What's missing from claims that neonicotinoids are killing bees, birds and fish?

Pesticides continually get a bad rap, much of it undeserved, some of it bizarre. A recently published study from Japan seems to show that neonicotinoid insecticides ("neonics"), used around the world to protect crops from insect infestations, are so destructive that even before they were on the market or ever used in farmers' fields, they were able to cause entire ecosystems to collapse. Sort of like "Back to the Future" meets "Jurassic Park."

At least that's what one must assume after reading the study, which like others purporting to show harmful environmental effects of neonics, got extensive and often sensationalistic coverage in the media. National Geographic, for instance, headlined "How the world's most widely used insecticide led to fishery collapse," adding a sub-headline alerting readers that the same thing is likely happening to aquatic ecosystems "worldwide."

Apocalypse-Shift

This is only the latest apocalypse being ascribed to neonics. As I've detailed in Part 1 & Part 2 of this series, the ongoing campaign by environmentalists and activist scientists against these insecticides highlights what I have dubbed the Pseudo-Scientific Method (PSM). Drawing its inspiration from Saul Alinsky, the author of "Rules for Radicals," rather than Newton or Galileo, the PSM first picks an enemy – in this case a popular, state-of-the-art insecticide – then manufactures the evidence needed to condemn it.

[Editor's note: This is part three of a three-part series on pollinator health and pesticides. Read part one and part two.]

During the years I've been writing about neonics, we've gone through a litany of supposed neonic-caused catastrophes that were widely trumpeted in the press only to be revealed a short time later to be either wholly fictitious or in no demonstrable way connected to neonics.

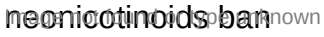

Image: CropNuts

The first was the famous "bee-pocalypse," the supposedly imminent extinction of the world's honeybee population. This was so serious and urgent – because, we were told, three-quarters of everything we eat is dependent on honeybees, and we were faced with worldwide famine – that the European Union, acting on the Precautionary Principle, instituted an immediate ban on the insecticides.

Shortly thereafter, I and other analysts actually looked at the data, something none of the media or, apparently, the EU officials who instituted the ban had bothered to do. The claims of plummeting honeybee populations had simply been fabricated by anti-pesticide activists. As we all know now, honeybee populations have been rising on every habitable continent in the world since neonics came on the market in the mid-1990s.

Without missing a beat, the warnings of apocalypse shifted to a purported collapse of "wild bees." This too

turned out to be a fiction. The biggest problem with this new apocalypse was that, first, extensive study had shown that those wild bees that come into most contact with agricultural crops, and thus neonics, are thriving.

The third supposed apocalypse sprang into the headlines less than a year ago, with the publication of the claim by long-time neonic-antagonist Francisco Sanchez-Bayo that the entire insect world was going extinct. (As young people say, OMG!) Of course, this got massive coverage in the media, but this time the study was so obviously contrived to produce its alarming result that it was widely criticized by other scientists. Even the environmentalist-loving BBC ripped it to pieces. Science writer Matt Ridley and investigative reporter Jon Entine revealed the study authors' penchant for simply fabricating evidence when the facts didn't support their case.

The next apocalypse du jour was the birds. Perhaps the most remarkable aspect of the claimed "bird-pocalypse" was how closely it replicated the (fictional) honeybee-pocalypse in the United States. For both honeybees and birds, real population declines in the post-World War II era leveled off and began to reverse in the mid-1990s, just as neonics were coming on the market. See the figure below from a 2018 review study:

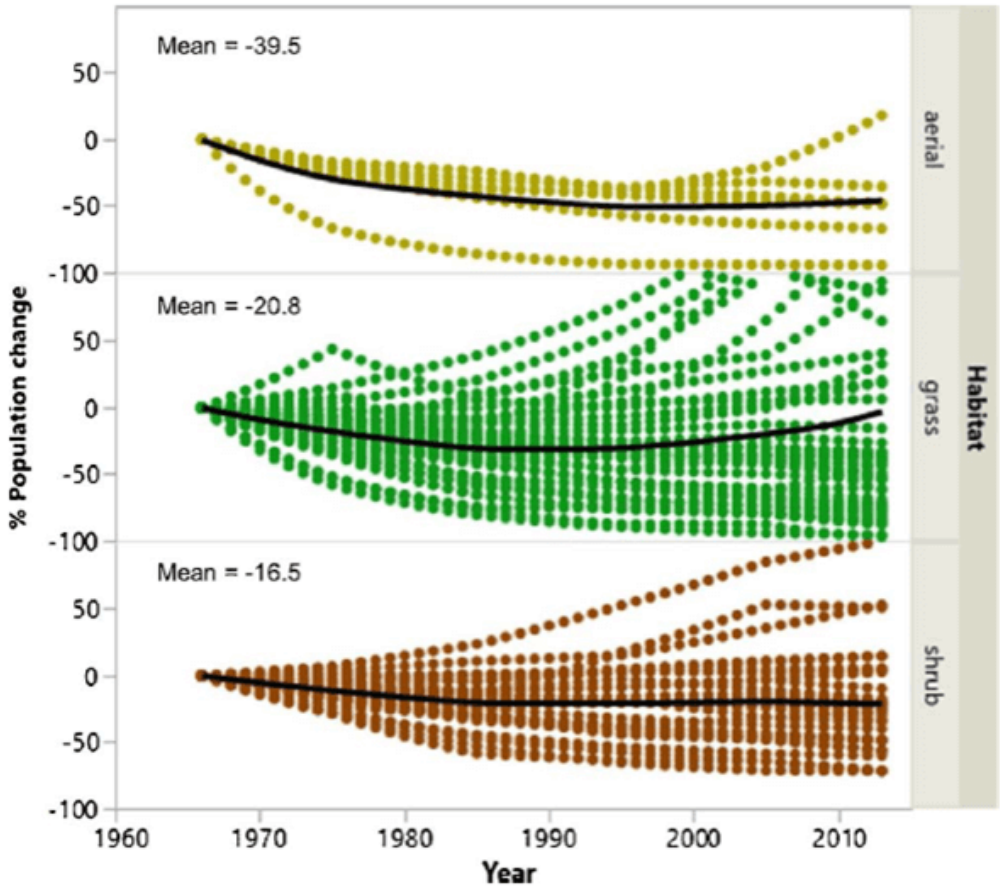

Fig. 2. Population trends of 77 North American farmland bird species based on data collected by the North American Breeding Bird Survey, 1966–2013 (Sauer et al., 2014). Dotted lines represent % change in individual species populations based on the average annual trend for each decade (1966–1975, 1976–1985, etc.). The solid black line and mean estimate represent the average trend for all species in each habitat guild over the duration of study period 1966–2013.

Fish gotta swim, birds gotta fly, activist researchers gotta lie

The discussion above brings us to the latest entry in the neonic-apocalypse playbook, the study published in November by Japanese researchers who looked at the collapse of fish populations (actually, only some fish populations) in Lake Shinji near the coast of Western Japan. Using the year 1993 as their reference point, because this was when neonics were first used by Japanese rice farmers, they show that yields of smelt and eel, which were abundant in the 1980s, have declined to near zero in the case of smelt, while eel remain considerably below earlier levels, despite yearly restocking of the lake with eggs.

The researchers, led by Masumi Yamamuro of the Institute of Geology and Geoinformation in Japan,

hypothesize that these declines were due to neonics carried into the lake from nearby rice fields and causing catastrophic declines in “zooplankton biomass” — the invertebrate species of insects and crustaceans that make up much of the fishes’ diet.

At first glance, Figures 1 and 2 – reproduced here as they appear in the published article – appear to support that thesis. In the top graph we see neonic quantities rising with time, while, in the bottom graph, zooplankton biomass dramatically collapses. Although this is only a correlation, or association, which would not prove causation, it is highly suggestive.

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Neonics: the wonder of time travel

There’s a critical problem with this apparent correlation, however. On closer examination, it is evident that the dates in horizontal axes of the two figures are not aligned; and if both graphs are centered on 1993 (below), the first year neonics were used, it becomes clear that zooplankton biomass had been in precipitous decline for at least a decade before neonics were introduced on rice farms.

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The fact that biomass more or less bottomed out in 1993 is clearly the culmination of a trend, a steep and persistent decline that had been going on for over a decade and very likely much longer. The fact that the use of neonics (which began in 1993) overlaps for one year with the tail end of this trend hardly can be said to represent a correlation, especially as the records show negligible quantities during the first six years of usage, from 1993-1998.

To state the obvious, neonics can’t be blamed for trends that started long before they were ever applied to farmers’ fields. But if one looks for the authors to provide an explanation of what was causing the rapid decline in all those years preceding the advent of neonics, one looks in vain. (More about this below.)

The supposed correlation becomes even less convincing given that Figure 1 doesn't even representactual measurements of neonic levels in Lake Shinji. The only actual measurements of neonic levels inthe lake water were made by the authors in one year, 2018, a quarter century after the 1993 referenceyear. The authors, in fact, have no idea what neonic levels in the lake were prior to 2018. They are askingus to accept, instead, a kind of surrogate for actual measurements – namely, the total sales volume ofneonics in the entire Shimane Prefecture, in which Lake Shinji is located.

Something is obviously very fishy here, which makes one wonder not only about the competence of the investigators but also whether, in overlooking these points and those discussed below, the peer reviewers and editors of Science, the journal in which this study was published, were comatose.

A dose of skepticism

Seed Treatments

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Seeds treated with a neonicotinoid insecticide.

That brings us to the critical issue of dose-response, or in this case, the actual levels of neonics in the water. From April through June 2018, the authors took several measurements in three different sampling sites in the lake. None of these measurements rise above the level of quantification, i.e. the amount that can be accurately determined given the limits of present-day technology, so they are hard to accept at face value. Even so, the one finding reported in the study itself – the highest and only significant concentration, which the authors calculated by adding all the different neonics' levels together – is not high enough to do the widespread damage to insect populations the authors posit.

This is especially true for crustaceans, which form a large part of the zooplankton biomass and are a critical part of the fish diet. As found in a 2018 study, crustaceans are generally much less sensitive to neonics than are the insect species on which the ecological benchmarks, or safety levels, are based.

Things look even worse for the November Yamamuro study if one applies the researchers' surrogate measurement (neonic sales) consistently. Compared to 2016, when sales in the prefecture were about 4,000 kg, sales during the first six years neonics were on the market (1993-1998) were below 200 kg/year; in other words, back then, neonics applied were far below amounts likely to do appreciable harm even to the most sensitive insect species.

Perhaps realizing they had a problem, the authors spent considerable time highlighting neonic concentrations found in the Sagami River as it flows through metropolitan Tokyo. For those not familiar with the geography of Japan, that's about 450 miles away from Lake Shinji, on the other side of at least three massive mountain ranges, and so in a completely different watershed — not to mention, in the middle of one of the largest, most populated cites on the planet. The possible relevance of this was not explained.

Other possible causes of zooplankton decline

Given the rather obvious chronology problems of attributing fish declines to neonics, it might have made sense for the authors to look for other possible causes. They aren't hard to find.

Heavy metal pollution. The lake has been undergoing significant ecological changes since at least 1922, when a canal was dredged between Shinji and nearby Lake Nakaumi, which caused saltwater to flow into the former, turning it brackish. And since 1966, according to the World Lake Database, "efforts have been made to establish a new industrial zone along the coasts of the two lakes" (Shinji and Nakaumi).

One might expect that a half-century of industrial development could lead to serious problems with chemical pollution affecting aquatic organisms. In fact, a 2011 study of chemical contaminants in Lake Shinji found exactly that, noting the lake's sediments "are moderately to strongly polluted with respect to As [arsenic], moderately polluted with Pb [lead] , Zn [zinc], and Cr [chromium]…" Other researchers (Hook and Fisher 2001; 2002) looking at the effects of zinc and other chemical pollutants on copepods (the small crustaceans that make up a good deal of the zooplankton food supply for fish in Lake Shinji) found that "exposure to contaminated food resulted in assimilation of the metals primarily into internal tissues" and that with "direct exposure, the metals showed up in the exoskeleton" leading "to sublethal effects (e.g., decreased egg production and hatching, ovarian development, and protein concentration in eggs) at concentrations 2~3 orders of magnitude less than lethal concentrations."

Eutrophication. Just as Yamamuro et al. fail to mention Lake Shinji's chemical pollution, they also neglect

to alert readers to the well-known, long-standing problems the lake suffers from eutrophication, the depletion of oxygen due to the proliferation of algae and other organisms. As Japan's Ministry of the Environment noted in 1996: "Deterioration of water quality by socio-economic activities in catchment area. Eutrophication with water bloom in summer."

Eutrophication is generally caused by excessive nutrients from sewage, fertilizer and other organic and inorganic pollutants that result in explosive algae growth, the buildup of hydrogen sulfide, and oxygen-depleted water. Although the researchers say that oxygen and some other measurements in Lake Shingi were similar before and after 1993, the effects of eutrophication on lake ecology are highly complex, can manifest over long time periods, and even to this day are not fully understood. In fact, the study's lead researcher, Ms. Yamamuro, acknowledged these issues repeatedly in a study of Lake Shinji and Lake Nakaumi, published in 2000:

> In recent decades, these waters have been strongly affected by eutrophication which is accompanied by oxygen depletion. Detailed study of the migration patterns and growth rates of particular fish species in the area would contribute to improving the management of local fisheries as well as to understanding the reaction of fishes to eutrophication….
>
> The decrease of the bottom-dwelling fish, however, might result from increased eutrophication…. The increase in plantivorous species, K. punctatus and S. zunasi, also might be related to an increase in phytoplankton, although relationships in the lake's food web are not clarified.

Habitat destruction. Other studies have pointed to severe disruptions of aquatic habitat that have caused significant declines in fish populations. For example, the study co-authored by Yamamuro in 2000 pointed to a large "decrease in Carassius sp" which the study attributed to the loss of "spawning and nursery areas, because 75% of the natural coast of the lake has changed with the construction of an artificial wall (Environmental Agency, 1993) during the course of urbanization of the area."

Perhaps it's not a coincidence that this wall appears to have been built around 1993, the authors' pivotal date in this new study when, they claim, the lake's environmental collapse began.

Another Fake News Fake Catastrophe

Yamamuro et al. end their 2019 article by quoting a particularly overwrought passage from Rachel Carson's Silent Spring. In it, "chemicals" threaten to "kill every insect, the 'good' and the 'bad', to still the song of birds, and the leaping of fish in the streams…" They conclude: "The ecological and economic impact of neonicotinoids on the inland waters of Japan confirms Carson's prophecy."

carson

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Image: Population Connection

That's fitting, because Silent Spring, like the Yamamuro et al. study, is agenda-driven rubbish. However, the media loved the Japanese research because it offered a narrative about yet one more environmental catastrophe, showing how neonics could not only harm specific insects, but disrupt the entire ecological web of life. (As though teenage activist Greta Thunberg and Rep. Alexandria Ocasio-Cortez (D-NY) weren't already having enough bad dreams.)

And just as the media never bothered to google "honeybee populations" before writing thousands of headlines about bees' imminent extinction, apparently none bothered to google Lake Shinji, either. It appears that despite massive eutrophication, chemical pollution from 50 years of industrial development, the destruction of fish spawning and nursery areas by construction projects – and even negligible, non-harmful levels of neonics – Lake Shinji is doing pretty well, thank you. Japan's Ministry of the Environment describes the lake this way:

> Rich Biodiversity in Brackish Water Ecosystem: Shinji-ko offers an essential habitat for approximately 80 brackish water species of fish and shellfish, including Japan's endemic Shinji-ko Goby, Japanese Seaperch, Eel, Icefish and Corbicula Clam. Shinjiko is blessed with the largest catch of Corbicula Clams in Japan. Shinji-ko is also home to 200 species of migratory birds. Especially, more than 20,000 Tufted Ducks and 5000 Scaups are sighted among over 40,000 wild ducks and geese. The lake regularly supports more than 1% of world population of Whitefronted Goose, Tufted Duck and Greater Scaup and it is the southernmost wintering spot for Tundra Swans along with Nakaumi.

So much for the Yamamuro et al. study, perhaps the worst, most irresponsible article I have encountered during more than 40 years of reading Science. And so much for the worldwide fish-pocalypse.

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