Microplastic pollution. Microplastics like these from the Patapsco River, Chesapeake Bay, are found in watersheds and oceans worldwide, but few have studied their ecological effects under environmentally relevant conditions.

ECOLOGY

Ecologically relevant data are policy-relevant data

Microplastics reduce fish hatching success and survival

By **Chelsea M. Rochman**[1,2]

History tells us that the motivation for new environmental policy is much stronger when there is demonstrated ecological impact. Multinational agreements to stop the use of DDT followed the precipitous decline of predatory bird populations. Similarly, decisions to regulate emissions to prevent acid rain followed widespread degradation of aquatic habitats. Ideally, environmental policy should be catalyzed by scientific evidence rather than environmental catastrophe. As scientists, we can do our part by providing evidence that is relevant to the natural environment. On page 1213 of this issue, Lönnstedt and Eklöv (*1*) take an important step forward in this regard by reporting ecologically relevant evidence on a growing environmental issue: microplastic pollution.

Plastic can remain in the environment for hundreds to thousands of years. Moreover, its production and global consumption outpace waste management (*2*). The mismanagement of plastic waste is now coming back to haunt us as marine and freshwater debris. Much of this debris is microplastics: plastic fragments <5 mm in all dimensions that are either manufactured that way (plastic microbeads in many personal care products) or are broken-down bits of larger pieces of debris (see the photo). Microplastic fragments float on the surface of every major ocean (*3*); microbeads are found in freshwater lakes (*4*); plastic fibers shed from clothing are coming down with rain (*5*); and a medley of plastic particles have been found in commercial sea salt (*6*), fish (*7*), and oysters (*8*).

Hundreds of studies have demonstrated global microplastic contamination, but few have investigated its impacts on animal populations, communities, and ecosystems. This pattern is not unique. For many chemical contaminants in the environment, widespread contamination is documented, yet little is known about their ecological impacts (*9*). A recent systematic review found that evidence of ecological impacts of microplastic debris is not lacking because there are none, but because scientists are not asking questions about impacts at biological levels above the individual organism (*10*). Most studies investigate suborganismal effects such as cell death, organ damage, or changes in gene expression in animals exposed to quick and unrealistically large doses of microplastics (*10*). These studies are critical for understanding physiological mechanisms but tell us little about ecological impacts that may be occurring in nature now (*11*).

To increase understanding of ecological impacts, Lönnstedt and Eklöv exposed fish to concentrations of polystyrene microplastics comparable to those found in nature. They studied European perch (*Perca fluviatilis*) at the sensitive embryonic and larval stages and exposed them to microplastics similar in size to those found in ocean samples. Most importantly, they asked ecologically relevant questions about survival and recruitment in their laboratory populations.

The results show that exposure of embryos to microplastics decreases hatching success. Moreover, exposed 2-week-old larvae were much less able to escape predation, leading to reduced survival. In another recent study, Sussarellu *et al.* exposed reproductively active oysters to an environmentally relevant concentration of polystyrene microplastics and found similar results: decreases in egg production and motile sperm, leading to reduced larval yield (*12*). Such ecologically relevant impacts, including compromised reproduction, reduced survival, and changes in predator-prey interactions, may translate to population- or community-level impacts.

Lönnstedt and Eklöv's study marks an important step toward understanding ecological impacts of microplastics. Future work should ask questions about multigenerational impacts, changes in biodiversity indices, community structure, and ecosystem function. Ideally, such studies will guide mitigation efforts—for example, by determining the types of microplastics that may be most hazardous and by identifying the most sensitive populations, species, and/or ecosystems. With such data in hand, practitioners can shift their energy toward prevention and avoid the need for costly recovery and restoration. ■

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