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Lockdown policy effects on invasive species: a perspective

Elia Lo Parrino ^a, Mattia Falaschi ^{a*}, Raoul Manenti ^a and Gentile Francesco Ficetola ^{a,b}

^aEnvironmental Science and Policy Department, University of Milan, Milan, Italy; ^bLaboratoire d'Écologie Alpine (LECA), University of Grenoble Alpes, CNRS, University Savoie Mont Blanc, Grenoble, France

ABSTRACT

Changes in human activities caused by the COVID-19 pandemic can have multiple effects on biodiversity but there is limited knowledge of how this can impact invasive alien species (IAS). Societal measures against the spread of COVID-19 can have both short-term and long-term consequences on IAS. In the short-term, reduced human disturbance on natural habitats can increase the activity of IAS and accelerate their spread. Furthermore, management agencies have reduced control activities, sometimes allowing IAS to thrive, and ongoing monitoring programs have been interrupted, hindering rapid identification and management of biological invasions. Long-term impacts could include global modifications to wildlife trade and increased releases of captive-bred species because of the fear of zoonotic diseases and also greater public awareness of the risks of pathogens being spread among animal populations. Long-term collection and sharing of data are crucial to modulate IAS management during and after the lockdowns.

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Introduction

The SARS-CoV-2 virus was first identified in January 2020 following an outbreak of pneumonia in Wuhan, China (Zheng 2020). Since then, this infectious disease known as COVID-19 has rapidly spread all over the world, becoming a global pandemic (Morens et al. 2020a). The SARS-CoV-2 virus possibly originated in pangolins or bats (Zhang et al. 2020, Zhou et al. 2020), making it a zoonotic virus - like other coronaviruses (Shereen et al. 2020). The ongoing pandemic confirms the risks of human-animal interactions such as wet-markets and wildlife-trade supply chains for human consumption (Huong et al. 2020, Morens et al. 2020b). As a response to the rapid spread of COVID-19 many countries have adopted multiple restrictions, social distancing policies and local/regional/national lockdowns (Ficetola and Rubolini 2021). These restrictions have had - and are having - major consequences for psychological health (Gualano et al. 2020, Rossi et al. 2020, Webb et al. 2020), economic performance (Bonaccorsi et al. 2020, Hu 2020, Rahman et al. 2020) and various other aspects of billions of people's lives. The reduction in the intensity of human activities has also impacted the environment. In several areas of the globe, for instance, air quality has improved as a result of the reduction of gas emissions (Diffenbaugh et al. 2020, Menut et al. 2020, Muhammad et al. 2020) and environmental noise and water pollution have also decreased

(Arora, Bhaukhandi, and Mishra 2020, Zambrano-Monserrate et al. 2020).

This situation offers a unique and unprecedented opportunity to assess the impacts of human activities on natural systems and wildlife (Bates et al. 2020, Rutz et al. 2020), particularly in those countries where the most severe restrictions have been applied, such as China, Italy, and Spain. There have been numerous reports in newspapers about animal sightings in urban and peri-urban areas all over the world which have been described as 'nature regaining its space' (Arora, Bhaukhandi, and Mishra 2020, Manenti et al. 2020). However, it must be underlined that these lockdown measures have also had negative consequences on protected areas management such as lower incomes, postponed and delayed conservation actions and, in some cases, increased illegal natural resources exploitation (Forti et al. 2020, Hockings et al. 2020, Manenti et al. 2020).

Current effects on biological invasions

Invasive alien species (IAS) are a continuing threat to global biodiversity (Pyšek et al. 2020); thus, it is essential to assess how lockdowns and decreased levels of human activities are affecting such organisms. It is probably too early to draw definitive answers to these issues though available data suggest multiple potential pathways (Figure 1).

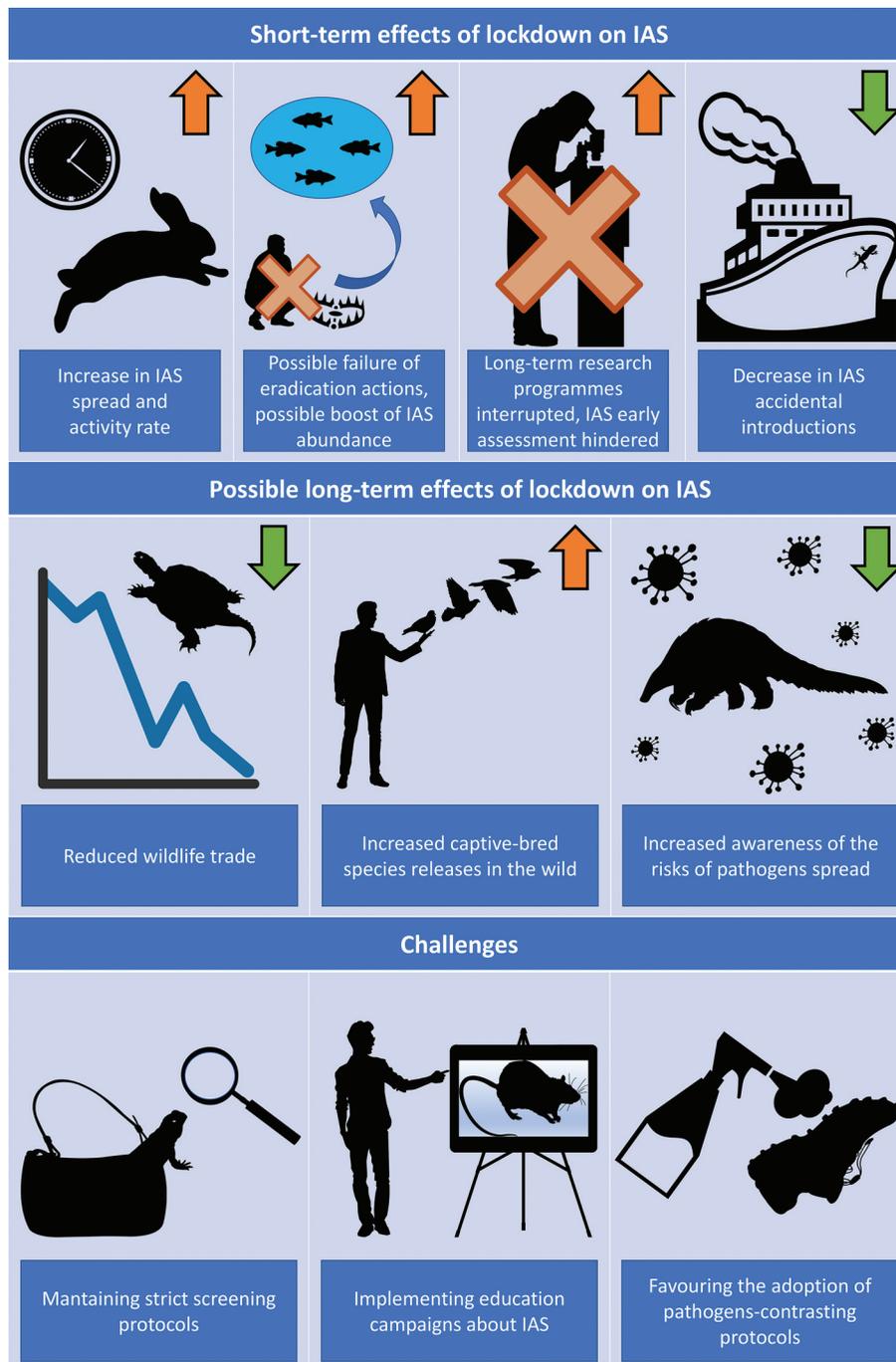


Figure 1. Effects of societal measures against the spread of COVID-19 on Invasive Alien Species (IAS), and future challenges. The direction of the arrows represents the possible effect on IAS. The colour of the arrows represents the possible positive (green) or negative (orange) effect on native biodiversity. Drawings by: Bob Comix, Creazilla, and Natasha Sinegina (CC-SA 4.0 license; <https://creazilla.com/>), JoyPixel (CC-SA 4.0 license; <https://commons.wikimedia.org/>), Lorc, and Delapouite (CC BY 4.0 license; <https://icons.com/>).

First, lockdowns can reduce human disturbance and increase the spread and activity rate of IAS. In fact, despite several IAS being synanthropic and well-adapted to live in disturbed, human dominated environments many of them live in natural environments and can be impacted by human disturbance through pathways not so different to native species. During

lockdowns, there was a significant recorded increase of alien animals in unusual habitats or active during unusual hours. The media often enthusiastically claimed that ‘nature was coming back’ even though IAS clearly do not represent the native biodiversity (Manenti et al. 2020). For instance, the Eastern cottontail (*Sylvilagus floridanus*) is mostly active at dusk and dawn.

However, during the lockdown period, introduced populations of North-Western Italy showed an impressive increase in daytime activity (Manenti et al. 2020). Similarly, during lockdowns, the invasive American mink (*Neovison vison*) increased its activity rate in Valdivia, Chile (Silva-Rodríguez et al. 2020). In turn, the increased presence of IAS can result in more severe impacts on the wildlife of invaded areas (Silva-Rodríguez et al. 2020).

Second, lockdown measures can halt or reduce the efficacy of containment actions by local conservation agencies. Protected areas have suffered from the loss of tourist flows due to lockdown measures and travel restrictions; some governments have cut conservation actions and research funds in the light of pandemic-associated economic recession, this being particularly evident in developing countries (Hockings et al. 2020, Forti et al. 2020). Consequently, several measures for the monitoring, containment, and eradication of IAS have been delayed, postponed or interrupted in many places allowing these organisms to thrive. For instance, the Gough Island mouse eradication project has been postponed due to the COVID-19 emergency (Cooper 2020, Forti et al. 2020). In April 2020, we contacted the managers of a number of Italian protected areas to gauge how their management activities were affected by the ongoing lockdown (see Manenti et al. 2020). They highlighted that various eradication projects targeting multiple alien species such as the coypu (*Myocastor coypus*), the pond slider (*Trachemys scripta*), the wels catfish (*Silurus glanis*), and the Eastern grey squirrel (*Sciurus carolinensis*) have been postponed or suspended due to lockdown restrictions undermining, in a few cases, the success of these measures (Manenti et al. 2020). These postponements and cancellations may directly affect local biodiversity particularly in island and freshwater ecosystems which are amongst the most vulnerable habitats to biological invasions (Sax and Gaines 2008, Strayer 2010). In several countries, lockdowns peaked in March-June 2020, coinciding with the mating season of many animals, particularly in the Northern hemisphere. As a consequence, the interruption or postponement of management measures can present particular problems. On the one hand, increased IAS abundance during spring months can determine a higher impact on threatened native species: on the other, management measures against IAS are often carried out during their breeding season - to reduce reproductive success. Interrupting IAS management strategies in spring months could, therefore, provoke an unexpected boost to their breeding success and abundance.

Third, in many countries, university labs and research facilities have been shut down, interrupting ongoing experiments. Field research has also faced many difficulties due to international and national travel restrictions (Corlett et al. 2020). This has had a negative impact in many research fields, including conservation biology. It has meant that studies about biological invasions mechanisms and field observations of invasive species have been halted or slowed down. In some cases, lockdowns have interrupted long-term research programs potentially disrupting the time series required to measure complex interactions between native and invasive species (Falaschi et al. 2019). Early assessment of IAS impact is crucial to help develop informed management decisions: a break in research activities could affect future management strategies.

Fourth, the increase of introduction events observed during recent decades has been linked to globalisation and the associated high level of international trade and travel (Westphal et al. 2008, Hulme 2009). The COVID-19 pandemic has severely curtailed international trade by sea and air reducing the long-range movements of both people and goods (Gössling, Scott and Hall 2020, Gruszczynski 2020). Notably, some countries have enforced strict screening protocols that may decrease the rate of accidental introductions of alien species, including pathogens, in both terrestrial and marine environments. Post-pandemic maintenance of screening protocols could be a key strategy in limiting new IAS introductions in the future.

Possible future effects on biological invasions

The COVID-19 pandemic could also have long-lasting effects on biodiversity conservation (Corlett et al. 2020) as well as on biological invasions. Although it is probably too early to understand whether and how deeply these consequences will influence biological invasions, inferences can be drawn from how human-animal interactions are evolving. The zoonotic origin of the SARS-CoV-2 virus has already increased world public awareness of, and scientists' attention to, wet-markets and wildlife trade that are believed to be vectors for potentially harmful pathogens (Aguirre et al. 2020, Nadimpalli and Pickering 2020, Shereein et al. 2020). It is possible that this situation could lead to a ban, or stricter regulation, of such practices in those nations where they are currently allowed or tolerated. Moreover, exotic wildlife trade could become less profitable if people start associating the import of animals with an increased risk of the spread of potentially

harmful pathogens. These conditions may lead to a reduction in the exploitation of some key species as well as a decrease in the occurrence of the accidental (and intentional) introduction of exotic species outside of their native ranges.

Alternatively, the correlation between wildlife and human diseases could increase the rate of release of captive animals into the wild, a pathway that has already caused multiple invasions on a global scale (e.g. Cadi and Joly 2004, Measey et al. 2012, Nguyen et al. 2017). For instance, a SARS-CoV-2 variant has been recently detected in North American minks (*Neovison vison*) farmed in Europe, with the risk of transmission to humans (WHO 2020, Oude Munnink et al. 2021). The subsequent closure of mink farms could have major impacts on biodiversity. The North American mink has been introduced from its native range to Europe, Asia and South America for fur farming and has established feral populations after escapes from farms as well as deliberate releases into the wild (Bonesi and Palazon 2007). The fur farming industry was facing a deep crisis in many European countries even before COVID-19 (e.g. Khusainova and Vorozheykina 2019) and the fear of contagion might represent the coup de grâce for this activity. Without strict controls, the sudden closure of hundreds of mink farms all over Europe could facilitate the accidental, and intentional, release into the wild of a large number of American minks. The release of minks could result in both a sanitary risk, with feral populations of American minks acting as reservoirs for SARS-CoV-2, and an ecological risk since this species has negative impacts on native ground-nesting birds, rodents, amphibians, and mustelids (Bonesi and Palazon 2007, Falaschi et al. 2020). Additionally, mink release could potentially spread the COVID-19 infection to other mammal populations. Therefore, education campaigns remain pivotal to avoid release events of captive-bred species.

Finally, the Sars-CoV-2 pandemic has made non-scientists much more aware of the risks connected to the spread of pathogens and the usefulness of protocols developed to combat them (Berardi et al., 2020). This consciousness should be exploited in the months and years ahead to develop appropriate information campaigns directed toward the stakeholders of protected areas to deal with alien pathogens that are already threatening native wildlife. For example, wildlife biologists are already well aware that it is essential to have a disinfection system available for personal outdoor equipment and facilities at each activity. Disinfection aims to prevent accidental translocation of organisms from one site to another and to reduce the spread of alien diseases such as the amphibian chytridiomycosis and the crayfish

plague (Phillott et al. 2010). So far, communicating awareness of this issue to the general public has been extremely challenging. It is possible that the present crisis will improve awareness of the risk of spreading diseases and, thus, inhibit the unwanted diffusion of pathogens.

Conclusions

COVID-19 has impacted people's lives and their relationship with the environment but it is too early to understand its long-term effects. Lockdown measures adopted by many countries and the unique situations thereby created represent an important opportunity to study the effects of human activities on biodiversity and environmental services. Short-term impacts on biodiversity, including invasive species, are being investigated by scientists all over the world but long-term effects are potentially going to influence biodiversity conservation for decades to come - and so the call for a greater focus upon them. Some parts of the globe will likely be less impacted by invasive species but, by contrast, others could be even more endangered than before due to the reduction or cessation of management initiatives. As data continue to be collected, quantitative analyses on these issues will become available thus affording scientists a better picture of the future challenges faced by biodiversity conservation.

ORCID

Elia Lo Parrino  <http://orcid.org/0000-0001-9619-9568>
 Mattia Falaschi  <http://orcid.org/0000-0002-4511-4816>
 Raoul Manenti  <http://orcid.org/0000-0001-6071-8194>
 Gentile Francesco Ficetola  <http://orcid.org/0000-0003-3414-5155>

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