

BIODIVERSITY AND LITERATURE, MUSIC AND TECHNOLOGICAL APPLICATIONS

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Abstract

The article addresses the topic of Biodiversity in itself and in relation to other cultural spheres. An overview of its relationship with Literature enables the reader to discover, or re-discover – in classical as well as contemporary texts – the presence of nature, declined in its diverse forms, depending on the geographical context, the historical period and the author's background. The paper provides a number of relevant examples on the theme of man-nature relationship taken from authoritative writers. It also discusses and documents the relationship between biodiversity, music and technological applications by mentioning several musicians in whose productions nature is widely present with sounds related to the environment. Moreover, it illustrates some innovative artistic projects in which the sounds of nature become music aimed at protecting our Planet. The article calls for a growing awareness and acceptance of the need to safeguard biodiversity, taking into account recent legislative references.

Keywords

Biodiversity, Nature, Ecology, Ecosystems, Biodiversity and Literature, Music, Biodiversity and Music, Music and Technological Applications, Biodiversity and Technological Applications.

1. *Biodiversity and Literature*

Science, Biodiversity and Literature, Music and Technological Applications, are not separate worlds, they are not always mutually exclusive. Sometimes they may intersect and intertwine, so that in one we can find the other and vice versa, often reinforcing each other.

The topic of the relationship between Biodiversity and Literature is of great importance. Dealing with it, we may discover or re-discover, in the pages of a literary text, the presence of Nature and the different forms in which it is presented, either as the background to the events narrated or as the protagonist.

Since the classical age, throughout the centuries, Nature, declined in the variety of its forms, has left its traces in literature with some differences depending on the sensitivity and the culture of the various authors.

Carlo Carena, one of the most authoritative scholars of classicism, in his work, *La natura nel mondo antico. Antologia classica da Omero a Plinio il Giovane* [Nature in the Ancient World. A Classical Anthology from Homer to Pliny the Younger](Carena, 2023), has chosen the most

beautiful pages from classical literary works to reveal the natural environment, the flora and fauna, as a repository of a primordial force, protected by the gaze of Zeus, able to ensure its integrity.

Carena quotes the Italian translation by Quasimodo of some verses taken from Homer in which the Greek poet emphasises the richness of Nature and its biodiversity when describing the cave where the nymph Calypso lives. (Quasimodo, 1945).

The world depicted by Homer is almost an earthly paradise, the nature is lush, the waters of rivers and lakes are crystal clear, the mountain peaks are snow capped and shining like diamonds: men believe that Nature is inhabited by divinities. The sky is clear, transparent, a blue tone not yet contaminated by fine dust and industrial waste.

In the Homeric poems, we can also perceive hints of a new interpretation of natural phenomena. The description of some scenes begin to reveal the origin of his inspiration, derived from the observation of the surrounding reality: particular attention is paid to country life, analysed in the most important moments, such as ploughing in spring, harvesting in summer and

grape harvesting in autumn. In the *Iliad*, for example, when describing the third section of Achilles' shield, Homer displays his interest in the work of man surrounded by nature.

In this passage, one can almost breathe not only the triumph of nature's generosity, but also the industriousness of man and his ability to interact with it, by respecting its laws. A harmonious relationship seems to have been established.

In a passage of the *Odyssey*, we are provided with a way of observing nature, consisting of a great admiration for the shapes, colours and scents it offers. An emblematic example is given in the verses dedicated to the description of King Alcinoos's garden, reiterated in the description of the place where Calypso lives, where, as we have seen, biodiversity dominates. One can also find there a predilection for cultivated nature, made more beautiful by the loving work of man.

The message conveyed by the poet Hesiod in his poem, *Works and Days* (8th century B.C.), is significant since here he anticipates a concept that has been widely taken up in many subsequent literary works: labour, commitment, tenacity and resistance to hardship enable man to reap the fruits of the earth, with respect for it and with the help of the weather.

In the *Georgics*, Virgil (1st century B.C.), thanks to his personal and cultural experience, moved by didactic motives, and in a form rich in charm and harmony, describes the skills a man requires to work the land and breed animals, thus laying the foundations for a profitable relationship with Nature. Virgil was a poet rich in *auctoritas*, of great human depth, endowed with a wide cultural background and compositional wisdom. For these gifts Dante elected him as his guide in his descent into Hell and ascent up the mountain of Purgatory.

Unfortunately, for contemporary men, nature has lost its 'sacredness'. Therefore, the earth, the woods, the sea, the sky are exploited for economic purposes and thus deprived of their intrinsic value, beauty and variety.

A new understanding is brought about by the advent of Christianity, which attaches great importance to Nature by regarding it as a divine creature.

Surprisingly for the times and for the dominant religious culture, Dante's stance is significant: the Supreme Poet's extreme attention to every being in the world of nature allows his readers to regard him as a naturalist and also an ecologist ante

litteram, as has been amply demonstrated in the open access Multimedia Project "*Dante as an ecologist and poet in the world. Divine Illustrations' by Gustave Doré. An open access multimedia project*" (Valzano & Sartor, 2021) and in the Multimedia Project "*Dante's journey in the Botanical Garden*" (Valzano, Accogli, Sartor, & Romani, 2022), both published in the international, diamond open access scientific journal, *SCIRES-IT - SCientific REsearch and Information Technology*.

In the 19th century, with the rise of Romanticism, Nature becomes one of the great themes in literature once again. During this period, the lyrics of many poets describe the enchanting and comforting fascination of nature, even if sometimes it may disappoint their expectations, as shown by the production of poets belonging to the Italian literary current of Romanticism, such as Ugo Foscolo (1778-1827) and Giacomo Leopardi (1798-1837).

Foscolo can be defined as a pre-romantic author for his early fascination for nocturnal and sepulchral landscapes. He elaborates a mechanistic idea of nature: it is a 'continuous becoming' and every being, including man, is made up of matter and, as such, subject to a cyclic process of transformation. The Universe is a machine ruled by precise mechanic laws and moved by a principle of conservation. In Nature, life and death depend on an ongoing process of aggregation and disintegration.

Leopardi's attitude towards Nature is ambivalent: Whereas he sees its beauty and its benevolent character, in his vision, Nature may become an evil "stepmother" that exerts its destructive force on man. In his "Dialogo della Natura e di un Islandese" (*Operette Morali, 1823-1828*), the Moon, which represents Nature, is the beautiful and terrible force that fascinates and, at the same time, terrifies the poet.

The English Romantic movement deserves specific mention since it, somehow, anticipates all the issues discussed in the present paper. The movement was not only a response to the scientific rationalisation of Nature of the Enlightenment but also a reaction against the changes society was undergoing since the end of the 18th century because of the Industrial Revolution. "Back to Nature" was the message the romantic poets conveyed through their poetry as a solution to the problems that industrial capitalism was posing.

Nature is not just an essential source of inspiration, a predominant theme in the works of the romantic poets, but, above all, a reaction to the threat posed by the Industrial Revolution, with the pollution and the poverty caused by the increasingly expanding industrial centres, which were perceived as a danger to the preservation of the environment. They were well aware that the exploitation of natural resources and the use of fossil fuels, on which the industrial system of mass production was based, would eventually bring about the destruction of the Earth's ecosystems.

The poet becomes a 'prophet' able to mediate between man and Nature by denouncing the evils of modern, capitalist society and showing the ideals of beauty, truth and freedom, thus providing a glimmer of hope in the belief that the natural environment could be preserved if only man reversed this destructive trend.

Nature is also a solitude place where the poets can find relief and inspiration for their poetry. The romantic poets feel in harmony with Nature, and are able to convey their feelings to their readers through their poetry.

While all the Romantic poets share a deep appreciation and love for nature, their vision and treatment of nature differ significantly.

In the Preface to the *Lyrical Ballads*, written in collaboration with Coleridge, William Wordsworth (1770–1850), described their poetry as "the spontaneous overflow of powerful feelings", an act of creation inspired by the sublimity of Nature. (1978). Wordsworth saw Nature as a living being, a moral guide, a spiritual influence on man's life. Therefore, communion with Nature represented a morally uplifting experience. He described his philosophy of Nature in a famous poem, "Tintern Abbey", and in the poem "The Prelude":

*One impulse from a vernal wood
May teach you more of man,
Of moral evil and of good,
Than all the sages can.*

The view of Samuel Taylor Coleridge (1772–1834) on Nature was ambivalent: on the one hand he shared Wordsworth's vision of Nature as a spiritual renewal; yet, on the other hand, he believed that Nature represented a temptation that might alienate man from social human commitment. His strong Christian faith prevented him from identifying Nature with God.

Coleridge's poem 'To Nature', dedicated to the environment, celebrates the beauty and wonder of nature:

*It may indeed be phantasy, when I
Essay to draw from all created things
Deep, heartfelt, inward joy that closely clings ;
And trace in leaves and flowers that round me
lie
Lessons of love and earnest piety.*

In 'Ode to the West Wind' (1820) Percy Bysshe Shelley (1792–1822) explored Nature to express his admiration and desire to be at one with it, as well as to address the social and cultural impacts of man's creative progress. Here Shelley wishes to spread his message of social change, and the wind becomes the means by which his prophetic words may be conveyed.

*Be thou, spirit fierce,
my spirit! Be thou me, impetuous one!
Drive my dead thoughts over the universe
like withered leaves to quicken a new birth!
And, by the incantation of this verse,
scatter, as from an unextinguished hearth
ashes and sparks, my words among mankind!
Be through my lips to unawakened earth
the trumpet of a prophecy! O, wind,....*

The poem ends with an optimistic note: *If Winter comes, can Spring be far behind?*

Shelley perceived the sublime aspect of Nature that he described in beautiful sceneries, yet, at the same time he was aware of its merciless and destructive potential:

*... But a flood of ruin
Is there, that from the boundaries of the sky
Rolls its perpetual stream; vast pines are
strewing
Its destined path, or in the mangled soil
Branchless and shattered stand: the rocks,
drawn down
From yon remotest waste, have overthrown
The limits of the dead and living world,
Never to be reclaimed. ("Mont Blanc: Lines
Written in the Vale of Chamouni", 1816).*

George Gordon Byron, known as Lord Byron (1788–1824) is today regarded not only as a great romantic poet, but also as an important ecological thinker.

In his book *Byron's Nature: A Romantic Vision of Cultural Ecology*, J.A. Hubbell states that Byron's poems are aimed at developing a cultural ecology encompassing a model of emancipatory ecopolitics and ecopoetics able to counteract the threat posed by human progress to the environment. (Hubbell, 2018) As a matter of fact, in many of his writings, he represents human culture and the environment as dynamically interconnected. Byron's conception was novel at that time, but today it becomes highly relevant to the present cultural-ecological discourse.

In his poem, "There is Pleasure in the Pathless Woods", (included in *Childe Harold's Pilgrimage*, 1812), he describes the joy experienced when walking a path no human being follows in an unspoiled Nature that is a haven and a balm for the soul:

*There is a pleasure in the pathless woods,
There is a rapture on the lonely shore,
There is society, where none intrudes,
By the deep Sea, and music in its roar:
I love not Man the less, but Nature more,
....
To mingle with the Universe, and feel
What I can ne'er express, yet cannot all conceal.*

Nature is central to the thought and writing of Walt Whitman's (1819-1892), one of the most influential writers and poets in American literature. Although with many differences, Whitman shares the Romantic poets' love for Nature, fascination with solitude and isolation, a belief in spiritual freedom, and an emphasis on human connection with the environment.

"Song of Myself" celebrates the unity of nature and humanity. In the poem, Whitman reminds us that we are intimately involved with nature and stresses the importance to protect the environment not only for the economics of survival, but also for emotional and aesthetic sustenance.

"The World Below the Brine" provides the reader with an insight into the life that lives just under the surface of the ocean. It was published during a period of rapid changes in science, following Charles Darwin's publication of his new ideas on the evolution of species. The poem represents Whitman's acceptance of 19th-century biological notions of human evolution, as we can see in the last line,

"The change onward from ours to that of beings who walk other spheres".

For her attention to Nature, Emily Dickinson (1830-1886) is often regarded as an American Romantic poet. Nonetheless, while her writings reflect the cultural influences of romanticism, she sought new approaches to the observation of Nature, raising awareness and respect for Nature among the readers, inviting them to reevaluate their attitudes toward Nature, thus displaying a more modern, 'green', attitude and representing a contribution 19th-century poetry can make to ecological consciousness in the 21st century.

Dickinson pays attention not only to enchantment and divinity in nature but also to such ecological concerns as respect for the environment and nonhuman life forms providing new reasons for opposing the exploitation and destruction of our biosphere.

By describing the various natural processes, phenomena, and beings she observed in Amherst, the place where she lived, which was the natural habitat of diverse creatures but was undergoing development and deforestation towards the end of 19th century, she shows her respect for biodiversity and provides the reader with precious ecological knowledge.

She avoided the description of creatures conventionally treated by the Romantic poets. Her approach to nature gave her the opportunity to present some aspects of nature that were neglected by the Romantics, such as the rat, the mushroom, the fly, the bat, the snake, the frog, the stones.

Dickinson's poem, "Nature is what we see" can be considered a true manifesto for the protection, care, and respect of the natural environment around us:

*"Nature" is what we see—
The Hill—the Afternoon—
Squirrel—Eclipse—the Bumble bee—
Nay—Nature is Heaven—
Nature is what we hear—
The Bobolink—the Sea—
Thunder—the Cricket—
Nay—Nature is Harmony—
Nature is what we know—
Yet have no art to say—
So impotent Our Wisdom is
To her Simplicity.*

Giovanni Pascoli (1855-1912) and Gabriele D'Annunzio (1863-1938) are two outstanding exponents of the Italian Decadent movement, a late 19th-century artistic and literary current

marked by the progressive fading away of positivism.

Nature plays an essential role in Giovanni Pascoli's poetry. It constitutes a constant source of inspiration, beloved in every season for its colours, its scents, and for the diversity of its greenery, above all its spontaneous herbs. For this reason, many scholars have regarded Pascoli as a poet having the competence of a botanist. Often, in his verses, he complains with regret that men have no respect for nature and their fellow human being.

In Gabriele D'Annunzio's writings we find the triumph of Biodiversity.

Nature, depicted with poetic tones, seems to come to life in his writings. A respectful and serene coexistence between man and the natural environment takes place in the lyric "La pioggia nel pineto", contained in "Alcyone" (Halcyon), composed in the summer of 1902, when D'Annunzio was living in a villa near the pine forest of Marina di Pisa.

We find ourselves immersed in a green and beautiful landscape: majestic pines, tamarisk, juniper, myrtle, broom. Silence reigns all around, extolled by the tapping of raindrops and, after the rain, by the song of cicadas and frogs, as in a musical score. The sensory sphere of hearing is joined by that of sight, as we are attracted by the marvelous flora and fauna housed in a small corner of the universe rich in biodiversity.

The tamarisks have been mentioned by countless authors, first and foremost Virgil, who in the proem of his "IV bucolica" states that he did not want to sing a courtly, erudite poem, but wished to sing and extol something small, simple, humble.

Better known as a German playwright, Bertolt Brecht (1898-1956), wrote a great number of poems. His verses contain a singular view on the challenges of our times, able to gather in the same perspective the perils of humanity and nature.

"The Old Man in Spring" is a hymn to the beauty of nature that is in danger of disappearing due to the carelessness of us humans, our irresponsible behaviour, our actions focused on profit and our thirst for resources and power.

*Oh back in my day when I was a youngster
Spring was lovelier than it is today*

.....

*Ask your mother: she thinks the same as I do
Nobody knows what's what before they're old.
The old have seen a lot and I can tell you
Yours is the age of iron and ours was gold.*

...

*It must be true that corn and meadow now
Are not so green and gold as they were then...*

(Translated from German, by David Constantine)

Writing during wartime, and although unaware of the climate and environmental issues that we are facing today, yet Brecht's writings convey a universal message sounding as a timeless warning. His works can still be used to gain awareness of our limits on the Earth.

In "Tant de Forêts" (So Many Forests), the French poet Jacques Prévert (1900-1977), highlights the need to preserve the plant life of our planet. In this poem, he criticizes the destruction of forests to produce paper pulp, ironizing on the fact that newspapers warn us about deforestation although they are made of paper themselves.

"Versicoli quasi ecologici: Non uccidete il mare" (Almost Ecological Versicles: Don't Kill the Sea) by Giorgio Caproni (1912-1990), represents a heartfelt plea to men to remind them that they are part of nature and cannot inflict violence on it without harming themselves. By exploiting the resources of the environment, humans do not realize that they are impoverishing themselves, destroying the basis of their own lives. The poem takes the form of an extreme lament on the condition of modern man who is recklessly destroying the environment, thus making it an inhospitable place. Caproni's words are an open denunciation of man's actions that are increasingly ruining our natural landscape solely for selfishness and profit.

During the 20th century, many Italian writers addressed the topic of the epochal transformations of the landscape and contemporary society. Among them, Pier Paolo Pasolini, Paolo Volponi and Anna Maria Ortese, who all reflected on these changes, exploring the complex relationship between man and nature.

In the years after World War II, Italy, was undergoing a change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing with an unparalleled acceleration. To use the strong words of the poet Andrea Zanzotto, it went, in just a few years, "*dai campi di sterminio allo sterminio dei campi*", with a play on words that cannot be translated literally into English and meaning: from extermination camps to extermination of fields.

Lately, at different times and in different places, a great number of writers have dealt with topics related to Nature, in a fascinated or sometimes critical manner, as in the writings of Mario Rigoni Stern, Carlo Sgorlon, Cesare Pavese, Giovanni Comisso, Guido Piovene, Claudio Magris, among many others.

From many quarters, a coexistence between Man and the Environment based on mutual respect is strongly called for, with words that denounce the increasingly unbalanced relationship, in the name of a progress that, gradually and irreversibly, is undermining the foundations of the necessary harmony between man and Nature.

The poet Andrea Zanzotto (1921-2011), regarded as one of the most significant poets of the second half of the twentieth century for his extremely prolific writing, his innovative language and the wealth of cultural echoes, equates progress to a slipknot that suffocates biodiversity in its beauty and richness of forms, taking away its breath.

In 2009, he engaged in a critical dialogue with Maurizio Breda, published by Garzanti, *"In questo progresso scorsoio"*, a title taken from one of his haikus: *"In questo progresso scorsoio / non so se vengo ingoiato / o se ingoio"* [In this slipknot-like progress / I do not know whether I am swallowed / or whether I swallow"].

Zanzotto addressed the ecological question without ever pronouncing apocalyptic prophecies or taking the role of prophet or guru. The country discussed with Maurizio Breda is not only vampirized by cement, it is also transformed into an item for tourist postcards, for a kind of tourism that is as reckless as the proliferation of modern construction.

We are a long way from the physical and psychological condition described in Gabriele D'Annunzio's poem *"La pioggia nel pineto"* (The Rain in the Pine Grove), in which the poet and his woman become one with the forest that surrounds them, in a complete fusion with nature, in a serene and respectful coexistence between human beings and nature.

The theme of Nature and Zanzotto's poetic composition are intertwined in one of his most famous collections, entitled *"Il Galateo in bosco"*, composed between 1975 and 1978, in which the protagonist is Montello, a place so dear to him.

In the preface, Gianfranco Contini defines him as an *"affable, although difficult poet, one who digs*

the subterranean depths of his forest with his hands».

Zanzotto is deeply attached to the nature and the landscape of his places of origin, not only Montello, but also the Pre-Alps and the Piave River.

His verses exalt the charm of these places and, at the same time, express his dismay at the increasingly devastating degradation in which centuries-old balances are being altered.

For Zanzotto, a beautiful landscape is the prerequisite for poetry, it is the emotional core that gives meaning to his life. For him, poetry itself is only conceivable in its precise territorial context. From Pieve di Soligo, his home town, he reluctantly moved away, preferring to receive relatives and friends at his home. He only left his home for essential academic duties, as in the case of his conference in Pisa at the Scuola Normale Superiore in 1999, where he and his wife Marisa Michieli also had the opportunity to meet his relatives: his cousin, the mathematician Pio Andrea Zanzotto with his wife Gabriella Sartor and their eldest son Nicolò. (Fig. 1).



Fig. 1: From right: Pio Andrea, the Poet, Nicolò Zanzotto, Marisa Michieli, Gabriella Sartor. (Private archive G. Sartor).

The thought of Salvatore Settis (1941) is regarded as highly significant due to the tireless battle for the environment against civil degradation.

An archaeologist and art historian, Salvatore Settis has always stood out for his commitment to safeguarding our country's artistic and environmental heritage, writing many books and articles and taking part in public debates in order to promote culture and protect the environment against civil degradation.

From 1999 to 2010, Settis was Director of the Scuola Normale Superiore in Pisa, President of the Consiglio Superiore dei Beni Culturali from 2007 to 2009, a founding member of the European Research Council (2005-2011). He is currently President of the Scientific Council of the Louvre and a member of the Accademia Nazionale dei Lincei. He is also a member of the editorial board of the international scientific journal *SCIRES-IT -- SCientific REsearch and Information Technology*, focused on digitisation and multimedia and information and communication technologies to support the documentation, conservation and enjoyment of cultural and environmental heritage.

Landscape, writes Settis, is a common good protected by the Constitution, it is a right of every citizen and must be defended by each of us, in the first person. It is the place in which we live, which we see and breathe every day, which we have inherited and which we, in our turn, will bequeath to future generations. Landscape is also environment, it is the product of the encounter between nature and culture.

Today we are destroying our landscape by pouring concrete and by carrying out speculative building projects, thus making an already high seismic risk area even more fragile. Agricultural and forest land is for mankind a source of food, oxygen and protection from hydrogeological instability. The damage done by covering it with concrete is perennial.

Across the world, in different situations, we are witnessing economic, technological, industrial and even tourist 'progress' that destroys forests, pollutes seas and lands.

Environmental pollution and building speculation are the two sides of the coin. The same people who spread poisoned waste across the countryside often build apartment blocks on top of it.

In his book *"Paesaggio Costituzione cemento. La battaglia per l'ambiente contro il degrado civile"* [Landscape, constitution, concrete. The fight against civil degradation](2012), winner of the prestigious *Gambrinus "Giuseppe Mazzotti"* literary prize for the "Ecology and Landscape" section, Settis also argues that the landscape is Italy's great victim of our times, since it is devastated with impunity every day, before everyone's eyes, for the profit of the few. What was once the *Bel Paese* makes havoc of itself, it is submerged in concrete that kills our historical memory and harms our physical as well as mental health, and infringes on

the rights of future generations. This rampant phenomenon is detrimental to every individual as well as the community.

"Mountains, countryside, coastlines are less and less the treasure and breath of all citizens, they are rather now the all too easy hunting ground for those who cynically devastate them, trampling the common good underfoot for their own blind profit. [...] This blind, suicidal devastation of the space in which we live, the "progressive transformation of the Italian plains and coasts into a single immense periphery", would not take place with impunity if there were among citizens "a clear perception of the value of the resource and the irreversibility of its consumption".(Settis, 2012).

Today's paradox, writes Settis, is that together with the growth of citizens' awareness, we are witnessing an increase in building speculation. This is why we must reverse course immediately, respecting the laws and getting involved personally.

In 2015, Pope Francis (Jorge Bergoglio) published the *Encyclical Laudato Si' on "Care for the Common Home"*, asking all human beings to convert to ecology: ecological conversion.

In this document, in which all scientists who deal with the environment recognise themselves, he explains that man is part of ecosystems, he has his own ecology that depends on the functioning of ecosystems. He is not outside Nature, he is part of Nature. He must safeguard it. *«Since all creatures are connected to each other, the value of each one must be recognised with affection and admiration, and all of us created beings need each other».*

For the first time in history, a world religious authority is not calling for conversion to a religion but to a science: ecology.

In the six chapters of the *Encyclical*, the Pope points out that our abused and plundered earth requires an *«ecological conversion»*, a *«change of course»* so that mankind can take responsibility for a commitment to *«caring for the common home»*. A commitment that also includes the eradication of destitution, care for the poor, equal access, for all, to the Planet's resources.

In the first chapter of the book, the Pope warns against the serious consequences of pollution and the *«culture of waste»* that seems to be transforming the Earth, *«our home, into an immense dumping ground»*. These dynamics can be countered by adopting different production models, based on reusing, recycling, and limited use of non-renewable resources.

Climate change is also «*a global problem*», the Encyclical explains, as is access to drinking water, which must be protected as an «*essential, fundamental and universal human right*», «*rooted in the inalienable dignity*» of man. Also central is the protection of Biodiversity since every year, because of us, «*thousands of plant and animal species are disappearing, and our children will never have the chance to know them*».

«*To a large extent it is man who slaps nature in the face all the time. We have kind of taken over nature, sister earth, mother earth. An old farmer once told me, 'God always forgives. We - human beings - sometimes forgive, nature never forgives', if you slap her she will slap you back. I think we have overly exploited nature.*» (Pope Francis, 2015).

Since its origins, the Church has recognized the importance of Nature and its biodiversity. Already in *Genesis*, the first book of the Bible, we find a powerful message about human responsibility towards creation, a call to know and care for the natural world, to preserve it and pass it on to future generations. In this regard, we recall the task the Creator assigns to Adam to give each animal a name, and to Noah, before the Great Flood, to take with him a pair of all animals on board the Ark.

For many years, Ferdinando Boero has been stating and trying to make everyone understand that we cannot put economics before ecology at the cost of self-destruction.

«*Sustainability is universally recognized as a stringent priority, but it gives primacy to economic and social values, relegating natural phenomena to a secondary role: natural goods are evaluated by economic measures (in monetary terms) giving primacy to economic laws over ecological ones.*» (Boero, 2021).

Ferdinando Boero, an internationally renowned scientist, has been full professor of Zoology and Marine Biology at the University of Salento and, subsequently, at the University of Naples Federico II. He is Professor Emeritus and Chair of the Anton Dohrn Zoological Station and President of the Dohrn Foundation. He works on marine biodiversity and ecosystem functioning, and sustainability.

He has written several policy papers on these issues for the European Commission, FAO, European Marine Board, European Academies Science Advisory Council, G7, among other international institutions. He has published many scientific articles in international journals and

informative books, including "*Economia senza natura. La grande truffa*" (Economy without Nature. The great scam) «*Look at that house built on a dune, ten meters from the sea. There, that's economy without nature*». (Boero, 2012), "*Ecco perché i cani fanno la pipì sulle ruote delle macchine*" (This is why dogs pee on the wheels of cars, 2018). "*Ecologia della bellezza. I gusti della Natura*" (Ecology of Beauty. The tastes of Nature, 2020).

He has promoted and implemented many projects nationally and internationally.

In 2009-2010, he designed and implemented, in collaboration with biologists and artists, the "*Eye to the Jellyfish*" Campaign in order to reconstruct the presence of the main species of gelatinous plankton in the Mediterranean. The poster, created by artist Alberto Gennari and graphic designer Fabio Tresca, has been translated into the languages of all the countries bordering the Mediterranean. The initiative was joined by several institutions and many people answered the call, thus enabling the detection of the large presence of the main species of gelatinous plankton. The project won the first "*Best Communication Award*" at the Big Blu Hall in Rome and the award for the best scientific campaign. It was included in a book that covers various topics and full of beautiful pictures and original illustrations, "*La biodiversità marina e il funzionamento degli ecosistemi*" (Marine Biodiversity and the Functioning of Ecosystems). (Boero, Gennari, Tresca, & Miglietta, 2010), published in 2010 as part of the project "*Ecosustainable Open Access Publishing*", initiated in 2009 by Virginia Valzano, for the development of open-access publishing and for the conservation and restoration of the natural environment, in collaboration with the Laboratory of Zoology and Marine Biology of the University of Salento (at the time directed by Ferdinando Boero) and the Botanical Garden of the same University (coordinated by Rita Accogli).

In 2015-2016, he coordinated and implemented, with the involvement of hundreds of scientists from 39 institutes in 22 countries, the "*CocoNet (Towards COast to COast NETworks of marine protected areas, coupled with sea-based wind energy potential)*" project for the protection of marine environments and clean energy production, for the creation of marine protected areas in the Mediterranean and the Black Sea. The project was published in 2016 in the international,

diamond open access scientific journal, *SCIRES-IT - SCientific REsearch and Information Technology*.

Boero has received prestigious national and international awards, including the, "Grand Medaille Albert 1er pour l'Océanographie" from the Institut Océanographique de Paris, the "Trident d'Or" from the International Academy of Underwater Sciences and Techniques (considered the "Nobel Prize of underwater activities"), and the "Medal for Physical and Natural Sciences" from the National Academy of Sciences."

Thanks to his articles, he contributed a great deal to the inclusion of the protection of Nature in the Italian Constitution. In 2012, he collaborated on the Constitutional Bill presented by Republic Senator Alberto Maritati (Italian magistrate and politician) with a proposal of amendment to the Constitution on the protection of natural heritage, and, in the following years, on the debate that led to the recent amendments to the Constitutional Charter.

Nature and landscape are not the same thing, Boero explains in his articles "Costituzione senza Natura" (Constitution without nature) and "L'equivoco nella Costituzione va chiarito: 'paesaggio' e 'ambiente' non sono sinonimi" (The misunderstanding in the Constitution should be clarified: 'landscape' and 'environment' are not synonymous). (Boero, 2021).

Landscape is «*what we see by looking around us, it gives us emotions and feelings, ... it is what we perceive by observing the environment, it can be defined as 'structure,' ... is derived from a millennial interaction between man and nature and is an expression of our cultural heritage, of which it is a part*». Nature is «*made up of two basic elements: biodiversity and ecosystems* ».

After numerous and extensive debates at the national level, the protection of the environment, biodiversity and ecosystems became a constitutional principle following the entry into force (on March 9, 2022) of the Constitutional Law of February 11, 2022. Specifically, this law, supplementing Article 9 of the Constitution, introduces among its fundamental principles the protection of the environment, biodiversity and ecosystems, also in the interest of future generations. Moreover, it establishes that state law regulates the ways and forms of animal protection. It also amends Article 41 of the Constitution, providing that economic initiatives may not be carried out in a way that harms health and the environment, and that the law determines the

appropriate programs and controls so that public and private economic activity may be directed and coordinated for environmental purposes. (Costituzione Italiana, 2023).

The presence of Biodiversity and its preservation is present in many works of scientific literature. The diversity of life forms and its value have been already well present in scientific literature for many decades.

The 19th-century English biologist, naturalist Charles Darwin concludes his major work, "*The Origin of Species*", still an inexhaustible source of reflection and interpretation of nature and biology, by stating, "There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved." (Darwin, 1859).

Charles Darwin (1809-1882) was a British biologist, naturalist, geologist and explorer, famous for formulating the theory of the evolution of plant and animal species by natural selection acting on the variability of hereditary characters, and their diversification and multiplication by descent from a common ancestor. His proposal that all species of life descend from a common ancestor is now generally accepted and considered a fundamental scientific concept.

Darwin first expounded his theory of evolution, supported by ample evidence, in his 1859 book *On the Origin of Species by Means of Natural Selection*, which represents one of the pivotal works in scientific history and one of the most outstanding in biology.

According to Boero, Darwin's book is the work of scientific literature that, more than any other, changed our worldview, as it is not only a book about ecology and evolution, it is also about philosophy. (Boero, 2010).

In 1871, following the formulation of the theory of evolution, Darwin published the volume "*The Origin of Man, and Sexual Selection*" (*The Descent of Man, and Selection in Relation to Sex*).

U.S. biologist Edward O. Wilson, in his best-known 1992 work "*The Diversity of Life*", introduced the term "*Biodiversity*" (Biodiversity, short for "*Biological diversity*"), which has since found wide use, not only in the scientific field, but also in everyday language. (Wilson, 1992).

Edward O. Wilson (1929-2021) is one of the great biologists of the 20th century, a classical naturalist fascinated by inhospitable places. He is a giant of biology and conservation theory of species and nature, regarded as "*Darwin's natural heir*".

He was Professor of Biology at Harvard University and was involved in various research topics, including *Sociobiology*, understood as the systematic study of the biological evolution of social behavior. He published numerous essays and was the winner of two "*Pulitzer Prizes for General Non-Fiction*".

Wilson conducted lengthy systematic studies on the behavior of insects, especially ants. On this topic, together with German biologist Bert Hölldobler, he published the book "*Journey to the Ants. A Story of Scientific Exploration*", translated into Italian by multiple publishing houses.

Journey to the Ants combines autobiography and scientific lore to convey the excitement and pleasure the study of ants can offer. Bert Hölldobler and E. O. Wilson interweave their personal adventures with the social lives of ants, building, from the first minute observations of childhood, a remarkable account of these insects evolutionary achievement." (Hölldobler & Wilson, 1994).

This is what Wilson and Hölldobler say of ants:

«*Ants continue to thrive in the midst of the ruins relentlessly produced by mankind, seemingly heedless of the presence, or absence, of humans, as long as they are left with a small portion of the environment undisturbed... Their abundance is legendary. A worker is less than one millionth the size of a human, yet on the whole ants contend with humans as the predominant organisms on land. Lean against any tree; the first creature to climb up you will most likely be an ant.*» (Bert Hölldobler, Edward O. Wilson)

Stefano Mancuso's studies and popular science books on the plant world are very interesting.

Stefano Mancuso is an internationally renowned Italian botanist and essayist who teaches General Arboriculture and Plant Ethology at the University of Florence; he is a founding member of the 'Société internationale pour le signalement et le comportement des plantes' and director of the International Laboratory of Plant Neurobiology.

In his books, he confronts humanity with its responsibility for the reckless use of the Earth's resources and highlights the innumerable qualities

of the plant world, which is capable of adaptation and long-term planning and is precious for our survival. For Mancuso, the future of mankind depends on the future of the plant world, which has equal "intelligence" and "sensitivity" and therefore deserves equal "rights".

One of Mancuso's most famous studies, which draws inspiration from those of other scientists and naturalists such as Charles Darwin and Gregor Johann Mendel, states that during their evolution, plants have developed a large number of solutions to the problems encountered, emphasising that the 'ability to solve problems' is a proven sign of intelligence. In Mancuso's opinion, one of the ways to avoid a catastrophic future for mankind is to look at plants in a new way, to use them not only for what they have to offer us, but for what they can teach us.

Mancuso's books include *Verde brillante. Sensibilità e intelligenza del mondo vegetale* [Brilliant Green, Sensibility and Intelligence of the Plant World], which marked a turning point in the way we look at plants (Mancuso & Viola, 2015); "*Plant revolution. Plants have already invented our future*" (Mancuso, 2017), which explores the plant world to imagine the future of humanity and illustrates how in the plant world there are already technological solutions that we will not be able to do without in our future; *Botanica. Viaggio nell'universo vegetale* [Botany. Journey through the plant universe] (2017): 'Plants not only feed and grow, they also breathe, communicate with each other, react to changes in their environment, move, learn, memorise and even experience emotions. And above all, with their peculiar complexity, they offer us innovative models for our social relations and organisational models'. *La nazione delle piante* [The Plant Nation] (2019), suggests an actual constitution of 8 articles on which to build our Earth-friendly future with respect for all living beings. *La tribù degli alberi* [The Tribe of Trees] (2022), is an exciting and adventurous story in which plants organise themselves into clans, have their own personalities, passions and each has its own character; they study each other, look like each other, help each other, and special friendships and unbreakable bonds are born between them.

In our contemporary era, exposed to the devastating consequences of the climate crisis and the loss of biodiversity, literature and ecology find fertile ground for mutual interaction. On the one hand, ecological discourse embraces narrative

constructions, often typical of the literary genre, to communicate with a wider audience and engage emotionally. On the other hand, literature relies on ecology to enrich its repertoire of themes by incorporating topics directly related to environmental issues.

Authors such as Italo Calvino, Roberto Saviano, Daniel Pennac, and Don DeLillo have written works dealing with waste and other ecological issues.

In the poem "The Whirling Disease" R.T. Smith (1947), an American writer and poet, Writer-in-Residence at Washington and Lee University, examines the human impact on the environment.

The author tries to save a trout suffering from whirling disease, an illness caused by the parasite *Myxobolus cerebralis*. Whirling disease now affects several species of farmed and free fish. The parasitic spores spread so easily that they can be carried by fishermen who have not carefully washed their gear. After attempting to save the doomed fish, the author contemplates how humans contribute to climate change and the spread of disease, although sometimes unconsciously. This poem discusses whirling disease, which afflicts the fish, as both a literal plague and also a metaphor for people who do not think that their actions affect the planet. It suggests that if we continue to refuse to care, then we, too, will be the ultimate victims of our planet's destruction.

R.T. Smith's poem is a lesson in how to creatively communicate environmental information to a wider audience. The education cannot solve all environmental problems, but it can take great strides towards doing so. (Smith, 2017).

According to Niccolò Scaffai, full professor of Contemporary Italian Literature at the University of Siena, ecology plays an increasingly important role in contemporary human experience. In his book *Letteratura e ecologia. Forme e temi di una relazione narrativa* [Literature and Ecology. Forms and themes of a narrative relationship], he illustrates how literary works, especially fiction, enter into a relationship with ecology. Therefore, the relationship between literature and ecology consists of an exchange, a mutual influence. (Scaffai, 2017).

In May 2023 and 2024, in order to promote reflection on Biodiversity and the relationship between humans and the environment within the world of culture, the Turin Book Fair set up the a

400-square-meter green space, "Bosco degli Scrittori" (Writers' Forest), housing thousands of plants. The event was devised by Aboca Edizioni in collaboration with the National Biodiversity Future Center and was attended by a great number of internationally renowned guests, writers, philosophers and scientists, who participated in several meetings and other initiatives dedicated to the topics of nature and environmental sustainability.

Our intergenerational responsibility to use natural resources properly, with the essential respect for biodiversity is an imperative that can no longer be conditioned.

2. Biodiversity, Music and Technology Applications

As we walk in Nature we are accompanied by the scents of flowers, the rustling of leaves, drops bouncing on the foliage, the whistling of the wind, noises animal communicating with each other, more or less high-pitched sounds, different melodies overlapping and staging a small concert, a true orchestral performance in large and diverse settings.

Since time immemorial, humans throughout history, have found inspiration in nature to create their music. Reproducing nature-related sounds in music has fascinated composers of all ages.

Nature has fascinated and inspired classical composers from Vivaldi to Beethoven.

Many of Antonio Vivaldi's works, actually, originate from observation of Nature and aim at imitating the voices of animals and the sounds of the environment. Antonio Vivaldi loved nature so deeply that he dedicated to it his best-known cycle, "*Le quattro stagioni*" (*The Four Seasons*), composed in 1720. Every element of nature is reflected in the instruments and the composition. He describes with his music a pristine and sonorous nature.

The environment that inspired Vivaldi has changed dramatically. Nature and the seasons are no longer as harmonious as they were in Vivaldi's time, and the world is increasingly affected by violent climatic changes that constantly alter its balance. Precisely for this reason, in 2019, in Hamburg, the "German Radio Orchestra" (Ndr Elbphilharmonie Orchester) led by conductor Alan Gilbert, staged Vivaldi's "*The Four Seasons*" revisited from a climatic perspective. The work was significantly titled "*For Seasons*" instead of "*Four Seasons*". For its implementation, musicians,

sound engineers and scholars collaborated to analyze scientific data on climate change, such as rising temperatures, frequency of extreme weather phenomena and species extinction, and translated them into music on the staff, thus creating what promises to be a new musical experience. The project, as stated by Alan Gilbert, clearly shows the effects of climate change on the environment, and adds an emotional dimension to the current debate. The harmonious passages that characterize Vivaldi's work have been made disharmonious, almost unpleasant, just like the seasons that have changed due to the effects of human activity.

Another illustrious example of naturalistic atmospheres in classical music is Ludwig van Beethoven's *"VI Symphony for Orchestra"*, composed between 1807 and 1808. During the composition, Beethoven spent a lot of time in the countryside and was fascinated by it, finding his peace in contact with nature. In this beautiful symphony, better known as the *"Pastoral"* symphony, the music evokes images of men in the midst of nature and cheerful farmers, animals by a stream, as well as weather events such as an unexpected storm or downpour.

All the music of Wolfgang Amadeus Mozart, an Austrian composer of utmost importance in the history of music, is centered on the language of nature manifesting itself as the inescapable essence of human life.

In recent years, experiments have shown that classical music, particularly Mozart's, is good not only for human well-being but also for plants. Sound represents the new horizon of biodynamic agriculture: by placing amplifiers among the rows of the vineyard and spreading Mozart's notes, the vines seem to yield more and better grapes, with interesting effects on the quality of the wine produced. After an experiment carried out in 2008 in collaboration with the above mentioned Professor Stefano Mancuso, an expert on plant neurobiology at the University of Florence, Giancarlo Cignozzi, a viticulturist from Val d'Orcia reported these promising results in a book published by Rizzoli, *"L'uomo che sussurra alle vigne"* (The man who whispers to the vines).

According to Sofia Panizza, owner of the Erbeville farm, Mozart's music, as well as Vivaldi's, is good for medicinal plants, for mountain herbs grown in the upper Val di Sole, in Vermiglio (Trento). Arnica, chamomile, cornflower and many other mountain herbs are loaded with active

ingredients, with a strengthened immune system and, as well as grapes, are able to naturally defend themselves against harmful insects and pests.

"The Hebrides" Overture (also known as *"Fingal's Cave"*), a symphonic poem among Felix Mendelssohn's most famous works, originates from the fascination exerted on the musician by the power of nature and the sea during a visit to the famous Fingal sea cave on the island of Staffa (Inner Hebrides, Scotland) in 1829.

In 2007, the University of Cambridge developed several environmental research projects, including the *"Cambridge Conservation Initiative - CCI"*, which aims at conserving biodiversity globally so as to ensure a sustainable future for all life on Earth. (CCI, 2007).

The project, based on the *"Hebrides Overture"*, has the aim to use music as a means of connecting listeners to the marine biodiversity crisis, hoping that the emotions aroused by listening to the musical poem will lead to greater awareness and effective measures to protect ocean ecosystems. (Cambridge Conservation Initiative, 2007).

Two Cambridge University academics, economist Matthew Agarwala and composer & conductor Ewan Campbell, have redacted Felix Mendelssohn's *"Hebrides Overture"* to show the precipitous decline in the North Atlantic Humpback whale population since the piece was written. The notes in the corresponding bars of music are redacted according to the percentage loss of the whale population.

Campbell split the *"Hebrides Overture"* into sections representing the decades since Mendelssohn composed the original pieces. Starting with the opening notes of the original *Overture*, Campbell then gradually removed notes from the score for every decade in which the whale population declined. The resulting piece, *"Hebrides Redacted"*, tells the story of the humpback whale through the notes that are missing from the well-known original piece.

By 1920, less than a century after Mendelssohn's composition, two thirds of the whales were gone. This is reflected in the score of *"Hebrides Redacted"*, where by the middle of the piece two thirds of the notes are missing. (Amens, 2022).

The theme of Nature has been sung in music for centuries, traditionally in folk songs. The close relationship between music and nature attests to the significant influence the natural environment has on human creativity and has been a lifelong

source of fascination to humans for centuries. From the rhythmic beats of rain to the melodic calls of birds, nature's soundscape has profoundly influenced the creation and evolution of music across cultures and eras. Indigenous cultures often incorporate natural sounds into their music, using instruments that mimic the rhythms of nature, creating a deep connection between their music and the environment. African drumming, for example, often replicates the sounds of animals and nature, embodying the essence of the natural world. Native American music, for instance, often features flutes and drums that mimic animal calls and environmental sounds, creating a harmonious link between music and the natural world. Similarly, the didgeridoo in Aboriginal Australian music produces a sound reminiscent of natural vibrations, symbolizing a connection to the earth.

In modern and contemporary music, nature continues to be a powerful theme. The environmental legacy of folk music has shifted through time. This is in the nature of folk songs, constantly shifting and evolving as they are passed from singer to singer. Today, folk music, with its long tradition of protest and resistance, as well as its link with the natural environment, represents a strong means to spread ecological messages. As the effects of pollution and global warming become more and more apparent, contemporary folk musicians are sounding the alarm often in collaboration with other artists and researchers who are particularly interested in collecting and sharing traditional songs that enshrine old knowledge and wisdom preserved and passed on from generation to generation.

The ties between music and environmental movements can be dated to the 1950's, 1960's and 1970's when many cultural shifts were happening in the USA and reverberating across western countries. Those decades were marked by civil rights and anti-nuclear movement, feminism, protests against the Vietnam War, and environmental movements fighting against pollution, overdevelopment, and resource wastage that impacted rural America. With society divided on so many issues, many musical artists found the theme of environmentalism as a way to connect with and unite listeners on a common goal.

One of the most famous pioneers of connecting music and environmentalism is American folk musician and activist Pete Seeger. Born in 1919 in New York City, he expressed his concern on the industrialization of his country in his songs, which

include the 1960s hits "Where Have All the Flowers Gone?", "If I Had a Hammer" and "Turn! Turn! Turn! (To Everything There Is a Season)", covered by a number of artists and counterculture groups. "We Shall Overcome," which he adapted from old spirituals, became a civil rights anthem. In 1966, Seeger released the album, "God Bless the Grass" which is regarded as the first album completely dedicated to environmental issues. Many of the songs on the album, like "My Dirty Stream", mourn the loss of pristine natural spaces due to human activities while also maintaining hope that these places can be saved. Throughout his life, he continued to write and perform folk music that reflected his passion for environmental causes and acted as a mentor to young folk singers.

During the 1950s and 60s several emergent pop and rock musicians willing to address environmental issues started to draw on folk music to find inspiration.

In 1969, a massive oil spill from an offshore well left beaches in Santa Barbara, Calif., coated with crude and littered with dead birds. The disaster brought to light the dangers of pollution and inspired the first Earth Day in 1970. Greenpeace was established the following year.

Many artists through their music actively committed to spreading messages in favor of environmental protection. For reasons of space constraints here we quote only a few.

"Big Yellow Taxi", Joni Mitchell's 1970 hit, it's also an example of an environmental protest song that denounces how the authorities covered a natural paradise with concrete, transforming it into a car park, with a hotel, a fancy shop, as well as a dancing club for the trendy people. Moreover the song is against the indiscriminate use of pesticides by farmers and the devastation of the natural environment.

Many musicians were also actively involved in the organization of benefit concerts to raise funds for the protection of the environment. Actually, since then rock music and environmental activism have become inextricably linked.

In 1971, Marvin Gaye wrote one of his best songs "Mercy Mercy Me", whose subtitle was "The Ecology", which underlined how pollution, overpopulation, the waste of resources, were killing the Planet.

Neil Young, a famous Canadian singer and songwriter, began expressing his environmental concerns as early as 1970, and has since developed

a systematic critique of environmental degradation in forty albums combining folk, rock, country music and spanning some sixty decades of prolific career of relentless environmental commitment. The song "After the Gold Rush", from an album released in 1970, is about how humans cause wars, destroy nature, and eventually create an uninhabitable earth due to environmental pollution, all for the pursuit of wealth. Among other social and political issues, in his songs he denounced environmental degradation, corporate power, the struggles of farmers, city pollution, oil drilling, the effects of warfare on nature's creatures, lamenting the greed that was destroying the Amazon rainforest, while also tying resource depletion (fish, timber, birds) to Arctic drilling and to corporate farming. He blamed the ecological crisis on over-extraction and political corruption issuing a series of frank pronouncements on stopping pipelines, ending fracking, and abandoning fossil fuels.

A great number of musicians of the first wave of punk were deeply involved in spreading environmental message. Here we quote just the punk band The Clash who spoke of the destruction of the ozone layer in their biggest hit, "London Calling",

The 1980s and 90s saw a host of rock stars committed to spreading the word about environmentalism. These included the most successful group of the decade, U2, alongside older artists such as George Harrison and Grateful Dead.

As the impending environmental doom was brought into complete focus in the 2000s, rock and music, in general, stepped up their efforts to raise awareness of the problem. In 2007, the worldwide concert, *Live Earth*, was held in multiple locations to raise awareness and prompt more action.

Among other Italian folk singers, a special mention deserve the songs and musical compositions by Daniele Durante, who passed away in 2021, artistic director of the "La Notte della Taranta" Foundation, the largest folk music festival in Europe, and founder, together with Rina Durante and Rossella Pinto, of the "Canzoniere Grecanico Salentino", which brought Salento's culture and folk music to the whole world, and which still, under the direction of his son Mauro, is a musical ensemble winner of many awards worldwide, and ranks at the top of world folk music charts. In his long career, Daniele Durante played unforgettable songs of the folk tradition with his unmistakable arrangements. Very

important are the songs in defense of the natural environment, including the fight song "No TAP", against the exploitation of the Salento landscape by the Trans Adriatic Pipeline, and "Xylella", the song denouncing the death of olive trees.

Moreover, many modern artists use field recordings or natural sounds and then incorporate them into their musical compositions.

Here we recall "Blackbird", the Beatles song in which Paul McCartney, at the end of the track, incorporated the song of a blackbird. "Conference of the Birds" by composer Dave Holland, who recorded a song inspired by birdsinging. "Songs of the Humpback Whale" is a musician-less album by U.S. biologist Roger Payne (1970): its five tracks are made up of vocalizations and songs of humpback whales (minke whales), recorded and played for the first time in front of a general audience, showing how complex, sophisticated and even artistic the language of these inhabitants of the seas can be.

Thanks to these and other successful musical recordings, whales are beginning to be perceived as sentient animals, thus prompting the first reflections on the legitimacy of their hunting.

Max Casacci's artistic project "Earthphonia" (2020), an album that exclusively uses electronically manipulated sounds and noises of nature to construct musical pieces, collects nature's sounds, animal noises, and the snapping of roots that he transforms into real symphonies without the use of musical instruments.

John Luther Adams' symphony for orchestra "Become Ocean" (2013), inspired by ocean ecosystems, is a musical journey that evokes the movement of waves and the immensity of the oceans. The work, in one movement, is inspired by the oceans of Alaska and the Northwest Pacific Ocean. Adams' score is accompanied by an explanatory note in which he clarifies the title of his composition:

«Life on this earth first emerged from the sea. As the polar ice melts and sea level rises, we humans find ourselves facing the prospect that once again we may quite literally become ocean».

Bernie Krause's "The Great Animal Orchestra" (2016) uses the recorded sounds of natural ecosystems to create an immersive sound experience that emphasises the richness of the soundscape of biodiversity. Bernie Krause is an American bioacoustician, scientist and musician who has been recording the sounds of nature for years, creating a project that combines these

sounds with musical compositions. He discusses in depth on his approach and explains how biodiversity has been deteriorating in the last decades. A meditative work on the need to preserve the beauty of the animal world, this unprecedented research constitutes a rare insight into the invisible world of animals. It reveals the beauty and intricacy of animal vocalisations, which today are in danger of being silenced by human activity.

An original example of the correlation between Biodiversity, Ecology and Music is represented by two great personalities, biologist Ferdinando Boero and composer and singer Frank Zappa, who share goals and values, courage, creativity, innovation, honesty and determination although working in different fields.

Frank Vincent Zappa (1940 - 1993) was an American composer, guitarist, singer and multi-instrumentalist. He is considered one of the greatest musical talents of the 20th century.

He was a source of inspiration for the names of many living organisms and animals discovered by famous scientists who loved his music. Zappa is actually an artist much beloved by scientists, biologists, palaeontologists, microbiologists, geneticists, astronomers, etc. Frank Zappa will forever remain in the history of music, in particular rock music, as well as in science, especially marine biology.

The above mentioned Ferdinando Boero is a great scholar of jellyfish and has described many previously unknown species.

Jellyfish have become more and more numerous in our seas and their abnormal growth is seen today as a worrying fact. It is considered a sign of a serious ecosystem imbalance in progress, for which human activity is largely responsible. The causes of this phenomenon can be attributed to global warming, brought about by climate change, and to overfishing, i.e. the massive and indiscriminate harvesting of fish species that feed on jellyfish.

Jellyfish, Boero says, are the world's oldest animals among those living today. There is evidence of jellyfish in fossils dating back 650 million years. «*Ancestral animals, jellyfish have found their golden age in the Anthropocene. They thrive around the methane platforms of the Adriatic Sea that provide shelter for larvae and polyps. Some species dwell in polluted waters. They do not suffer from the depletion of oxygen in the oceans caused by the phosphorus poured into the sea by human*

activities, nor from the warming of the waters due to climate change. They are predators of fish: they feed on eggs, larvae and juvenile fish. Therefore, more and more jellyfish and fewer and fewer fish».

Boero is also known to the general public for his love of rock music, mostly Frank Zappa's music.

An exceptional fan and a great scientist, Ferdinando Boero, in the early 1980s, conducted studies and research at the Bodega Marine Laboratory (a branch of the University of California-Berkeley), located outside the centre of Bodega Bay, on a cliff just a few metres from the Pacific Ocean whose waters are rich in jellyfish.

In 1983, on the same beaches where Hitchcock shot "*The Birds*", Boero discovered several unknown species of jellyfish, including a very small, six millimetres in diameter, hemispherical specimen, which needed to be named. He used the discovery as a pretext to meet his musical myth. He wrote to Frank Zappa saying that he wished to name one of these small, unknown creatures after him.

Zappa replied: «*There is nothing I would like better than to have a jellyfish named after me*».

Since that day, "*Phialella zappai*" has been the name of the tiny jellyfish in Bodega Bay harbour.

It is a story that Ferdinando Boero has told many times now, which he happily recalls and continues to fascinate listeners. Boero told us about this magical moment in a video-interview "*La grande Nota di Frank Zappa*" (The Great Frank Zappa Note), published in the "*Treccani*" (Boero, 2013).

Boero has described scientifically the species in an article appeared in the "*Journal of Natural History*", where he writes «*I am pleased to christen this species in honour of the modern composer Francis (Frank) Vincent Zappa*».

This act of love for the artist started a beautiful friendship. The two met several times both at Frank's home in Los Angeles and in Europe on several occasions.

In June 1988, Frank Zappa dedicated his last concert in Genoa (known as the "*jellyfish concert*") to his friend Nando (Boero) and readapted his famous "*Lonesome Cowboy Burt*" into "*Lonesome Cowboy Nando*" (later published in 1992), in honour of Boero himself, who was standing in the audience. "*My name is Nando, I'm a marine biologist*", Zappa sang from the stage.

A reproduction of the scientific illustration of *Phialella zappai*, which Boero gave to Zappa, remained framed in the musician's studio for

years, next to the computers with which he composed his last albums. (Fig. 2).



Fig. 2: Frank Zappa's studio in Los Angeles, 1989. On the left, a drawing of the jellyfish *Phialella zappai*. (Photo by Ferdinando Boero).

In April 2002, the 'Monterey Bay Aquarium' (located in Monterey, California, on the coast of the Pacific Ocean.) organised a special exhibition, entitled "*Jellies: living art*", and asked Boero to document the connection between a jellyfish and music. Boero commissioned a painting from Alberto Gennari, a famous artist from Lecce, representing a colony of "*Phialella zappai*" polyps attached to a shape inspired by the neck of one of Zappa's guitars. The adult jellyfish, top left, has its tentacle placed higher up with a series of *cnidocysts* (the stinging cells) arranged like the notes on the score of "*The Black Page*", a musical composition by Frank Zappa known to be

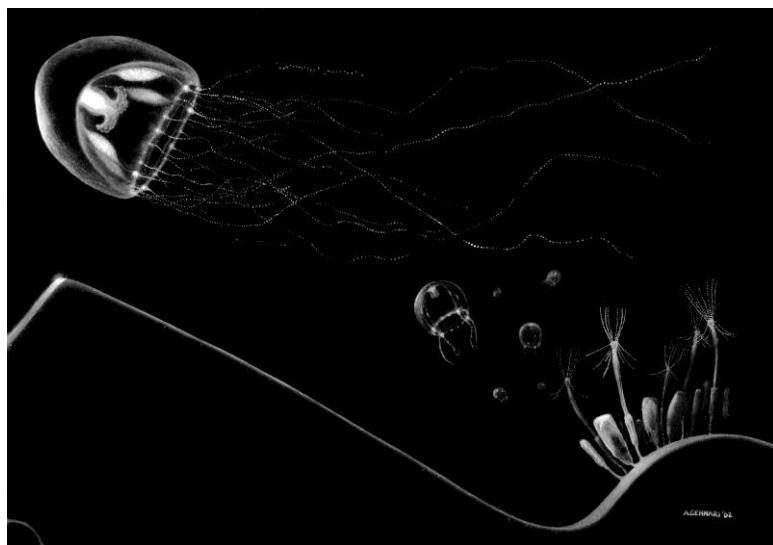


Fig. 3: Painting by Alberto Gennari-Monterey Aquarium

particularly difficult to perform. All on a black background. (Figs. 3 - 4).

In an article published in 2013, in the weekly magazine *Internazionale*, entitled 'Frank Zappa and the Meaning of Life', Boero attempts to demonstrate that everything can be seen from an ecological-evolutionary perspective, simply because we are an animal species: the product of evolution within an ecological system. (Boero, 2013).

«Everything can be traced back to this matrix; the rest are superstructures. This (everything can be traced back to ecology and evolution) also applies to Frank Zappa. There is no subject in the world (or nearly so) that Frank Zappa did not cover in his lyrics, and there is no musical genre that Zappa did not consider and practice, having then created his own. Zappa gives us two essential concepts: the "big note" and "conceptual continuity". Music is one "big note," and everything there is united by a continuity that embraces everything».

«Zappa made a digital recording of the "London Symphony Orchestra" in 1983; it is the first digital recording of an entire orchestra, dismembered by elements, one track for each instrument».

The music of the individually sampled instruments was stored in Zappa's studio computers: *«Dozens of separate recordings, but the true composition emerges only when the music is played in unison, when it is "one big note," as Zappa called it. The same thing applies to ecology, which is the science of interactions. Everything is connected; there are no soloists. Human beings, jellyfish. The planet is «one big note».*

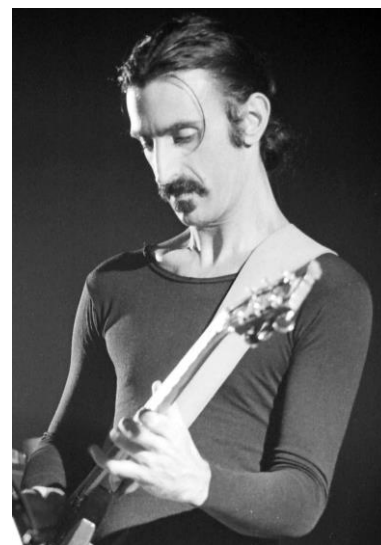


Fig. 4: Frank Zappa, Ekeberghallen, Oslo, Norway, 1977 (Helge Øverås)

Nature, in addition to always being a source of inspiration, has also become part of the works of many artists almost as if it were a co-author.

Nature's music can also be an indicator of the health of ecosystems, of the dynamics within them. Living organisms reveal their presence through acoustic signals that can be easily detected and analyzed so as to understand their dynamics, how they communicate, interact, mate and move.

Today there are various instruments and machineries available for both terrestrial and aquatic environments monitoring. The study of the sounds of individual species, *Bioacoustics*, *Ecoacoustics*, the science that investigates natural and anthropogenic sounds and their relationship with the environment, together with *Passive Acoustic Monitoring*, a new methodology for measuring human impacts on marine ecosystems, are critical for the collection of long-term information on the distribution of animals and changes in community dynamics, for the assessment of habitat quality, environmental protection and Biodiversity.

Biodiversity also manifests itself through the sound complexity of habitats.

«A picture is worth 1,000 words but a soundscape is worth 1,000 pictures» says Bernie Krause, one of the leading American exponents of Bio-acoustics, a true natural sound hunter and founder, in the 1960s, of the "Wild Sanctuary", one of the world's most important sound archives. (Krause, 1968). A greater understanding of the variety and complexity of natural systems – he argues – requires a sensory approach not limited to the visual landscape, but oriented towards the sound dimension of nature, its soundscape.

A fundamental book on the soundscape is that of R. Murray Schafer (1977). Equally interesting is the work on 'acoustemology' (acoustics+epistemology) a coinage by Steven Feld (2015).

The careful monitoring of environmental sounds and the creatures that generate them has become a crucial activity for the preservation of our Planet.

A great message on the planetary biodiversity crisis and the urgent ecological transition is delivered by the "Sonosfera@" in Pesaro, a transportable technological amphitheatre for deep listening to ecosystems and music designed by composer David Monacchi. It allows for a 360-degree immersion in the soundscapes of the equatorial primary forests of Amazonia, Africa and Borneo, with the highest biodiversity, recorded

with innovative three-dimensional technologies over almost twenty years by Monacchi for the *Fragments of Extinction* project (Monacchi, 2019).

Recently, on the occasion of World Earth Day 2024, also the "Museum for the United Nations - UN Live" joined the United Nations' call for urgent and effective collective action for the protection of the environment, and did so by setting up the "Sounds Right" project: a global initiative that recognises Nature's status as an "artist" and allows it to generate royalties from the use and reproduction of its sounds, to raise funds to support its own conservation. "UN Live" is an international organisation whose main goal is to use culture to inspire initiatives involving millions of people worldwide for nature conservation and to counteract climate change. It defines itself as an unconventional, independent and borderless museum, without a collection of material goods, but with the civic function of a museum: it collects stories, creativity, know-how and exchanges of knowledge about the problem-solving ability. "Sounds Right" is a collaboration between artists, producers and environmental groups who want to put music at the centre of a global discussion on Nature conservation and restoration. It allows artists to credit Nature as co-author when using its sounds in their compositions. Through its sounds, Nature becomes an official artist on the various streaming platforms, thus raising funds for the protection and preservation of ecosystems.

The recording of the sounds of Nature will no longer be done just for ecosystem monitoring, but so as to constitute the basis for real music pieces through the activity of Partners such as "The Listening Planet Library", one of the world's most important private collections of nature sounds in existence, founded by Martyn Stewart, the world's leading sound recorder since 1975 (Stewart, 1975), and "VozTerra", an audio platform created in 2019 by a multidisciplinary collective with the aim of raising awareness about caring for our Planet through the power of sound and music (VozTerra, 2019).

The sounds of nature become music to protect the Planet.

Melissa Fleming, UN Under-Secretary-General for Global Communications, said:

«*Sounds Right is a groundbreaking music movement. It unites people around the world in a shared commitment, recognizing the intrinsic value of Nature. Together, we must act now to protect our Planet for our common future.*».

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