate change also makes it challenging to distribute duties of mitigation and climate finance between states, as the causal links are diffuse and impossible to identify specifically. For example, it is not possible to point out one state's emissions as the cause of a specific climate-related impact in another state. Concepts like historical responsibility and climate justice try to solve this issue by suggesting how these duties can be distributed in an equitable way.

By asking the question *What duties do Norway have towards international climate finance?*, this article sheds light on the global trend of a mitigation bias in climate finance. This bias is present, too, in Norway's contribution to international climate finance, which means that projects that mitigate emissions are favoured over ones that help people adapt to the consequences of climate change. To answer the question, the article first presents the theoretical framework. It will then explain further the concept of climate finance and the mitigation bias, climate justice, and Norway's historical responsibility. The discussion is rounded off with a look at Norway's duties through a cosmopolitan lense.

Normative ethical theory in International Relations

The theoretical framework of this paper is based on a normative approach to international relations (IR): a theoretical approach that is interested in what states should do, rather than what they actually do. It therefore also prioritizes concepts like *duties* and *responsibility* (Shapcott, 2017, p. 205). The development of normative theory in IR started as a response to the insufficient attention that has traditionally been given to normative and moral issues within mainstream theories like realism (Frost, 1994). As Frost (1994, p. 110) argues, engaging in normative theory means trying to explain the meaning of a range of normative concepts like *equality, justice*, and *human rights*. Further, when we apply a normative ethical approach to IR, the focus lies on the transboundary duties of states and how they should treat those within and beyond their borders (Shapcott, 2017, p. 205).

Closely linked to the concept of states' responsibilities is globalization, which has increased the interconnection between states (Shapcott, 2017). This interconnection results in a higher possibility of states affecting each other, which intensifies the ethical dilemmas that are important within a normative approach (Shapcott, 2017). In a globalized world where no universal definition of justice among states exist, questions on what principles should rule often arise (Shapcott, 2017, p. 206). The latter part of my discussion will show how these questions closely relate to the case of international climate finance.

Is morality universal or particular?

In a normative approach to international ethics an important distinction exists between cosmopolitanism

Lion Parliament: Riche Rwahim Latiff

and communitarianism (Shapcott, 2017, p. 207). This revolves mainly around the questions of whom states have a moral obligation to, and distinguishing whether morality is universal or particular, ie. whether it applies to everyone or some particular groups. As mentioned in the introduction, this article takes a cosmopolitan standpoint and argues that states have a moral obligation outside their boundaries. However, I will also briefly introduce the communitarian approach so the reader is aware of the several possible explanations and answers to the question of climate finance.

Communitarians argue that morality is derived from specific communities and is therefore particular rather than universal (Shapcott, 2017, p. 207). A central argument within a communitarian approach to international relations is that all states have territorial integrity and political sovereignty (Walzer, 1980). This means that the individual state is responsible for what happens within its own borders, and that intervention by other states would be a serious breach of the state's and citizens' rights (Walzer, 1980, p. 214). Communitarians therefore argue that morality is particular to the state's own citizens. This approach has been criticized for being statist, and for placing the rights of states above the rights of individuals (Doppelt, 1978).

In cosmopolitanist morality, on the other hand, universal and moral codes apply to everyone (Shapcott, 2017). This entails that in a cosmopolitan understanding, individuals, and not states, are the ultimate subjects of morality (Beitz, 1979, p. 409). The theory "…denies the existence of state centered distributive responsibilities that are generally strong enough to override global obligations." (Beitz, 1979, p. 421). A weakness of the approach is that it does not define any principles of international distributive justice (Beitz, 1979, p. 409). Being decisive about the insignificant role of state boundaries, the approach rather assigns states different duties to eliminate global injustice.

Duties

Central to cosmopolitanism is the distinction between positive and negative duties. These can be seen as responsibilities given to states to make sure that morality stays universal. Positive duties mean duties to act, for example the doctrine of the responsibility to protect (Shapcott, 2017, p. 208). It includes assistance, like humanitarian aid or climate finance. These duties require states to take action when others are in need of help regardless of causal responsibilities. In contrast, a negative duty refers to stopping or avoiding doing something that unnecessarily harms others (Shapcott, 2017, p. 208).

A central problem arises here because good intentions can sometimes create harmful consequences that the actor did not have the knowledge about before the act was implemented. Did the actor then violate its negative duty? Negative duties are further problematic as they involve distributing responsibility between actors. Sometimes one can clearly identify the actor who is responsible for causing harm, while in other situations the effects are more diffuse or involve several actors (Shapcott, 2017, p. 208). In relation to climate change, mitigation is a good example of a negative duty. My analysis will also discuss how climate finance can be used by states to fulfil their negative duties.

Justice and climate finance

As mentioned in the introduction, I have chosen Norway's climate finance as my case. I will first introduce the concept of climate justice. With the help of this concept I will discuss Norway's duties towards climate finance. I will also explain what international climate finance is and what a mitigation bias entails, before I present the specific case of Norway.

Climate justice and historical responsibilities

The term climate justice has no official definition but it addresses the unequal burdens and responsibilities to address climate change. Part of the general knowledge on climate change is that today's rich industrialized countries have over time contributed most to global warming due to their early industrialization. This means that these countries have emitted more greenhouse gases historically than developing countries have. I will later argue that Norway, as a producer and exporter of oil and gas, has a historical responsibility of addressing climate change and supporting other countries in doing the same. By historical responsibility I mean that a country which has emitted high levels of greenhouse gases in the past has more duties towards reaching the goals of the Paris Agreement than a developing country that has not contributed as much historically. The unequal burdens within climate change are further illustrated by developing countries experiencing the worst consequences of climate change and therefore being even more vulnerable than developed countries.

When states acknowledge the unequal burdens of climate change, several actions can be taken to eliminate the injustice. First, industrialized, developed nations can increase their ambitions when it comes to domestic mitigation goals. These goals must be increased to make sure that we are able to meet the 1.5-degree goal of the Paris Agreement. Secondly, industrialized nations can bear the brunt of the costs of climate change by transferring funding to poorer nations (Shue, 2014, p. 28). One way this is done today is through a system of international

climate finance, which is supposed to help developing countries to be more resilient to climate change, as well as to support them in the shift to using green energy. Climate justice therefore clearly refers to the costs of alleviating climate harm and how these costs can be distributed fairly (Duus-Otterström & Jagers, 2012, p. 747). In summary, climate justice can be understood as a situation where the countries that are most responsible for climate change take the biggest cost of its harm and by doing so, removing the unequal distribution of vulnerability between countries caused by climate change today.

Climate finance and the mitigation bias

Climate finance can be described as a type of aid that is oriented towards stopping further emissions and alleviating the unavoidable consequences of climate change. In this sense, it presents aspects of both the positive and negative duties described by cosmopolitanism. Article 9 of the Paris Agreement defines climate finance as "...financial resources to assist developing country Parties with respect to both mitigation and adaptation…" (Decision 1/CP.21, 2015). Further, this "shall" be provided by developed country Parties (Decision 1/CP.21, 2015). The Paris Agreement further establishes that there should be a balance between finance to mitigation and adaptation (Decision 1/CP.21, 2015, Article 9.3). Mitigation is herein defined as "...a human intervention to reduce the sources or enhance the sinks of greenhouse gases" (IPCC, 2014a, p. 4), while adaptation refers to "the process of adjustment to actual or expected climate and its effects" (IPCC, 2014b, p. 5). Although these official definitions exist, it is difficult to determine current climate finance accurately. This lies in the fact that the terms mitigation and adaptation are not mutually exclusive, which means that an investment implemented as part of an adaptation strategy might also be defined as mitigation (Abadie, Galarraga & Rübbelke, 2013, p. 445).

Internationally, we find states prioritizing funding to mitigation over adaptation, thus creating a significant mitigation bias in climate finance. Buchner, Falconer, Herve-Mignucci, Trabacchi & Brinkman (2011) identify a split between finance to mitigation and adaptation of 95:5. Although the Paris Agreement does not establish what the desired balance between mitigation and adaptation finance is specifically, one can argue that this split of 95:5 does not reflect a balance in any sense. Abadie et al. (2013) identify several reasons for this international bias towards mitigation financing. These include among others better perspectives for private funds in mitigation projects, government'os interest in supporting projects abroad, that cheap mitigation options in developing countries can reduce domestic costs of mitigation, and that mitigation today saves adaptation cost in the future (Abadie et al., 2013, pp. 945-947). Some of these reasons have moral justifications,.

The case of Norway

In 1969 what is popularly called the "Norwegian oil adventure" began. Since then, the Norwegian petroleum industry has grown substantially and provided Norway with the resources to build a stable welfare state for its citizens. In 2017, the export value of Norwegian petroleum products was 442 billion NOK, amounting to almost half of the total goods exported that year (Olje- og Energidepartementet, 2019). It is clear that the petroleum industry has had and still has an important economic value for Norway, but it also gives Norway historical responsibility for climate change. Not only is Norway's emissions per capita almost double the global average (Energi og klima, 2019), but the export of oil and gas also contributes to emissions abroad, both historically and today. Seeing that Norway has signed the Paris Agreement and agreed to its principles and commitments, Norway has a duty to address climate change.

The international mitigation bias is present in Norway's funding to international climate finance. A recent report signed by several Norwegian NGOs show that of the finance provided by Norway in the period of 2010-2016, to cross-cutting projects (Appelt & Dejgaard, 2017, p. 10). This trend stems from the major focus on deforestation projects found in Norwegian official development aid (ODA), as well as support to renewable energy projects (Appelt & Dejgaard, 2017, p. 10). The deforestation projects, such as REDD+, count as mitigation. Norway's focus on large forest projects also impacts which countries receive the majority of climate finance. Indeed, the same report revealed that the majority of funding goes to middle income countries (MIC) like Brazil, where Norway has several interests in terms of rainforest projects (Appelt & Dejgaard, 2017, p. 57). The report further calculates that only 27 % of climate finance from Norway went to least developed countries (LDC) in the period 2010-2015 (Appelt & Dejgaard, 2017, p. 57).

A second report written by Stockholm Environment Institute discusses Norway's fair share in meeting the Paris Agreement (Kartha, Holz & Athanasiou, 2018). It highlights how current ambitions are neither adequate in terms of domestic mitigation nor international climate finance to reflect Norway's real historical responsibility (Kartha et al., 2018). This report states

that Norway should in fact provide 65 billion NOK to international climate finance annually, and that 15 of these should be directed towards adaptation (Kartha et al., 2018, p. 7). This is not, however, reflected in Norway's state budget for 2020, which only provides around 7 billion NOK to international climate finance. This is divided between the budgets of the Ministry of Climate and Environment and the Ministry of Foreign Affairs. The Ministry of Climate and Environment receives around half of the share, which is possibly due to the forest initiatives that are governed by this department (Prop. 1 S., 2019a). Funding for adaptation however would rather fall under the responsibility of the Ministry of Foreign Affairs. The share provided to the Ministry of Foreign Affairs is further split between funding to renewable energy, sustainable oceans and environment and climate, thus leaving a smaller share to adaptation (Prop. 1 S., 2019b).

Discussion: Moral justifications for Norway's current contribution

As the results from the reports presented previously show, Norway's current contribution to international climate finance does not reflect the historical responsibility that being an oil-rich nation entails. Before I go into what duties Norway has and should fulfil according to a cosmopolitan standpoint, I will briefly discuss some moral explanations or justifications for the current distribution of climate finance. Burden-sharing of climate duties is a complicated issue, and although I have chosen to take some normative standpoints to this issue, I find it important to not discard the possibility that some alternative moral or ethical considerations are present in Norway's current contribution to climate finance.

One explanation is that since mitigation has global effects, Norway contributes to the common good by providing most funding to mitigation. As Buchner et al. (2011, p. 7) argue, it makes sense to invest in mitigation while the irreversible changes of climate change are still possible to avoid, and to focus on costly adaptation measures when those changes are truly unavoidable. Further, it has also been identified that early adaptation measures that reduce the vulnerability of developing countries also reduce these countries' willingness to implement mitigation efforts (Abadie et al., 2013). This can lead to a contradiction of the common good that mitigation contributes to in terms of climate change. On the other hand, many LDCs are already highly vulnerable and in need of assistance to adapt to severe impacts caused by climate change (Appelt & Dejgaard, 2017, p. 57). Therefore, from a cosmopolitan standpoint, such a mitigation bias can still be said to go against the moral duties that Norway has.

Another explanation of why Norway's current contribution already reflects morality is more in line with a communitarian approach to ethics. Mitigation actions abroad have positive impacts on Norway, while the effects of adaptation are mainly local (Abadie et al., 2013, p. 946). It can therefore be argued that from a communitarian stance, Norway is fulfilling its moral duty towards its own citizens by focusing on mitigation strategies abroad. It not only benefits Norway because it limits the impacts of climate change, but also because it allows Norway to continue its domestic industrial and economic activities as before. This is made possible through mechanisms like the Clean Development Mechanisms, where big polluters can substitute expensive domestic emissions reductions with cheaper ones done in developing countries (Abadie et al., 2013, p. 946). This strategy can be called indirect mitigation (Duus-Otterström & Jagers, 2012, p. 749). Norway is doing this through, for example, its support to forest projects abroad, which allows it in exchange to continue its domestic extraction of fossil fuels. This again has causal implications for climate change, and a cosmopolitan critique would argue that Norway is focusing only on self-interest and not the common good.

Cosmopolitan duties of an oil rich nation

The discussion of climate change is part of the literature on global justice, which has been focused around what we owe others (Duus-Otterström & Jagers, 2012, p. 748). In normative theory, this is called positive duties. Cosmopolitans would argue that positive duties are global, meaning that we all owe the same concern to persons no matter where they live (Duus-Otterström & Jagers, 2012, p. 748). Positive duties are usually not based on previous wrongdoings, which means that the problem with distributing causal responsibility is not present here. Positive duties should rather be defined by a state's capacity to assist others without itself suffering any significant losses. This is for example evident in official development aid, where developed countries support developing countries. This typology is also present in terms of climate finance, since the Paris Agreement establishes that this funding should be provided by developed countries to developing countries (Decision 1/CP.21, 2015).

Negative duties, on the other hand, are also central in the climate change debate. Concepts such as 'common but differentiated responsibilities' and 'historical responsibility' implies that those who have a high causal contribution should take the burden (Duus-Otterström & Jagers, 2012). This identification of causal responsibilities is, as mentioned previously, what makes negative duties problematic to distribute.

In terms of climate change, an obvious negative duty is to reduce emissions, as we already know what harms they cause. In addition, funding to adaptation can be argued to belong in the group of negative duties. Although climate adaptation finance involves the act of providing funding, the measures are oriented towards alleviating harm caused by historical emissions. In this sense, countries with a historical responsibility like Norway can avoid doing harm by making sure that vulnerable countries are able to adapt and thereby prevent them from experiencing the harmful impacts of climate change.

It is important to acknowledge that even though negative climate duties are most often ascribed to those who have historical responsibility, one should not exclude so-called "new" polluters. These are countries who have not emitted large amounts of greenhouse gases, but who are doing so now. China is an example of such a country. These countries also have a negative duty to reduce emissions, as they can cause more harm in the future. Duus-Otterström and Jagers (2012) argue that positive duties are general, while negative duties are special, meaning negative duties apply to some actors, while the positive duties apply to all who can shoulder them.

Norway's position as an oil-rich nation involves a historical responsibility for climate change, if we acknowledge that Norway has a causal responsibility for the impacts we experience today and in the future. By emitting excessive amounts of greenhouse gases that have global effects, Norway has violated its negative duty of not causing harm to others. By taking measures like direct and indirect mitigation, as well as compensatory adaptation, Norway can make up for this violation (Duus-Otterström & Jagers, 2012, p. 749).

As climate finance is a type of aid given by developed countries, it is most obvious to place it within what cosmopolitanism describes as positive duties, but since it can also be used to undo harm it should also be considered a negative duty. A normative issue regarding negative duties for climate change is that most of the emissions that are blamed for climate change today took place before we had knowledge of what consequences they create (Duus-Otterström & Jagers, 2012, p. 750). It can therefore be argued that it is morally wrong to distribute duties based on harm that states did not know they would cause. However, if Norway (and other developed countries) decided to ignore the consequences that previous wrongdoings are creating, then this would act against the principle of climate justice, which requires the biggest contributors to take their historical responsibility.

Categorizing climate finance as a positive duty further means that it applies to all who can shoulder it (Duus-Otterström & Jagers, 2012, p. 747). Climate change is expected to cause dire need, and from a moral perspective all states have the duty to help those who will experience this. In terms of climate justice, these duties should be taken mainly by those who are most responsible. Duus-Otterström and Jagers (2012) call this altruistic adaptation. It can be compared with normal aid, and states therefore have this duty because of their ability to help without unreasonable sacrifice (Duus-Otterström & Jagers, 2012, p. 751). Although Norway is a small country in size and population, it is in a unique situation in terms of economic development and welfare. This is illustrated by Norway often appearing at the top of the UN Human Development Index (United Nations Development Programme, n.d.). Being in this situation, Norway has the capacity to shoulder positive climate duties like financing adaptation in vulnerable areas. The mitigation bias found in Norway's climate finance is therefore a problem of both morality and justice, as it means that Norway is also violating its positive climate duties.

Duus-Otterström and Jagers (2012) identify compensatory adaptation also as a negative duty that applies to countries with a historical responsibility. Compensatory adaptation is described as preventing harm by helping others to adapt to the effects of climate change (Duus-Otterström & Jagers, 2012, p. 749). This applies to Norway because of the history it has as a polluter (Duus-Otterström & Jagers, 2012), and represents the duty Norway has to provide funding for climate adaptation finance. Currently, only a small portion of Norway's climate finance goes to adaptation, which does not reflect Norway's fair share (Appelt & Dejgaard, 2017; Kartha et al., 2018). Norway is therefore only partly fulfilling its negative duty to prevent harm through adaptation.

Part of Norway's negative duties towards climate finance is also direct and indirect mitigation. Direct mitigation refers to domestic emissions reductions, while indirect mitigation is the act of offsetting own emissions (Duus-Otterström & Jagers, 2012, p. 749). Norway's climate finance currently is largely oriented towards indirect mitigation (Appelt & Dejgaard, 2017). Duus-Otterström and Jagers (2012) identify this as one of the strategies responsible countries can take towards undoing the harm of historical emissions. On the other hand, embedded in the Paris Agreement is the aim for climate finance to have a balance between mitigation and adaptation. This is largely to make sure that international climate finance respects the vulnerability some countries

experience due to climate change (Appelt & Dejgaard, 2017, p. 57). However, as I previously discussed, several incentives exist for Norway to favor indirect mitigation in terms of economic self-interest. By offsetting own emissions by funding mitigation abroad, Norway is both fulfilling and violating its negative duty. Violating it because it allows for business-as-usual in domestic mitigation policies and fulfilling it because it involves emissions reductions that do have important global effects.

Conclusion

A normative discussion usually entails a focus on what states "should" do, rather than what they actually do. In this paper I have tried to combine the two by underlying my discussion of Norway's duties with research on the actual contribution and responsibility of Norway. By doing this I have been able to identify some moral explanations of Norway's current contribution to climate finance, but also that there exist several contradictions in terms of Norway's actual responsibility. One of these contradictions is that Norway favors mitigation in its funding to international climate finance, while it clearly has a responsibility to also qcontribute to adaptation. I have also discussed how Norway's position as an oil-rich nation brings several global responsibilities, both in terms of positive and negative duties. My analysis was rounded off with a reflection on what Norway ought to do in light of climate justice. As a consequence of arguing from a cosmopolitan lense, this article does not present the whole and only truth. The answers to moral questions are not objective, but depend on the lense you use to see the world.

This paper aimed to answer the research question; *What duties do Norway have towards international climate finance?* The previous discussion identified that being an oil-rich nation places several negative duties on Norway in terms of undoing harm caused by past emissions, but also that as a developed country Norway has a moral responsibility to fulfil its positive duty by taking action when others are in need. Since climate change represents a global relationship, it means that Norway has duties past its own territorial borders. These duties are as we have seen difficult to distribute, but we also know that fair burden sharing is necessary for climate justice. This burden sharing should be based on both states' causal contribution and ability to assist (Duus-Otterström & Jagers, 2012, p. 751).

Photo: Sven Emil Hinderaker

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