The World Foundation for Natural Science
The New World Franciscan Scientific Endeavour of The New World Church
Restoring and Healing the World through Responsibility and Commitment in accord with Natural and Divine Law!

Fact Sheet — Insects and Birds — November 2017

Spring is Falling Silent

Why Insects and Birds Are Increasingly Disappearing

At present, mankind is aware of 1.4 million species of living organisms on Earth. Insects, arachnids and crustaceans account for 61% of them. The insects and their close relatives thus account for the predominant part of the biodiversity of our planet and they take on important functions in our ecosystems. Already in 1962, the American biologist and science journalist Rachel Carson warned of an impending 'Silent Spring', should the industrialization of agriculture progress unchecked. A spring without the familiar humming of bees, bumblebees, flies, beetles and without the cheerful song of birds. This scenario is now threatening to become reality, if we do not act immediately. Reports on bee mortality have been made for several years now, but in reality it does not only occur in bees – the existence of all insects is threatened. In addition to the advancing extinction of insect species, their population density is also dramatically decreasing. In the last 20 years, the number of insects in Europe has declined by up to 75%. The disappearance of the insects, in turn, has an impact on the birds, which mostly feed on insects; on the pollination and the diversity of species of the flowering plants, as well as on the metabolism of the soil, as the first step in this process is carried out by insects. The main causes of the large-scale insect mortality and the disappearance of the birds are known. It is the destruction of natural habitats, lack of nutritional basis, toxic plant protection products and technical radiation. The solutions to stop and reverse the disappearance of insects and birds are already available today. However, they must be implemented more consistently.

Bee Mortality Is Only Part of the Problem

Between 2003 and 2015, the winter losses of honey bees in Germany fluctuated between 10% and 27% (ROSENKRANZ ET AL 2014). Nevertheless, there are statistics showing an increase in honey bee colonies, and Institutes for Bee Research that claim there is no problem with bee mortality. Every year before the start of winter, the number of bee colonies is determined. However, this figure does not indicate how many bee colonies may not survive the winter, and how many resources the beekeepers must invest to laboriously build up new bee colonies so they can maintain the same amount of bee population as in the previous year. This is only possible because the honey bee has an extraordinarily strong reproductive drive that can be used to start new young bee colonies. It is only with great effort that the beekeepers can compensate for the high winter losses. Moreover, this artificial reproduction of bee colonies does not correspond to the natural cycles. It is interesting to note that the increase in the number of bee population mainly occurs in the cities, as more and more people enjoy being hobby-apiarists in their spare time. The real problems, however, lie within the agricultural areas. Figures showing an overall increase in bee colonies worldwide leave aside strong regional differences. For example, the number of bee colonies in Russia, the USA and Germany has decreased by as much as 60% since 1960, whereas in China, Argentina and Spain, their amounts have increased between 100% and 360% in the same period (see Figure 2).

Fig. 1: Most birds feed on insects. Therefore, insect mortality also leads to a decline in the bird population.

Wild honey bee colonies however, have become virtually extinct in Europe.

It is also necessary to distinguish between honey bees kept by apiarist and wild honey bee colonies.

The figures given above are all based on bee colonies maintained by beekeepers. The honey bee as such is very robust and is very good at buffering the effects of toxins and poor food supply by creating food storages, 'exuding' fat-binding toxins through the wax, or quickly compensating the losses of individuals with an extremely large number of offspring.

If the honey bee is struggling, other, more sensitive insect species stopped being able to survive a long time ago.

As a result, the honey bee is a very bad indicator for the early detection of negative environmental effects.

The Disappearance of Insects and Birds

It is rarely reported that not just the honey bees are threatened in their existence, but that this is also true for all insects. At present, mankind is aware of 1.4 million species of living organisms on Earth. 61% of these are insects, arachnids and crustaceans, 18% higher plants, 3.5% vertebrates, and 17.5% fungi, bacteria, viruses, protozoa and other creatures (MARKUS 2014). The insects thus constitute the predominant part of the biodiversity of our planet. It is assumed that, in addition to the approximately 1 million insect species already known, there are as many species as yet undiscovered. Globally, an estimated 16.5% of all insects are threatened with extinction; in some regions even more than 30% (IPBES 2016). Regarding bees and butterflies, it is even more than 40%. This trend is on the rise. Moreover, in reality, these values are more likely to be twice as high, as there is not enough data to make an assessment for more than half of the species (IPBES 2016). In Germany, one-third to one-half of the species of many insect groups and birds are on the Red List (are threatened with extinction, endangered or extremely rare). On a European level, the numbers are 10% to 20% (see Table 1). More than half of the species show shrinking population sizes over the last 20 years. In Europe, the insect population has decreased by a third during this period. This data becomes even more explosive when looking at certain case examples. It would be within reason to assume that the last biotopes, in which a high diversity of species can be preserved, are the natural forests. However, even the Leipzig Riverside Forest, which still has a natural composition of tree species, only contains a fraction of the insects found there 14 years ago. During the period between 2002 to 2016, 49% of bee and wasp species have disappeared from there and their individual numbers have decreased by 71% (SÄRING ET AL 2016).

Between 1989 and 2013, the number of insects in the conservation area of Orbroich near Krefeld in Germany fell by 75%
(SORG ET AL 2013).

There are, therefore, not only fewer species, but those remaining species also have a lower number of individuals. Even nature reserves can no longer preserve their originally high biodiversity, because everything is

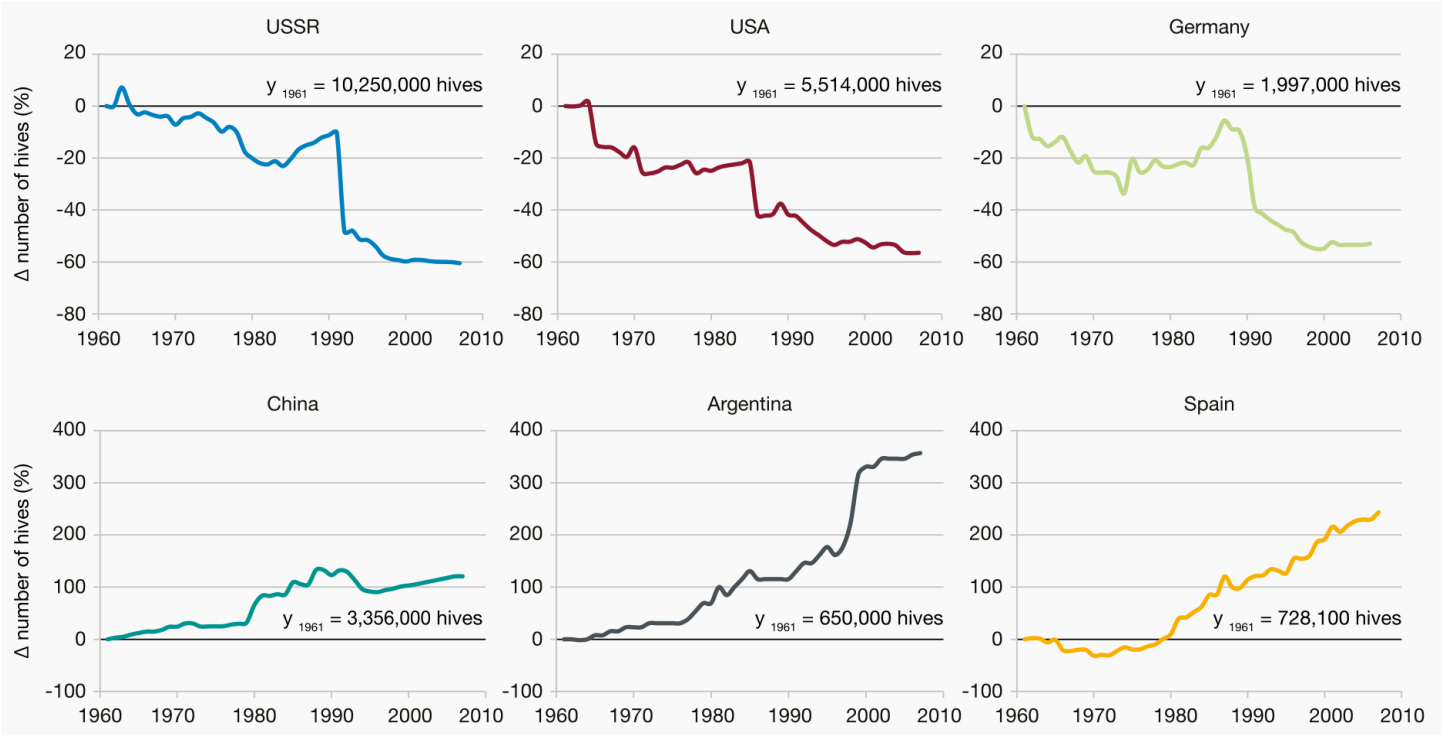

Fig. 2: Number of cultivated honey bee populations (Apis mellifera) in selected countries from 1960 to 2008. (AIZEN AND HARDER 2009)

connected, and protected areas are also dependent on the influences of their environment.

The Valuable Services of Insects and Birds

The loss of insects influences the birds, which mainly feed on insects; on the pollination and species diversity of the flowering plants and on the metabolism of the soil. The insects are a fundamental part of the food chain, which is made up of all living organisms, such as plants, birds, mammals and, ultimately, also humans. Most of the insects feed on plants; in return, they are eaten by amphibians, reptiles, birds and bats. Therefore, the insects have the important task of transforming plant food into animal protein, which nourishes other animals. The decline in bird species is to a large extent due to the lack of food supply in the form of insects. Fewer birds, however, also means there are less natural enemies for the insects in the fields. Unwanted field guests are thus able to spread more widely again; this is true not only for insects but also rats, mice and other rodents, whose populations are otherwise regulated by birds of prey.

Besides reducing the insect population, birds also provide other important services. The excrements of marine birds are food for phytoplankton, which small fish feed on. Birds spread plants by storing nuts and seeds as a food supply and then not using them, or by unintentionally carrying the seeds in their plumage. Eurasian Jays, Eurasian Nutcrackers and Clark's Nutcrackers are particularly industrious rangers and have already established many forests (see Figure 3).

Insects Are the Motor of the Ecosystem

Insects help with the utilisation of dead organic material, which is composed of plant residues or even the carcasses and faeces of animals. The degradation and metabolism are parts of a long chain of processing steps, in which the organic material is increasingly crushed and finally separated into its individual molecules by microorganisms, to be re-absorbed by plants. The first step in this process is carried out by insects and invertebrate animals, such as springtails, beetles, mites, moths and earthworms. Without these animals, man would literally be suffocating in dirt, and the soil would no longer have sufficient nutrients for plant growth. By contributing so strongly to the metabolism in the soil, insects provide a very valuable service for the ecosystem.

	Germany	Europe
Wild bees	➤ Species on the Red List: 52% (Binot-Hafke et al. 2011) ➤ 87% of species show declining population sizes (IPBES 2016)	➤ Species on the Red List: 9% (IPBES 2016) ➤ Individual numbers have decreased by 37% (IPBES 2016)
Butterflies	➤ Species on the Red List: 52% (Binot-Hafke et al. 2011) ➤ 69% of species show declining population sizes (IPBES 2016)	➤ Species on the Red List: 20% (IPBES 2016) ➤ Individual numbers have decreased by 31% (IPBES 2016)
Birds	➤ Species on the Red List: 46% (Red List of German Breeding Birds 2016)	➤ Species on the Red List: 13% (BirdLife International 2015) ➤ 27% of species show declining population sizes (BirdLife International 2015)

Tab. 1: Information on a number of threatened species on the Red List, as well as population trends of the species groups wild bees, butterflies and birds in Germany and in Europe

Fig. 3: The Eurasian Jay and its relatives collect more food supplies than they consume, and thereby plant innumerable trees.

However, hardly any observation data are available for this group of 'soil pollinators'. The decimation of these insects is probably even greater than for the insects living above ground, as most of the toxic plant protection products trickle into the soil with the rain.

Pollination Must Not Be Taken for Granted

The annual global value of pollination is estimated at around EUR 265 billion (Lautenbach et al. 2012). The absence of animal pollinators would reduce food yields for humans by about a third. The consequences would not be equally drastic for all countries; regions such as Argentina, Northern Africa and large parts of Asia would be particularly affected (see Figure 4). Only the harvests of wind-pollinated plants, such as rice, grains, grapes and corn are not dependent on the pollinators. However, the pollination performance of the insects should not only be regarded in terms of how it benefits humans. The work of the insects is also responsible for the propagation of thousands of plant species, thus ensuring the variety and colourful flowerage of the landscape, as well as the nutritional basis for birds, other insects and many other animal species.

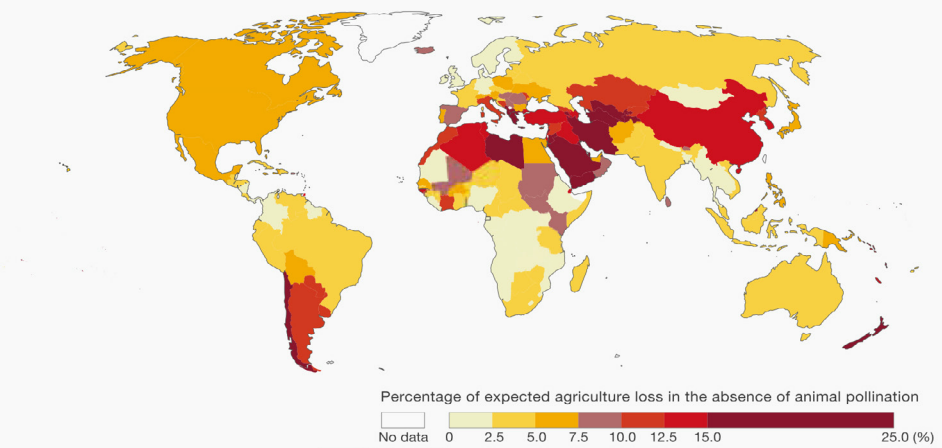

Fig. 4: Estimated loss of agricultural production in percentage on a worldwide scale in the absence of animal pollinators in 2012 (BASED ON FAOSTAT 2013; method according to VON AIZEN ET AL. 2009).

Technical Advances Inspired by Insects and Birds

Insects and birds have often provided inspiration when we humans look towards nature to find solutions on how to lead a simpler life, promote technologies or bring about healing in medicine. Flying is probably the best-known example of how man learns from nature. From the early aeronautical machines of Otto Lilienthal and the Wright brothers to modern aircraft, birds have always been the model for the flying constructions. Mimicking the texture of the compound eyes of moths provided the template for creating the surfaces of solar cells (see Figure 5). This new surface is more absorbent, thus loss of solar energy due to reflection can be almost completely prevented, which allows for more energy to be generated. Termites have taught us how self-regulating ventilation systems work; they transport used CO_2 to the outside of their structures while transporting fresh O_2 to the inside. The invention of paper in ancient Egypt was inspired by the building material wasps used for their nests. Even today, fly larvae are still used to clean wounds, and in the tropics, the jaw clasp reflex of weaver ants can be utilised for wound closure. Architecture has imitated the hexagonal honeycombs, as their shape provides the most stable construction with minimal material usage (MARKUS 2014). We do not know which technological or medical miracles the insect world still holds in store for us. But one thing is for sure – the more insects become extinct, the less we can learn from them.

Fig. 5: The surface of solar cells is based on the eyes of moths to maximize light absorption.

Birds and Insects Promote Health and Inspire Humans

Protecting the birds and insects should be a central concern of our society, not only because it is our ethical responsibility to protect the life and diversity on this planet, but also because they play an important role in people's lives. Studies on the lack of exposure to natural environments, that is people who predominantly live in an urban landscape, show that natural environments with sounds of rippling streams, the rustle of the wind in the treetops, and the humming of insects and singing of birds have positive effects on the psyche, blood pressure, cardiac rhythm, and the number of white blood cells (LEE ET AL. 2009, LEE ET AL. 2017). The flying skills and independent nature of birds inspire the spirit of man and delight his mind with their chirping, singing and whistling. Birds are symbols of hope and freedom for humanity. Imagine a world without birdsong, without birds in the sky, without the return of migrating birds in spring. It would be an empty and sad world. Insects, and above all bees, are also sources of inspiration for art, music, literature and religion. "Flight of the Bumblebee" by Rimsky-Korsakov, is one example of how bees inspired music. Sacred passages about bees can be found in the Mayan Codices, the Surat An-Nahl of the Qur'an, the traditional Chinese writings of Chuang Zhou, and other writings of Hinduism and Buddhism.

The Reasons for Silent Spring

The main reason for the extinction of species – not only in insects and birds but in all living creatures – is the destruction of natural habitats by converting them into usable space for man (PIMM AND RAVEN 2000). In 2013, 40% of the European land area was used for agricultural purposes. In Ireland, the figures even reached 72.5% and in Great Britain, it was 70.5% (EUROSTAT 2017). Many habitats are separated from each other by cities, roads or huge fields, so animals can no longer move freely between them. Without leading and protective structures, such as hedges and rows of trees, many animals are no longer able to cross the vast farmlands.

The extinction of a species always has an impact on other species. Specialized animal species, which only feed on a certain prey or plant, are often the first to disappear. The loss of insects is problematic for all animals that feed on insects. Especially birds, bats and small rodents lose the main supply of their food source. Many species of wild bees need the pollen of a certain plant for the rearing of their offspring, and in some

ecosystems, they are also the only pollinators for this plant. If one of the two dies, the other will also not be able to survive. The caterpillars of many butterflies also only accept a certain kind of plant as their food source. The decline in plant diversity has numerous causes.

Due to intensified seed cleaning, less and less wild herbs grow on arable land. Many plants insects feed on are controlled in modern agriculture as they are classified as weeds and are killed off through the herbicide glyphosate (the main active substance in the herbicide RoundUp). Due to over-fertilisation many plants are no longer provided with suitable living conditions. Through wind and water erosion, fertilisers and herbicides are transported from the fields to the adjacent habitats. They are also washed into the groundwater with the rain, and from there, they are distributed to almost everywhere. Many rare plant species are adapted to survive in nutrient-poor conditions. However, fertilisers increase the nutrient content of soils, which means that other plant species, which can make better use of these conditions, grow faster and displace native plant species.

Technical Radiation Affects the Orientation of Animals

It has been known since the 1970s that bees are able to detect the Earth's magnetic field and use it for orientation (GOULD ET AL. 1978, WALKER AND BITTERMANN 1985, HSU ET AL 2007).

Fig. 6: In their last winged stage of their development, mayflies (Ephemeroptera) live only a few days; they use this time exclusively for mating and laying eggs.

In recent years, it has been found that electromagnetic fields also play an important role in weather perception, food detection, and communication among bees. The wing veins and tiny hairs on the bees' bodies function like small antennae with which they can detect a variety of frequencies. However, these sensitive processes are disturbed by the steady increase in radio frequencies used for technological purposes. By now, this discovery is also supported by scientific studies which clearly show how the orientation of the bees is disturbed, and how sensitively they respond in their behaviour to technical radiation (You can find more information in the WFNS Fact Sheet "The Worldwide Disappearance of Bees"). Birds also use the Earth's magnetic field for orientation; thanks to the protein Cryptochrome in their eyes, they can even see it (SOLOV'YOV ET AL. 2010). It has already been proven that radio waves disturb the migratory behaviour of birds (ENGELS ET AL. 2014, SCHWARZE ET AL. 2016). This also applies to other living organisms. In a meta-analysis, CUCURACHI ET AL. (2013) evaluated the results of 113 scientific studies dealing with the ecological effects that artificial electromagnetic fields in the mobile radio frequencies between 10 MHz and 3.6 GHz have on animals and plants. 65% of the studies showed negative effects to such a degree, they could endanger the survival of animal and plant populations. Insects and birds were most commonly affected. A wide range of effects, such as behaviour, growth, orientation, sensory organs, DNA double-strand breaks and fertility, were observed.

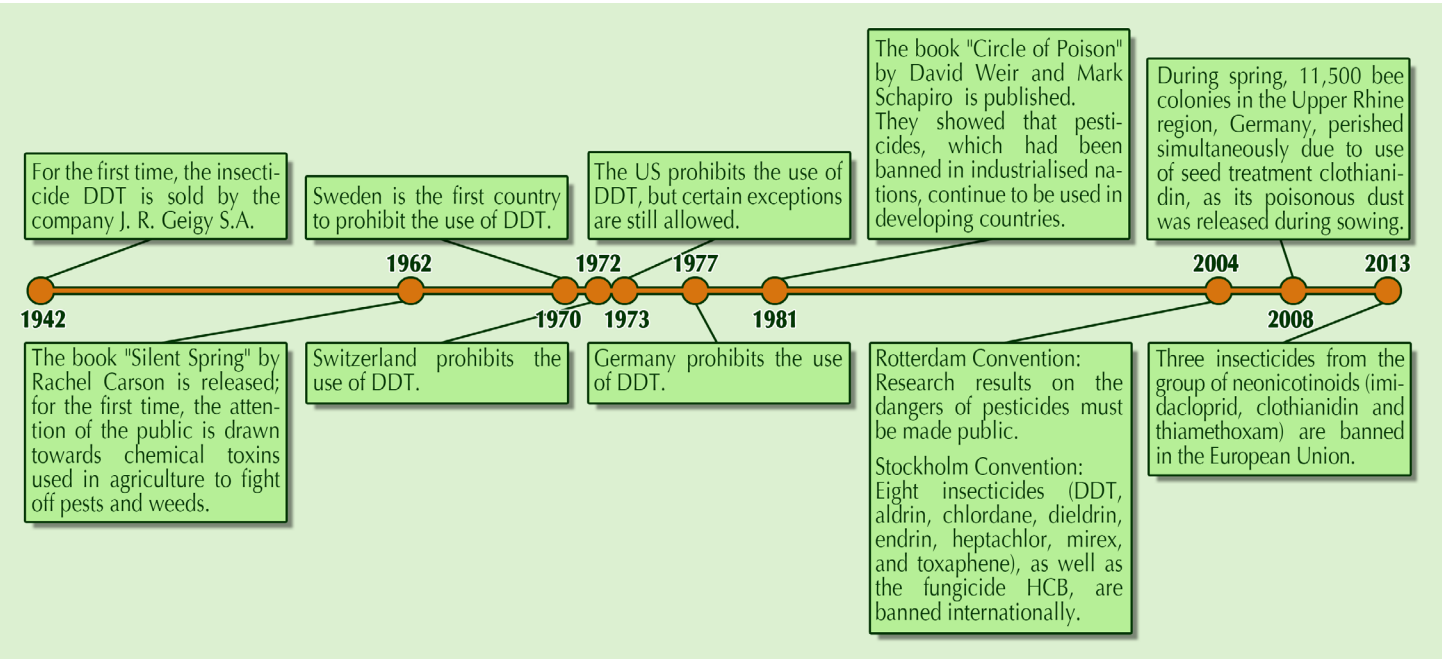

Fig. 7: Timeline of pesticide use and important political turning points in the handling of pesticides.

Box 1: Agrochemical Companies

Trade sales of pesticides are growing faster than sales of pharmaceutical products. Since 1970, the market value of pesticides has grown sixfold. Over the same period, the market value of pharmaceutical products only increased fourfold. Investors, therefore, earn more with pesticides than with pharmaceutical products. (BERNHARD ET AL. 2017)

After the planned merger of Bayer and Monsanto, and that of Syngenta and ChemChina in 2017, only three companies have combined control of 76.7% of the world market of agrochemicals (see Figure 8). The two German companies, Bayer and BASF, together account for 44.2% of the global market. They produce pesticides that are banned in Germany (e.g. the highly toxic insecticides Fipronil (BASF), Regent SC (Bayer) and Thiodan (Bayer)) and export them to other countries, such as Latin America, Africa and India. Through food imports, the crops grown in those areas are transported back to Europe and land on our plates.

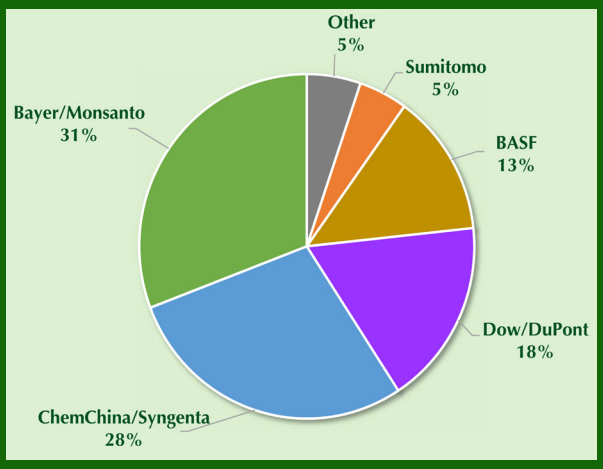

Fig. 8: The new world of agricultural chemicals. The merger of several agrochemical companies means that only three companies have a global market share of more than 75%. (BLOOMBERG INTELLIGENCE 2017)

The effects were all documented below the existing limit values. In addition to studies on the honey bee, investigations were carried out on fruit flies (*Drosophila melanogaster*), moths (*Manduca sexta*), American cockroaches (*Periplaneta americana*) and ants (*Myrmica sabuleti*). In the group of birds, chickens (*Gallus gallus*), Japanese quail (*Coturnix coturnix*), sparrows (*Passer domesticus*), white storks (*Ciconia ciconia*) and great tits (*Parus major*) were examined as representatives.

Solutions for the reduction of technical radiation are already available. A large part of the radiation load could be reduced by combining different radio networks. The radiation intensity can be reduced if a building's interior is no longer supplied through antennae from the outside, and transmission no longer has to pass through thick walls. Inside buildings, data transmission with frequencies close to the visible light can be used. Information between permanently installed radio masts can now be transmitted via fibre optic networks. Thus, it is possible to reduce or even completely eliminate the technical radiation of nature (HENSINGER AND GUTBIER 2017). Read more about the effects of technical radiation in our detailed information materials.

Fig. 9: Learn more about the effects of technical radiation in our information material.

The Downside of Artificial Light

Artificial light in cities, villages and along roads can also be catastrophic for insects; this phenomenon is called light pollution. Street lamps attract insects from a distance of up to 700m. Many insects die directly because of the heat of the lamp or are distracted during vital activities, such as foraging for food, mating and laying eggs (SCHEIBE 2003). According to an estimate by the University of Mainz, every night more than one billion insects die because of artificial lighting (EISENBEIS 2009). But there is a solution for this. Insects mainly react to short-wave light. Lamps with long-wave light (e.g. low-pressure sodium lamps) hardly attract insects but they are more expensive to purchase and maintain.

Pesticides

"Pesticide" is the umbrella term for toxic plant protection products used in agriculture against such animals and plants regarded as pests because they eat, damage, displace or compete with them for nutrients, water and light. Pesticides are divided into groups of organisms against which they are directed. The best-known groups are the 'herbicides' used against plants, 'fungicides' used against fungi, and 'insecticides' used against insects. The intensive use of pesticides began in 1942 with the herbicide DDT. We have provided a timeline so you can see, how often the dangers of pesticides have already been identified and what has been done in an effort to contain them (see Figure 7). Read more about the influence of pesticide producers in Box 1.

Neonicotinoids

Especially the active substance group of neonicotinoids is currently posing a major problem. They are the latest generation of insecticides. Their active ingredients are neurotoxins; they strongly resemble nicotine in their structure and they block certain signalling pathways in cells. For honey bees, some neonicotinoids are 10,000 times more toxic than DDT (GIBBONS ET AL. 2015). In the spring of 2008, 11,500 bees were simultaneously killed in Oberrhein, Germany, by the insecticide Clothianidin. In Scotland, the number of bumble bee queens was reduced by 85% within 6 weeks because they were adversely affected by imidacloprid (WHITEHORN 2012). Even in small quantities, the neonicotinoids lead to developmental defects, as well as loss of memory and orientation in bees and other insects (TIRADO ET AL. 2013). Although pesticides are not directly fatal to birds, they destroy the birds' main food source. After the use of insecticides, birds, which normally hunt insects in fields, have less food to raise their young. As a result, the bird populations are decreasing (HALLMANN 2014). Read more about the spread of neonicotinoids in the environment in Box 2.

In 2013, three active substances from the group of neonicotinoids (imidacloprid, clothianidin and thiametoxam) were banned in the European Union because of the precautionary principle. The ban will be valid until the harmlessness of the active substances against non-target organisms, i.e. living organisms, which are not to be primarily killed by the insecticide, is proven. The manufacturers Bayer, BASF and Monsanto filed a suit against this decision before the Court of Justice of the European Union and claimed damages. They thus challenged the basic precautionary principle. On 22 June 2017, this action was dismissed. These substances are still banned. However, the ban does not include the entire group of neonicotinoids. Other active ingredients of this group are still permitted and they are still widely used.

Preventive Use of Pesticides

Today, the standard in agriculture is to treat seeds with poisons even before sowing. In this so-called 'seed treatment' or ‚coating', the seeds are covered with the insecticide. The seedling then grows while being protected from the pest and absorbs the poison during growth. Insects that eat

Box 2: Pathways of Neonicotinoids in the Environment

Poisons accumulate in the ecosystem and are only degraded very slowly. The half-lives of neonicotinoids in soils can, for example, exceed 1,000 days. Because they are so persistently used, these substances have caused large-scale contamination, including soil, water and air (VAN DER SLUIJS ET AL. 2014).

Between 2% and 20% of the neonicotinoids that have been distributed on the field are absorbed by the plant. Insects that eat the roots or leaves of this plant poison themselves through the food (see Figure 10).

These so-called target organisms, which could damage the plant, should be poisoned by the pesticide. However, this poison is also passed on to the pollinating insects through pollen and nectar. Seeds produced by the treated plants pass the poison on to birds and other animals. A part of the pesticide is flushed directly into the bodies of water through surface run-off, or is accumulated in puddles, from which the animals in the field drink. The majority of the pesticide, 80-98%, is washed into the soil with the rain, enters the groundwater and continues on this pathway into the surface waters. In the waters, fish and the insects developing there, are also contaminated. Birds and small rodents that feed on these insects are also poisoned. In addition, the pesticides are also distributed in the surroundings over a distance of several kilometres via dust (SANCHEZ-BAYO 2014).

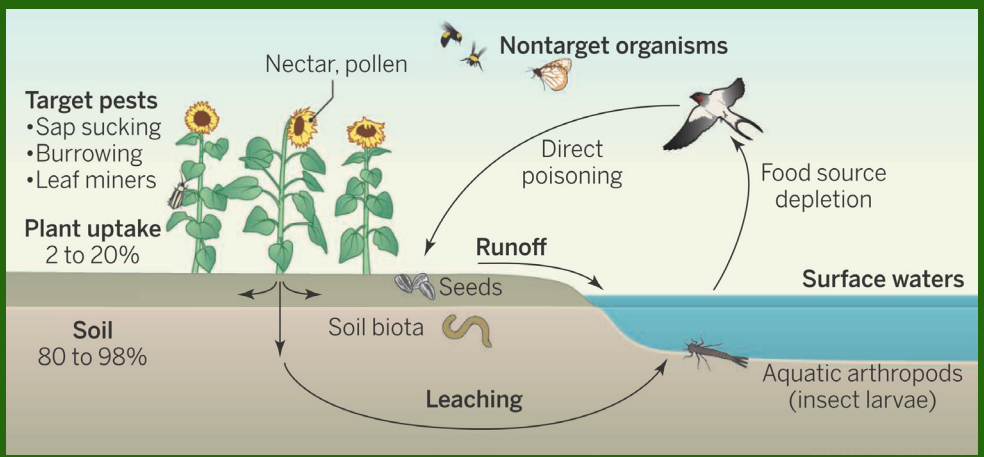

Fig. 10: Fate of neonicotinoids and pathways of environmental contamination (from SANCHEZ-BAYO 2014)

parts of the plant are also killed. The poison is supplied as a preventive measure, even if there is no danger of pest infestation at all. The prophylactic use of pesticides is also criticised by the European Academies' Science Advisory Council: "Current practice of prophylactic usage of neonicotinoids is inconsistent with the basic principles of integrated pest management as expressed in the EU's Sustainable Pesticides Directive" (EASAC 2015). The benefits of an increased harvest do not justify the risks to the environment that arise due to the use of poisons. During an investigation of the United States Environmental Protection Agency on the cultivation of soybeans, their division BEAD (Biological and Economic Analysis Division) concluded that "these seed treatments provide negligible overall benefits to soybean production in most situations. Published data indicate that in most cases there is no difference in soybean yield when soybean seed was treated with neonicotinoids versus not receiving any insect control treatment" (MYERS ET AL 2014). Many genetically modified plants have been deliberately immunized against certain pesticides. Consequently, even more toxic substances can be used in agriculture. Some plants have been genetically modified in such a way that they themselves produce toxins that repel insects. In their report to the UN General Assembly and the UN Human Rights Council, the two Special Rapporteurs Hilal Elver and Baskut Tuncak accuse the agroindustry of playing down the dangers of pesticides by making false claims (ELVER AND TUNCAK 2017). Farmers are often blamed for causing environmental damage and are accused of improper usage of the products. In their report, the experts expressed their "[…] concern about aggressive, unethical marketing tactics that remain unchallenged, and huge sums spent by the powerful chemical industry to influence policymakers and contest scientific evidence" (OHCHR 2017). Read more about the adverse effects of pesticides on human health in Box 3. The Special Rapporteurs also point out that safe solutions for pesticide-free agriculture are often only developed after the state has exerted enough legal pressure on the industry. Prohibitions for individual pesticide groups or banning the use on individual areas will not improve the situation. The poisons enter the entire ecosystem through the soil, groundwater and the food chain, and are degraded more slowly than they accumulate (see Box 2).

The costs of pesticide treatment are just as high as the financial loss of crop caused by pests without pesticide treatment. The applications of poisons do not show any economic benefit. Agriculture is not dependent on them.

"It is time to overturn the myth that pesticides are necessary to feed the world and create a global process to transition toward safer and healthier food and agricultural production."
(OHCHR 2017)

A more holistic approach to agriculture is required, in which man and nature effectively cooperate, and the use of poisons is not necessary. Organic agriculture shows that it is possible to successfully cultivate agriculture even without pesticides and synthetic fertilisers; this approach furthermore promotes the diversity of plants, insects, birds and other animals.

Box 3: Pesticides and Human Health

Humans are also affected by the enhancement of pesticides in the food chain. Studies in foodstuffs in the USA in 2014 showed that all the fruits and vegetables tested, contained at least one neonicotinoid; 72% of the fruits and 45% of the vegetables contained at least 2 neonicotinoids (CHEN ET AL. 2014).

A study conducted in Japan in 2004 showed that 90% of the tested subjects had urine samples contaminated with at least 4 different neonicotinoids; namely imidacloprid, clothianidin, dinotefuran & thiacloprid (UEYAMA ET AL. 2014).

In addition, studies are increasingly providing evidence that neonicotinoids (especially imidacloprid) may interfere with human brain development and neurotransmission in the human brain (KIMURA-KURODA ET AL 2012, VALE ET AL 2012)**. Studies show the statistical correlations between pesticide exposure and a higher risk for numerous cancers (especially prostate cancer and lung cancer), developmental disorders in children, sterility, neurological and immunological disorders, hormone disorders, Alzheimer's disease, Parkinson's disease and hypersensitivity** (ALLSOP ET AL. 2015)**. Every year, 200,000 people die from pesticide poisoning worldwide, most of them in developing countries, where regulations are weaker and less strictly applied. Farm workers, people living near fields, pregnant women and children are particularly vulnerable** (ELVER AND TUNCAK 2017)**. International agreements aimed at protecting the environment only exist for a few pesticides. For a large proportion of the pesticides and countries, however, there are no regulations that provide adequate protection.**

Fig. 11: The glass-winged butterfly (Greta oto) is one of the few of its species with translucent wings.

Solutions for a Buzzing and Chirping Spring

An insect will only become a pest if we provide it with an unnaturally large supply of food, and it can, therefore, multiply very strongly. So, we human beings are the ones who cause this disharmony in nature. This can be prevented by cultivating smaller areas of arable fields with alternating crops. However, using crop rotation with annually changing cultivated plants prevents the same pests from accumulating over a long period of time. Some pests can be controlled with the so-called push-pull technology. Hereby, a plant which functions as a repellent for the pest (push) is planted between the crops, and on the circumference of the field, another plant, one the pest prefers to the actual field crop (pull), is planted. The pest then moves into the outside area of the field. The method has been very successfully implemented in East Africa with European corn borer moths (MARKUS 2014). However, if there is a problem of excessive insect breeding, this can be partly regulated by their natural enemies, which are mostly birds. Birds need hedges and trees to breed in, but unfortunately, these are structures humans have increasingly removed; now it is time to rebuild them. Besides birds, there are also other natural enemies that can be used. Ladybirds eat aphids. Whiteflies in tomato and cucumber cultivations can be fought off with the wasp species *Eucarsia formosa*, and the wasp *Apanteles glomeratus* can fight off cabbage white butterflies in cabbage patches (MARKUS 2014). However, this is also only an unnatural and short-term treatment of symptoms. The natural enemies should be allowed to re-settle on their own terms. After evaluating a total of 193 studies, the meta-analyses of Jane Bengtsson and David Hole show that the diversity of species on organic farmland is on average increased by 30% compared to industrial farmland, and that the populations of butterflies, spiders, bugs, ants and beetles are significantly increased (BENGTSSON ET AL. 2005, HOLE ET AL. 2005). At the same time, a decrease in pests was also observed. Responsible for this are the numerous useful insects that hunt for the pests (MARKUS 2014). In the long run, the beneficial insects prevail. However, deciding against the use of insecticides requires providing a higher structural diversity in the form of hedges, smaller fields and wide field margins, to give them the chance to settle at all. In a diverse agricultural landscape, this is possible.

Organic Agriculture

Organic agriculture manages to make do without herbicides such as glyphosate. By cultivating customised crop rotations, it is difficult for weeds to establish themselves in the field. Special harroweeders and machine hooks are used to mechanically remove germinating weeds. A certain degree of weed infestation below the damage threshold usually occurs as a normal side effect of plant cultivation, which is why we are not speaking of weeds but of accompanying flora of cultivated land. The undoubtedly higher density and diversity of wild herbs on organically managed areas are of great importance for the stability of the agricultural ecosystem, as well as for the conservation of biodiversity. In turn, thousands of species of animals, insects and microorganisms, which also fulfil important functions in the natural ecosystem and in the soil, are dependent on the existence of wild herbs. Furthermore, weeds also reduce erosion through wind and water, as well as the seeping of nutrients into the groundwater.

In a natural agriculture, the use of pesticides is not necessary if the occurrence of large pest populations is stopped by a variety of methods of cultivation, the promotion of beneficial organisms, and the knowledge of ecological connections. Pesticides are not the sole cause of insect mortality,

Fig. 12: Promote the diversity of birds in your own garden by using simple means and enjoy valuable observations and soothing birdsong.

At present, the intensive agriculture produces only slightly larger quantities of food than organic farming, but it earns less and causes at the same time enormous ecological problems. "Resultant problems include biodiversity loss, massive soil erosion and degradation, eutrophication and oceanic dead zones, pesticide effects on humans and wildlife, greenhouse gas emissions, and regime shifts in hydrological cycling."
(PONISION ET AL. 2015).

but they are one of the reasons we could immediately eliminate from one day to the next – and we should do so.

Many farmers today are dependent on large agricultural companies because their seeds also require their special fertilisers and pesticides. A departure towards an independent or even organic agriculture needs courage and perseverance. But it is worth it. The sales prices of organic foods are up to 32% higher (CROWDER ET AL. 2015). Meanwhile, the yield of organic farming under optimal cultivation methods is only 8% lower than under conventional cultivation methods (PONISION ET AL., 2015).

Currently, only about 1% of the global agricultural area is managed using organic measures (CROWDER ET AL. 2015). What would happen, if only organic farming were to be carried out on all agricultural land? Could we still feed the entire population of the world? The answer is – yes, even with an increasing population, the world could still sustain itself using organic farming methods. This was already demonstrated by the 2009 report of the International Assessment of Agricultural Knowledge, Science and Technology for Development (MCINTYRE 2009).

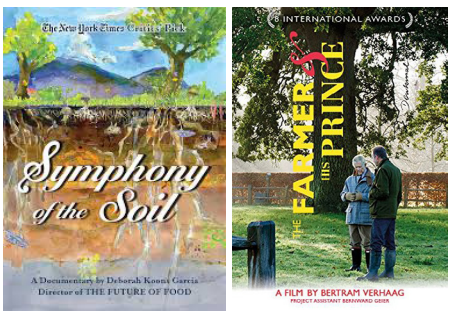

Fig. 14: For more information on organic farming, please watch the award-winning documentary "Symphony of the Soil" and "The Farmer and His Prince".

Fig. 13: By using simple means you can promote the variety of insects in your garden; as a reward, you will be able to make valuable observations and receive higher harvests due to increased pollination..

We have arrived at a point, where conventionally produced foods cause great collateral damage in the ecosystem. When buying an apple from conventional or organic farmers today, we can indeed choose whether or not 10 bees have died for its production. If we buy the conventionally treated apple, we pay more in the long run. If the fruit farmer uses pesticides that kill useful bees, he must hire a beekeeper in the following year to provide him with bee colonies because the bees can no longer pollinate directly on the farm, and so the apple becomes more expensive. Box 4 tells you how you can generally support birds and insects, and especially how to do so in your own garden.

Nature Always Provides a Solution

Earth is our home and we must remember that our children must continue living in this world. The insects are part of nature and cannot be replaced in the tasks they fulfil. When approaching the world of insects, one soon discovers a variety, intelligence, beauty, and rich colouring that is rivalled only in a few other animal groups. Let us protect the insects and birds, so we can continue to learn from them. What is needed is a complete agricultural change towards organic farming without synthetic poisons, and exchanging the currently used radio technologies for a method that is in harmony with the natural order. Organic agriculture shows that nature has a solution for all problems – all we need to do is watch and learn. This is the only way to preserve the environment, save insects and produce healthy food. We can no longer rely on politics and agriculture alone to find a solution for this problem. The insects need our and your support now!

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Box 4: This Is How You Can Support the Insects and Birds

- ➤ **Buy organic foods from your local farmer that have been grown without the use of pesticides.**
- ➤ **Inform conventionally working farmers and other people in your community about the disappearance of insects and birds and their causes.**
- ➤ **Write letters to those responsible, such as politicians and grocers, and demand pesticide-free food, regardless of organic certification.**
- ➤ **Reduce your use of wireless technologies.**
- ➤ **For the sake of the insects and birds, make do without pesticides in your own garden.**

Special Tips to Promote Insect Diversity in the Garden

- ➤ **Plant a variety of insect-pollinated indigenous plants in your own garden, and ensure you offer a varied, lasting selection of blossoms from spring to autumn.**
- ➤ **Refrain from buying ornamental plants that produce very little to no pollen or nectar.**
- ➤ **Install nesting aids for insects (insect hotels). Also, build walls of clay and create open ground areas, as two-thirds of the wild bee population nest in the ground.**
- ➤ **Install a shallow water trough with stones in it, so insects can drink from it without drowning.**

Special Tips to Promote Bird Diversity in the Garden

- ➤ **Plant fruit trees that offer the birds valuable food, especially in late summer.**
- ➤ **Place a sand bath for birds in a sunny place.**
- ➤ **Sweep fallen leaves under the bushes, or just leave them lying on the ground. Birds love searching for food under the leaves.**
- ➤ **Preserve branches and old trees with caves, even if they are already dead. They provide valuable habitat for cave-nesting birds.**
- ➤ **Support birds while breeding by:**
  • putting up nesting caves for blue tits and great tits, starlings or redstarts, and
  • installing semi-hollows as a nesting aid for black redstarts, wagtails, spotted flycatchers and wrens.
- ➤ **Feed the birds all year round. Birds rely on their feeding areas and do not only need additional food during the winter but also in summer.**

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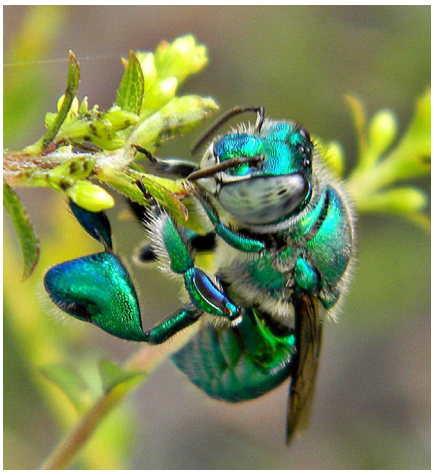

Fig. 15: The males of the tropical orchid bees (Euglossini) coat themselves with aromatic oils from orchid blossoms to attract females.

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