European
Commission

Science for Environment Policy

Seven UV filters with potential endocrine-disrupting properties found at low levels in eggs of seven wild bird species, national park, Spain

01 August 2018
Issue 512

[Subscribe](#) to free weekly News Alert

Source: Molins-Delgado, D., Máñez, M., Andreu, A., Hiraldo, F., Eljarrat, E., Barceló, D. and Díaz-Cruz, M. S. (2017). A Potential New Threat to Wild Life: Presence of UV Filters in Bird Eggs from a Preserved Area. *Environmental Science & Technology*, 51(19): 10983–10990.

Contact:
silvia.diaz@idaea.csic.es

Read more about:
Biodiversity, Chemicals, Environment and Health, Marine ecosystems, Water Waste

Personal Care Products (PCPs) are of increasing global concern, as thousands of tonnes enter the environment every year. Similar to persistent organic pollutants (POPs), some substances used in PCPs are toxic, persist in the environment and accumulate in the bodies of organisms that take them in. This study focused on the presence of ultraviolet filters (UV-Fs) (used in PCPs such as sunscreens and cosmetics) in the unhatched eggs of wild birds.

Worldwide evidence is mounting that UV-Fs from PCPs — but also from plastics, paints, textiles and adhesives — are entering food chains in multiple habitats across the globe, through entry into water bodies, sediment and thus aquatic wildlife. Bioaccumulation — or build-up — has been found to occur in fish, mussels, birds and, more recently, marine mammals. Biomagnification — increasing concentration of chemicals in the tissues of organisms at successively higher levels in a food chain — may also occur, as shown in a European study where UV-F contamination in the predatory Andalusian barbell (*L. sclateri*) was higher than in other fish species examined[1]. Two species of dolphin contaminated with UV-Fs showed 20-fold mother-to-foetus biomagnification. In wild birds, UV-Fs ingested from dietary sources are transferred into their unhatched eggs, meaning eggs could be used as bio-indicators of UV-F levels in the environment.

UV-Fs are an emerging risk due to their ubiquitous use in PCPs and the fact that they are not efficiently removed from waste water by conventional treatment; there is also no regulation of concentrations in urban waste-water effluent or the environment. Bioaccumulation of UV-Fs in the fatty tissue of organisms, along with proven endocrine-disrupting (ED) effects on some species and potential ED effects on humans[2,3], have led the European Parliament to recognise them as important organic contaminants in the aquatic environment.

Oxybenzone — one of the UV-Fs focused on in this study — is currently listed by the European Chemicals Agency (ECHA) in its Community rolling action plan (CoRAP), because of its ED potential. After a two-yearly review required by the Water Framework Directive, one UV-F — 2-Ethylhexyl 4-methoxycinnamate — has recently been removed from a watch list of potential water pollutants, as sufficiently high-quality monitoring data are now available for them[4]. A list of approved UV-Fs and their maximum allowed concentrations in commercial products has been set by the relevant regulatory authority in Europe. Currently 28 UV-Fs are allowed in cosmetics in the EU.

This study sought to address the paucity of data available regarding the presence of UV-Fs in the environment by examining 39 unhatched eggs of seven wild bird species near the Doñana Natural Space, south-west Spain, for the presence of seven UV-Fs[5]: BP1, (oxybenzone, BP3), 4HB, 4DHB, 2-ethylhexyl ODPABA, 2-ethylhexyl OC, and UVP. Oxybenzone (BP3) is the parent compound of 4HB, 4DHB and BP1. The collected eggs were frozen, thawed, homogenised, freeze-dried and stored at minus 20ºC. All seven UV-Fs were analysed using 0.1 gram (g) freeze-dried samples.

Analysis of UV-Fs in the samples was performed by liquid chromatography — a technique used to separate each component in a mixture — coupled with mass spectrometry — to detect, identify, and quantify the separated chemicals from their mass-to-charge ratios. The fat content present in the samples — in which UV-Fs accumulate — was determined according to weight.

Continued on next page.

1. Gago-Ferrero, P. *et al.* UV filters´ bioaccumulation in fish from Iberian river basins. *Sci. Total Environ.* 2015, 518: 518–525.

2. Kunz, P., *et al*. (2006). Comparison of *In Vitro* and *In Vivo* Estrogenic Activity of UV Filters in Fish. *Toxicological Sciences*, 90(2): 349-361.

3. Rehfeld, A. *et al.* (2017). EDC IMPACT: Chemical UV filters can affect human sperm function in a progesterone-like manner. *Endocrine Connections*, 7(1): 16-25.

4. https://ec.europa.eu/jrc/en/science-update/updated-surface-water-watch-list-adopted-commission.

5. Benzophenone 1 (BP1), benzophenone 3 (oxybenzone, BP3), 4-hydroxybenzophenone (4HB), 4,4'-Dihydroxybenzophenone (4DHB), 2-ethylhexyl 4-(dimethylamino)benzoate (ODPABA), 2-ethylhexyl 2-cyano-3,3-diphenyl acrylate (OC), and 2-(2-benzotriazolyl)-p-cresol (UVP)

European Commission

Science for Environment Policy

Seven UV filters with potential endocrine-disrupting properties found at low levels in eggs of seven wild bird species, national park, Spain *(continued)*

01 August 2018
Issue 512

Subscribe to free weekly News Alert

Source: Molins-Delgado, D., Máñez, M., Andreu, A., Hiraldo, F., Eljarrat, E., Barceló, D. and Díaz-Cruz, M. S. (2017). A Potential New Threat to Wild Life: Presence of UV Filters in Bird Eggs from a Preserved Area. *Environmental Science & Technology*, 51(19): 10983-10990.

Contact:
silvia.diaz@idaea.csic.es

Read more about:
Biodiversity, Chemicals, Environment and Health, Marine ecosystems, Water, Waste

All seven UV-Fs were commonly found in the egg samples (95–100% frequency); however, some were present at such low levels in some eggs that they couldn't be quantified. This was largely the case for: 4DHB, ODPABA and OC. In particular, ODPABA was present in most egg samples and across all species but at such low levels it could not be quantified. In contrast, oxybenzone was present in all samples at quantifiable levels. A breakdown product (metabolite) of oxybenzone — 4HB — was found in all samples at the highest concentrations of the seven UV-Fs, peaking in white stork (*Ciconia ciconia*) eggs at 3 488 nanograms per gram dry weight (ng g^{-1} dw). Similarly, BP1, another oxybenzone metabolite, was found at high levels in all bird species' eggs, except those of the white stork, where it could not be quantified. Despite being found at very low levels in some samples, OC was detected in all egg samples, with the highest levels found in two predatory species — the white stork and the black-headed gull (*Chrocoephalus ridibundus*). UVP was found least often (95% of samples), and at the lowest concentrations (up to 8.4 ng g^{-1} dw). The levels of UV-Fs accumulated in wild bird eggs were similar to those of the polybrominated diphenyl ethers (flame retardants), but higher than those of the pyrethroids (used as household insecticides).

The white stork, western marsh harrier (*Circus aeruginosus*), and black-headed gull, all predatory species, were consistently among the most contaminated species overall, which may indicate that UV-Fs biomagnify in the food chain.

According to the EU Cosmetics Regulation[6], the maximum concentrations of BP3 (Oxybenzone), ODPABA and OC allowed in PCP formulations are 6% (reduced from 10% in September 2017), 8% and 10% (as acid), respectively. UV-P is used as an additive in food-packaging plastics[7] and is very stable; its lower-level use, due to a small local population, may explain the lower occurrence in eggs analysed in the study, as might a lack of industrial activity in the area — a large contributor of UV-P to the environment. Local domestic waste-water discharge, containing substances derived from PCPs, is likely to be the source of most UV-Fs found in this study.

Oxybenzone BP3 is on the CoRAP list, because of its potential ED properties. If oxybenzone is confirmed as affecting hormones, it may qualify for the REACH candidate list of chemicals, for eventual inclusion in Annex XIV, thus requiring authorisation. While the study doesn't address oxybenzone's potential ED properties, it provides further evidence of exposure levels leading to bioaccumulation and, potentially, biomagnification in wildlife[8].

The study data show that birds' eggs are useful bio-indicators to assess the occurrence of UV-Fs and their derivatives in the environment. Because some of the target UV-Fs in this study are ED chemicals, these findings highlight the need for a risk assessment regarding exposure of wildlife and humans to UV-Fs. The study also shows the need for further research into the bioaccumulation of UV-Fs in wild birds and the potential trend of biomagnification of UV-Fs in predatory species. Finally, further research on techniques for removing UV-Fs from waste water should be considered.

---

6. Cosmetics regulation (EC) N° 1223/2009: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02009R1223-20160812&from=EN

7. **UV-P** is approved for use in rigid and flexible PVC applications for food, consumer-care products and pharmaceuticals, preserving the package contents from the detrimental effects of light.

8. Valle-Sistac, J., *et al.* (2016). First assessment of prenatal exposure to Benzophenone-4 and Benzylparaben: placenta analysis from women exposed to UV filters and parabens. *Environment International*. 88C: 243-249.DOI: 10.1016/j.envint.2015.12.034