



Impact of COVID-19 pandemic on biodiversity conservation in the Israeli occupied West Bank, Palestine

Mazin B. Qumsiyeh* e Mohammad Abusarhan*

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1. Introduction

The recent pandemic of COVID-19 which is far worse than anything we humans dealt with since the 1917-1918 flu caused massive human suffering but presumably led to less human impact on the environment (Corlett *et al.*, 2020: 3; March *et al.*, 2021: 2; Pinder *et al.*, 2020: 1061; Sharma *et al.*, 2020: 1; Saadat *et al.*, 2020: 5). In fact, this is one of the largest involuntary human confinement in history with massive repercussions for biodiversity (Bates *et al.*, 2020: 4). The initial published data point to a mixed effect on environmental conservation. These recent studies were not focused on developing countries like Palestine. Herein we look at COVID-19 impact in Palestine (the geographic area which is now Israel and the Occupied Palestinian Territories). Another question to address is whether we are locally and globally learning from this pandemic to alter our destructive behavior that has been ongoing since the industrial revolution and that lead to climate change and massive destruction of biodiversity. Have we for example learned anything from the fact that high pollution rates makes the population more vulnerable to pandemics (Zheng *et al.*, 2020: 1) or that pandemics seem to arise more frequently due to human impact on the environment resulting in contact with wildlife and zoonotic diseases like COVID-19 (Everard *et al.*, 2020: 9; Khetan, 2020: 1; Shreedhar & Mourato, 2020: 963).

In some parts of the world, there were unexpected environmental impacts of the pandemic of COVID-19. For example, satellite imagery shows an increase in the Amazon forest fires after lockdown (Amador-Jiménez *et al.*, 2020: 1081). Other environmental challenges imposed by COVID-19 include the large-scale production of face masks (Fadare & Okoffo, 2020: 2) and the disruption of plastic reduction efforts (Silva *et al.*, 2020: 5). Another example is that increase in visitation to public parks and green spaces was noted to increase in some areas and decrease in others with differing effects on wildlife in those areas (Rutz *et al.*, 2020: 4). The consensus of the earlier studies show that pandemics and lockdowns have more complex relation to environmental conservation and that more data are needed especially with regard to charting post-pandemic societal responses. This

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* Palestine Institute for Biodiversity and Sustainability, Bethlehem University, Bethlehem, Palestine.

initial study in Palestine is intended to be a first step in addressing some of these challenges in a developing country under colonial occupation.

The first COVID-19 local cases were reported in the Palestinian areas on March 4th 2020 (brought in by a group of tourists to Bethlehem). Lockdown was immediately announced locally but then expanded to all the West Bank and Gaza. Lockdown/shelter-in-place rules were relaxed briefly (2-4 weeks in May) to then see a new wave of infections and subsequent new lockdowns (Ilustração 01). We looked at impact on biodiversity over a five month period (March to August) by surveying the views of biodiversity experts (29 individuals) in the area (including from the Environment Quality Authority).

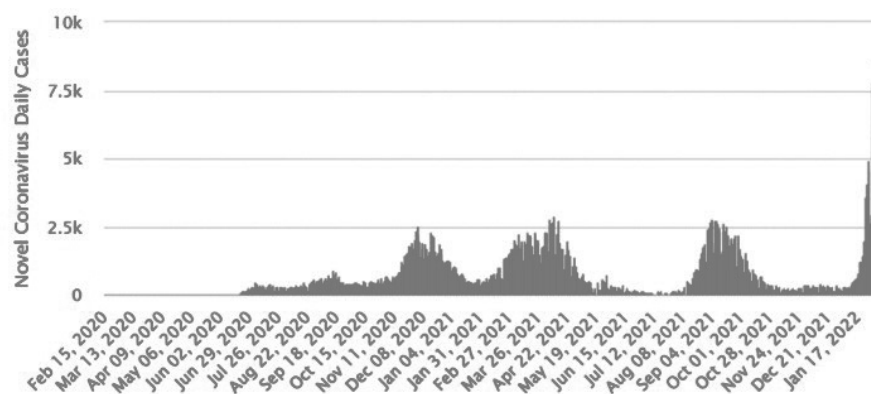


Ilustração 01 – Palestinian COVID-19 daily cases. Retrieved on 4 Feb 2022.¹

As a land considered holy by religions (Islam, Christianity, Judaism, Bahai), Palestine received nearly 2 million tourists in the first half of 2019 and was expected to increase significantly by 2020 (Palestine Central Bureau of Statistics and Ministry of tourism²). However, tourism came to a halt 4 March 2020 when the first COVID-19 cases were reported (from a tourist delegation) and the government ordered all tourism to be halted.

2. Methods

We sent a survey to 65 individuals who were selected because they directly work either in research or education about wildlife/biodiversity in our area and thus are expected to be familiar with the situation. Questions were asked about the effect of the COVID-19 pandemic on unintended fires, overgrazing, illegal hunting of wildlife, cutting woods in forests and protected areas, dumping of solid and liquid wastes, non-renewable energy usage (fossil fuels, electricity from company), conservation efforts generally, and their own environmental activities. They were also asked if they have ideas going forward on how best we can protect the environment in a post COVID-19 world. We also initiated a survey of a particular popular ecotour path of Al-Makhrour Valley (Gola *et al.*, 2010:

¹ [Online]. [Consult. 21.March.2022]. Available at: <https://www.worldometers.info/coronavirus/>.

² [Online]. [Consult. 21.March.2022]. Available at: <http://www.pcbs.gov.ps/site/512/default.aspx>.

62). This is an ecotourism path surrounded by the communities of Beit Jala, Battir, Husan, Al-Khader, and Al-Walaja. The area is a UNESCO world heritage site (MoTA, 2013). More than 12,000 visitors walked the path in 2019 (our own data). We have compared the amount of trash in the valley in April and May 2019 with that noticed in the same season 2020. We also looked at *atobservations.org* and *inaturalist.org* to assess any changes before and during the pandemic in Palestinian data entered at, posted in portals intended for amateur naturalists.

3. Results and Discussion

The results came back from 30 individuals who filled out the survey (Tabela 01).

Tabela 01 – Questionnaire data from 30 expert Palestinian respondents

Question	Increase	Decrease	No effect	Don't Know	Total
COVID-19 effect on unintended fires	16.7 %	33.3 %	23.3 %	26.7 %	100 %
COVID-19 effect on overgrazing	53.3 %	13.3 %	23.3 %	10 %	100 %
COVID-19 effect on illegal hunting of wildlife	63.3 %	20 %	6.7 %	10 %	100 %
COVID-19 effect on cutting woods in forests and protected areas	40 %	26.7 %	20 %	13.3 %	100 %
COVID-19 effect on non-renewable energy usage (fossil fuels, electricity from company) in Palestine	50 %	30 %	10 %	10 %	100 %
COVID-19 effect on dumping of solid wastes	53.3 %	33.3 %	3.3 %	10 %	100 %
COVID-19 effect on dumping of liquid waste (sewage)	46.7 %	16.7 %	26.7 %	10 %	100 %
COVID-19 effect on own conservation and environmental protection activities	43.3 %	46.7 %	3.3 %	6.7 %	100 %

COVID-19 effect on funding for projects related to biodiversity	20 %	63.3 %	10 %	6.7 %	100 %
COVID-19 effect on awareness of importance of mitigating of climate change	60 %	30 %	10 %		100 %
	Positive effect	Negative effect	No effect		
COVID-19 effect on your own projects this year	6.7 %	76.7 %	16.7 %		100 %

A set of questions produced no clear-cut answer on the impact of the pandemic while others clearly had a significant majority one way or the other. The ambivalent ones included pandemic's effect on unintended fires (16.7 % increase, 33.3 % decrease, 26.7 % don't know), logging in forests and protected areas (40 % increase, 26.7 % decrease, 13.3 % don't know). Answers that were more emphatic showed respondents felt COVID-19 pandemic increased dumping of solid waste (53.3 % vs 33.3 %), of liquid waste (46.7 %), overgrazing (53.3 %), hunting (63.3 %), non-renewable energy use (50 %), and awareness of issues around climate change (60 %). Some (43.3 %) believed the pandemic in our area increased conservation activities while 46.7 % thought it decreased it. 63.3 % thought this pandemic decreased funding for environmental work while only 20 % thought it increased it. The largest margin was obtained for the question on impact on their own work where 76.7 % said that it had a negative impact (decreasing their work for biodiversity). Further, it was noted that there is a significant increase in personal protective items like masks and gloves both in Palestine and elsewhere (Al-Talalfeh & Al-Monawer, 2020: 1; Silva *et al.*, 2020: 5). These were not expected findings considering the projections of positive impact from reduced air travel and other travels (Cheval *et al.*, 2020: 18). Overall, if we can generalize from this survey is that in Palestine, the impact of the pandemic was not necessarily positive for biodiversity.

There was also one open-ended question: Do you have any ideas going forward on how best we can protect the environment in a post COVID-19 world? Some of the most relevant answers were:

- Raising the Awareness of the Public and the policy and decision maker about the important of Ecosystem services and protection of nature.
- More collaboration with local, regional, and international institutes and organizations.
- Local COVID-19 response plans should follow those made by FAO, WFP, UNEP, World Bank, WHO, OCHA, among others.
- More organic and eco-friendly local food production... this also helps increase human immunity...programs to promote home gardening.

Despite the lockdown, the amount of solid waste was higher (estimated this year at over 3 tons) compared to the similar period (March to June) last year. One possible explana-

tion is that while there was a significant decrease in organized tour groups, individuals from the nearby communities did a lot of recreation activities without the benefit of tour guides (who are trained to give instructions on trash issues).

According to *observation.org* in 2019 Palestine had 581 records while in 2020 only 204 records were incorporated in this database. By contrast *naturalist.org* data continued to grow from 218 in 2018 to 1127 in 2019 and to 1505 in 2020. For both websites, the data from other countries indicated a slowdown in growth rate of entries between 2018 to 2020. This indicated less people going out and recording species presence. Those individuals are usually ones interested in environmental conservation.

The Palestine Institute for Biodiversity and Sustainability at Bethlehem University is engaged in a number of conservation efforts (see palestinenature.org/conservation). It is the largest group engaged in biodiversity and conservation and was recently selected to produce the 6th National report for the Convention on Biological Diversity (CBD) and the National Biodiversity Strategy and Action Plan (NBSAP) updating the one produced in 1999. Since 4 March 2020, our institute has had to struggle to do its research, education and conservation efforts. Research efforts were hampered by movement restrictions that limited our ability to reach field locations (research output was maintained but was dependent on existing data). Reported to us through the survey was that the pandemic lockdown impacted negatively many of the NGOs working on environmental conservation. Indeed, our own educational efforts were heavily impacted as the pandemic halted the visits to the botanical garden and the Palestine Museum of Natural History. We adapted by creating virtual tours and posting material to social media. Conservation efforts (dependent on research and education) were also affected. For example, basic monitoring of environment changes were reduced due to reduced mobilities. In few instances we were able to go to protected areas despite mobility lockdowns in Palestinian cities and restrictions imposed by the Israeli occupation forces. What we noted with these data gathering trips was disturbing in that solid and liquid waste disposal was the same as before the pandemic and in a couple of places (Al-Makhrou valley, Wadi Qana, and Wadi Zarqa Al-Ulwi) trash dumping has actually increased during lockdowns. The explanation from local stakeholders is that people can't get to their jobs so are more inclined to go to parks and protected areas. We may add that enforcement mechanisms became more lax.

A significant success in conservation efforts engaged in during the pandemic was increase in interest in local food production. In all communities, the lockdown allowed residents to plant things in their gardens and tend to existing plants in ways that increased their food production (in April alone we noted over 900 posts related to agriculture in the Facebook timeline connected to the museum compared to less than 50 in one month before the pandemic). In agricultural fields near people residences there was also an increase in food production. For example, we had a project funded by the Darwin Initiative to encourage eco-friendly agriculture in four marginalized communities (Al-Walaja, Battir, Husan, Beit Jala) that surround a biodiversity rich area (Al-Makhrou Valle, a UNESCO world Heritage Site). Over the past three years we worked with 80 farmers distributed among the four communities. We noted that interest actually expanded during the pandemic. We were able to maintain and even expand eco-friendly agricultural activities even in total lockdown by getting special permissions (Ilustração 02). If anything, the pandemic did highlight the importance of local food production.



Ilustração 02 – Farmers in Husan getting instructions in composting and enriching soils from the agricultural specialist of the Palestine Institute for Biodiversity and Sustainability.

The initial optimistic predictions were that the lockdowns associated with COVID-19 would reduce the human impact on the environment and give our planet time to recover for wildlife and may even help people reflect on the damage they inflict so that a post-pandemic caring world is produced. The findings reported herein correspond to other findings in showing that this scenario may have far too optimistic. The social upheaval resulting from the pandemic did not necessarily translate into clear positive outcomes in regards to environmental conservation (Corbera *et al.*, 2020: 1; Buckley, 2020: 194). A notable addition to the growing literature in this field of pandemic in connection to biodiversity is that our experts thought (and our field data confirm) that there was also increased solid and liquid waste produced by human communities in the periods of the lockdown associated with the pandemic. While reduction in human activities did decrease the demand and use of petrochemicals, it also increased poaching and other resource harvesting (due to economic depression such as decline in tourism) and decrease conservation efforts markedly as shown by our findings and of others (e.g. Buckley, 2020: 1).

Community mobility reports³ for our area (put under Israel to include the whole area) show an increase in mobility to parks (park visitation) by 32 % compared to baseline. The most comprehensive recent study of data on recreational activities showed that, while

there are still knowledge gaps, they have a negative impact on the environment (Larson *et al.*, 2016: 13). Even so ecotourism can have a negative impact on the environment (Shannon *et al.*, 2017: 42; and Stronza, 2019: 244). Our findings above (both the survey and the direct observation) do show an increase of damage due to an increase in visitation to green areas during lockdowns.

Initial work on impacts of COVID-19 on agriculture focused on supply-chain disruptions and the plunge in commodity prices (Siche, 2002: 3; Gray, 2020: 242). Our preliminary results regarding increase in eco-friendly agricultural activities during the pandemic in an area near Bethlehem adds another angle, which potentially could indeed point to a future direction of local food production to ensure sustainability. We thus initiated more programs to enhance permaculture in local marginalized communities. Ecosystem services become more important than ever in times of crisis and pandemics.

The American Institute of Biological Sciences (AIBS), Biodiversity Collections Network (BCoN), Natural Science Collections Alliance (NSC Alliance), and Society for the Preservation of Natural History Collections (SPNHC) surveyed individuals affiliated with US biodiversity science collections to better understand the effects of COVID-19 disruptions and closures on biodiversity research and education collections, and the people who use and care for these scientific resources in April 2020: 96 % of natural history collections were unavailable for use in April. More than 90 % of respondents were working from home, mostly on some aspect of data transcription based on specimen images captured prior to the shutdown. When asked about chief concerns arising from a 1-3 month closure: just under 64 % were worried about their ability to provide vital research resources; just under 49 % were worried about a loss of funding for collections care materials and supplies; just over 47 % were concerned about their ability to provide outreach opportunities for the public.⁴

Most authors do agree that we need more research in areas relating to biodiversity conservation and sustainability during pandemics but that we also need advocacy in ways that will change and challenge norms of societal behavior that led us to massive biodiversity loss and climate change (Corbera, 2020: 194; Rutz, 2020: 4; Turney, 2020: 996). There is increased awareness of effects of human activities like pollution on susceptibility to pandemics (Zheng, 2020: 541) or effect of these activities on increase of zoonotic disease (latest pandemic originated from a bat coronavirus). Yet this awareness directly relevant to human health needs to be translated to societal behavioral change that actually leads to conservation (Baudron & Liégeois, 2020: 1; Schwartz, 2020: 1).

As more data are gathered on animal movement and monitoring of effects on wildlife of human trends, we believe it becomes clearer that human activities, even the presumed benign one like ecotourism will be far better understood in terms of its impact on wildlife. In the interim we agree with the recommendations of Rutz *et al.* (2020) that: **a)** field biologists must be allowed to continue and even intensify data collection during pandemic lockdowns, **b)** that local field researchers collaborate with larger networks (e.g. <https://www.bio-logging.net/>) to develop standardization of data collection methodologies, and **c)** more funding is needed for measuring human impact in time and space. We should add that in transitioning to a post-COVID-19 world, all countries should not merely go “back” to the status ante but should seriously consider structural changes of a dramatic nature that reverses the human induced climate change that has such a devastating im-

³ [Online]. [Consult. 21.March.2022]. Available at: <https://www.google.com/covid19/mobility/>.

⁴ [Online]. [Consult. 21.March.2022]. Available at: <https://bcon.aibs.org/2020/05/19/covid-19-impacts-on-biodiversity-science-collections/>.

pact on wildlife. In Palestine, as elsewhere this means initiatives to work towards eliminating things like use of fossil fuels and plastics. But the most significant aspect we believe is to transition to a green economy with local eco-friendly food production in a post COVID-19 world (Altieri & Nicholls, 2020: 881).

4. Conclusion

A survey filled by 30 researchers and experts of biodiversity shows that initial expectations of COVID-19 effect on biodiversity were far too optimistic. The majority of our surveyed experts indicates that COVID-19 pandemic has decreased the funding for environmental work and increased human impacts on green areas like Wadi Al-Makhroul (e.g. trash dumping, hunting). We also noted a slowdown in growth (for iNaturalist.org) or some decline (for observatons.org) in use of portals to record field observations. The data and accumulating literature highlights the need for better biodiversity conservation and local food production in times of pandemics.

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