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WILD BEES AND THEIR CONSERVATION

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ABSTRACT

About sustainable agricultural environment and world food security, major crops mainly dependent upon managed honey bees and wild bee pollinators which are of great significance. Bee pollinated crops being a great part of the bio-diverse system, 4,000 native bees, and offer over US$1.5 billion each year in North America. In US, the value of wild bees in food production was determined to be over $1.5 billion annually. However, the worth of wild bee pollination in insect cross pollinated crops may be much more. These great wild players are now in fast declining phase or possibly extinct due to human-disturbed habitats. More investigations are required in various topics of wild bee fauna, such as basic studies in population biology, abundance, bee protection measures, suitable habitat, nesting sites especially their immediate conservation strategies. After realizing the importance of wild bees in pollination, in the present review, we highlight the various measures and actions to conserve the wild bees so that they can serve the growers as co-players to managed honey bees in boosting the agricultural food production worldwide.

Key words: Wild bees, pollinators, bio-diversity, habitat, crop, improvement, yield, buzz pollination, conservation, ecosystem, management, sustainability

Globally, wild bees are the major crop pollinators, being responsible for the cross pollination, seed setting and fruit production of various major field crops. For many years, being neglected part of bio-diverse system, they have been badly suffering from a decline by the unnecessary human-disturbances and farm practices in the environment. Apiculturists are now anxious about the immediate and effective measures to protect the native bees for using in crop pollination, enhanced agriculture production and for the sustainability of bio-diverse ecological environment. Human interest in the bee conservation increased greatly, due to many new research findings presented on the newspapers radio and TV (Schatz, 2020; Tanda, 2019, 2021a, b, c). Some insects remain unnoticed from people acceptance which are less-charming (Hart and Sumner, 2020), encouraging bee pollinator protection program is an interesting subject to educate majority of the people groups. Although this subject is familiar to many, a lack of knowledge and understanding of the topic is blatant and has a gap between information and its comprehension (Wilson et al., 2017). This break is due to the absence of knowledge about role of hoverflies and butterflies in bio-diverse ecosystem. About 80% and 99% of the reports in Great Britain and the United States described that bees are the key crop pollinators (Wilson et al., 2017). Mostly, people understood the honeybee *Apismellifera*, as the main crop pollinators. Further, the crop pollination mechanism now known as entpollinatology (Tanda, 2021c), the significance of flower assets and nesting site environment, major groups of pollinators with specific needs has become more significant. The insufficient reports may result in irrelevant activities for the conservation of endangered bee pollinators (Wilson et al., 2017; Schatz, 2020; Didham, 2020; Penn, 2021; Tanda, 2019, 2021a-h). Harvey et al., (2017) designed a program for pollinator's conservation and their retrieval as a base for bee scientist studies. In the last 10 years, the population of several insect species has disappeared by 9% and including the native bees (van Klink et al., 2020). Observations on the illeffects of ecosystem on the population dynamics of native bees are abundant (Potts et al., 2010; Goulson et al., 2015; Tanda, 2019, 2021a, b, c, d, h) and several bees are endangered locally and facing disappearance, but still survive in their geographical habitat (Primack et al., 2012). This unique event can be observed by looking at European and IUCN Red Lists studies (IUCN, 2016). A number of native bees are under threat in Belgium, or even disappeared locally but their population is not absent at the European scale (Drossart et al., 2018) showing the protection activities in various regions. There is a gap between the scientific information and awareness (Wilson et al., 2017). This gap is generally described by an ignorance of knowledge about the prominent abundance of bees, hoverflies, and butterflies in the living environment. Survey reports in Great Britain and the United States identified that bees are important, but only 3% and 14% can assess the pollinator's distribution in different regions (Wilson et al., 2017). Many people are capable to recognize honeybees and bumblebees crop pollinators, however the other native bees are poorly identified as main species. Less than 50% of the participants were even unable to name at least one bee worker (Wilson et al., 2017). Through large presentations, mainly focused on the honeybee *Apismellifera*, the general public was understanding the value of crop pollination, but not the distribution and its population size. Flowers importance, sites of bee nesting, favorable environment and the existence of main bee pollinators with their specific requirements were also not known to the people. This incomprehension of scientific reports could therefore may support to unrelated activities, wrong, or even ineffective measures for the conservation of endangered bees (Wilson et al., 2017; Drossart and Gerard, 2020). This shows that with the scientific understanding, the public awareness has not advanced. For workers, bee identification and ranking endangered species is challenging and a principal project to ongoing studies and an informative program for wild bee conservation and their improvement system to be framed. About 9% terrestrial insect populations per decade has perished and the wild bee abundance are also not an anomaly (van Klink et al., 2020). On wild bee populations, studies on the harmful impact of pressures are sufficient (Potts et al., 2010; Goulson et al., 2015; Tanda, 2019, 2021a-h). Knowing the harmful impacts of climate, decrease in the bee population, national and regional actions associated with the wild bee fauna conservation and their protection methods should be implemented urgently. Allthe possibleconservation measures will be of great importance in the preservation of native bees and their bio-diverse habitat. As many native bees are threatened and vanishing, they may still survive quite long time in their habitats (Schatz, 2020; Penn, 2021; Tanda, 2021h). Such changes can be reported in IUCN Red Lists and the European scale studies (IUCN, 2016). Many bee species are disappeared in Belgium, as their abundance are not good at European level (Drossart et al., 2018). Undoubtedly, the bee population degree as well as the declining factors are greatly investigated, still reports on the preservation methods of wild bees are not well described. A general and up-to-date evaluation of the conservation actions, technology as well as their effectiveness and efficiency, is still wanting. Keeping this in mind, firstly, we reviewed the significance of preserving native bees, bee population's assessments at risk alongwith the factors associated with declining their abundance. Secondly, we emphasized on the conservation measures, associated factors, and the effectiveness of these methods. We have highlighted on the conservation actions that improve the bee-friendly environment such as semi-natural landscapes to urban and crop habitats naming the required floral resources and nesting sites, and alien species with habitat control process. To fill many gaps of native bee protection studies, some new projects and reports have been presented in this review.

Wild bee's protection should be our priority

Bees being the main flower pollinators in many bio-environments, pollinators are involved in the propagation of 80% of angiosperms (IPBES, 2016). Due to this breeding technology, crosspollination is contemplated as one of the most crucial jobs in the working of bio-diverse system and boosting in crop production globally (IPBES, 2016; Potts et al., 2016). About 85% of field crops benefit from insect pollination service that directly influences the quality and quantity of food production (IPBES, 2016) which is worth 100 to 500 billion euros annually globally (Lautenbach et al., 2012). The decline in wild bees is fascinating move in humans to non-pollinator dependent crops for food and fronting lack in essential nutrients, causing economic and health problems (IPBES, 2016; Potts et al., 2016; Bauer and Wings, 2016). Native bees can be the key pollinators in few field crop productions (IPBES, 2016), while other crops are cross pollinated by managed honeybees. Only a little bee population forage on crop plants. So, pollination management alone is not enough to confirm true alone for the protection of local bees. Wild bees are also of specific significance due to their capability to visit flowers in a different type of climatic conditions and environment (Brittain et al., 2016). Bumblebees can forage even in cold weather and even visit at high sonication. In wild flora, the high strength and diversity of local plant pollinators increases a complementary and synergistic activity with domesticated honeybees (Fründ et al., 2013; Garibaldi et al., 2014; Isaacs et al., 2017). Grab et al., (2019) has mentioned this in the phylogenetic diverse studies and bee abundance related with crop pollination. Engaged bee population also act like a main operator to boost the crop yield (Martins et al., 2015). In the urban area too, (Säumel et al., 2016), forests (Cummings et al., 2016), and natural bio-ecosystem (Cummings et al., 2016; Massaro et al., 2013), the significant contribution of native bees has also been reported and their abundance is associated to the density wild flowers (Ollerton, 2017). In bees and flowers, the ecological interaction disappearance, is disregarded frequently instead of the bee extinction reports (Valiente-Banuet et al., 2015). This loss of bio-diverse factor still occurs at the same time or may result in the disappearance of the bee species (Valiente-Banuet et al., 2015; Jacquemin et al., 2020). Many bees are related to a specific habitat and food resources, which make them resist that environment and agitating food. Specialist bees forage on a few flowers whereas generalist pollinators have great foraging alternatives (Jacquemin et al., 2020). Thus the all-rounders are more resistant to the different climatic environments associated with human actions as they are capable to manage on other food resources (Roger et al., 2017). Damage of these biotic interplay effect in rapid species disappearances and negatively influence the working of the eco-bio-structure (Diaz et al., 2017). To avoid the collapse in environmental services to humans, the importance of interplay of biotic agents be contemplated (Jacquemin et al., 2020) to assess the fitness of environment and to determine the possible environmental matters (Aizen et al., 2012; Dirzo et al., 2014). The aim in Andalucía BeeFun project, is on the increase of knowledge and understanding of the impact of habitat, bee crop-pollination process and social groups (Underwood et al., 2020;Drossart and Gerard, 2020).

Bees are disappearing-a warning

Studies and assessment of bee population technology needs a basic action for global fluctuations in the decline and benefit of the bee species. In this worldwide transformation, a few species can survive or finish as described in the United Kingdom (Powney et al., 2020). IUCN Red List technology guides to assess the possible extinction of a bee species at regional, national, and global levels (IUCN, 2016) and there may be variations in the assessment techniques in different environments. To establish a fundamental base for the preservation actions and assessment of the species to execute monitoring, conservation strategy, management and policy formation, this is the most powerful technology. For wild bees Red List, at European level and many more countries are also compiling their Red Lists at national and regional level (Drossart et al., 2018; Reemer et al., 2018). At continental scale, in North America, IUCN has also undertaken the efficiency evaluation for the *Bombus* spp. (Hatfield et al., 2020). This research report for wild bees helps in indicating the bee abundance, species, and areas under threat. Bee conservation measures also indicate to record the factors influencing the bee abundance (Harvey et al., 2020; Primack et al., 2012; IPBES, 2012). Scientists are focusing at the degree of decline and factors responsible for the population withdrawal (Forister et al., 2019). Besides fire, drought, hydrological and geophysical events having a non-negligible influence on native pollinators (Nicholson et al., 2019), global warming, crop escalation, habitat and diseases greatly influence the bee populations (Potts et al., 2010; IPBES, 2016). Either effect of single element (Potts et al., 2010) and expected feasible interactions (Goulson et al., 2015;Meeus et al., 2018) have been reported in many countries, still a detailed scientific informationgap remains in the measurement of the spatial and temporal influences from the various threats alongwith the historical information independently (Bartomeus et al., 2019). Furthermore, the knowledge of the genetic variation in species, population dynamics and speciation are also important and more and more utilized in conservative biological aspects (Epps and Keyghobadi, 2015). New reports in genetic conservation has encouraged the scientists to utilize molecular biotechnology to determine more better about bee bio-diverse system (Epps and Keyghobadi, 2015; Lopez-Uribe et al., 2017), with new gene bio-techniques also appearing (Woodard et al., 2016). This is clear in cryptic bumblebee species having high degree of morphological convergence. Less genetic diversity which can result in inbreeding depression and lessen the health is alarming (Packer et al., 2016). Based on the historical reports and distance assessments (IBD), the assessment of the relation among bee population, their effective part and biotic and abiotic operators, researchers can classify the vanishing bee species (Cerna et al., 2017; Lecocq et al., 2017, 2018). Using various tools and the assessment of the threatening elements, through population assessments scientists are now capable of conservation tactics by policy agreements, applied plans, and actions with ongoing studies (van Klink et al., 2020; Forister et al., 2019; Drossart and Gerard, 2020).

Protection measures is the answer

After knowing the population tendencies and decline operators, then important action is to protect the suitable environments. In fact, based upon the scale and the landscape, there is a great wild bee heterogeneity and population diversity (Belsky and Joshi, 2019). Native bee make-up is framed by landscape fitness globally, from mountainous tropical habitats of Colombia (Cely-Santos and Philpott, 2019) to dry grasslands in Missouri, USA (Grover et al., 2017). Grasslands with blossoms provide a great bee abundance and habitats than crops devoted to livestock and full of flowers. So to protect such suitable habitats can be attained by the development of safe areas using legal actions to avoid any changes, and by buying such important ecosystems. Flexible management of bees and environment, in such protected areas, have to be established to explain the best programs and adaptive actions for the success and failures of the bee management. Nevertheless, many anthropogenic urban environments can never offer the same degree of bee shelter than the semi-natural ecosystem, but still need conservation activities. To attain similar targets, many joint programs aiming at the environment, intensification of bio-diverse ecosystem, least entry of alien bees or the communication about diversity damage have been undertaken by the World Bee Project. To integrate cloud computing with wild bee research worldwide the World Bee plan aims to serve all new intuitions and information to design modern programs for bee decline globally, various environment conditions and enhanced food sustainability and subsistence to intercontinental extent merging other strategies undertaken by the European Union (EU, 2011) implemented nationally (Belgian NFP-CBD, 2020) and in USA at other different scales to manage the bee disappearance (Heinz Center,2013); in France, (Gadoum and Roux-Fouillet, 2016); in Ireland, (PPSG, 2015). Bee and Butterfly Habitat Fund, Seeds for Bees, and The Dutch Bee Strategy, the English National Pollinator Strategy are helping stakeholders to exchange their expertise and information collectively from various cultures (Saunders et al., 2018; Turo and Gardiner, 2019). Public advice and the participation of youth is significant for running such projects (Turo and Gardiner, 2019). We suggest that main efforts should be concentrated on the safety, preservation and the restoration of native bee habitats, concentration on the urban and agricultural fields, and execution of man-made tools to provide nests, potential invasions by alien species and the training of people groups with efficient transmission.

Do wild bee environment renovation

Preservation of native bees can be started by the protection of semi natural environments to rebuild huge natural habitats for the establishment of a bio-diverse ecosystem. In the decline and protection of terrestrial insects in the safety of habitat Bee environment is most important (van Klink et al., 2020). These environments are bio-diverse activities to explain the important action to consider for the distinct diverse habitat (Sobral-Souza et al., 2018). Such new standardized models can be assessed by the Ecological Niche Models (Krechemer and Marchioro, 2020) as tested in bumblebee species in South-America. Protected eco-environments can boost native bees in landscapes and geographic regions (Tonietto and Larkin, 2018). Improvement of the environment by repairing techniques implicit an investigation of the habitat of the target species. They evaluated the preferences of bumblebee likings in the crops and suggested natural landscapes and field boundaries for the bee population survival. Wild bees can react differently in changed environments. Carrié et al. (2017) described that hedgerows, grasslands, and forest edges with potential attributes for example in solitary and ground-dwelling bees foraging a large number of flowering plants, but the social and above ground nesting bees visiting a few blooms in such ecosystem. Rainforest could improve above-ground nesting for bees as found in Brazil, conversely (Ferreira et al., 2015) showing the conservation activities importance in a protected bee-habitat. The restoration devices can be made double-edged and depending upon the demand and situation. As grazing and burning are followed in grasslands to aid floral blooming, however they can also destroy wild bees hibernating in the plants (Tonietto and Larkin, 2018). These restoration measures are conducted in the framework of LIFE plans funded by the European Union. They focus to renovate bee habitats directed in Natura 2000 bee sites mentioned in “Birds” and “Fauna-Flora-Habitats”. If bee protection is at its inception compared to birds and mammal’s safety, aiming at butterflies and LIFE in Quarries will indirectly help to local bee fauna with the bee conservation and the environment renovation similar to quarries, peat bogs, biological meadows, and hedgerows (Folschweiller et al., 2019). As LIFE projects failed, similar program such as Urban bees LIFE are in action (www.urbanbees.eu) and are targeting management to increase the bee population and bio-diverse environment of local bees in potential urban and peri-urban areas. Hall and Steiner (2019) described that US state projects did not consider the significance of bees in comparison to vertebrates leading in less understanding of their needs, and restoration actions. Few conservation focusing in semi-natural environments are believed in schemes at national/sub-national level.

Develop and use conservation methods

In Urban and Agricultural Areas Conservation measures are crucial and in anthropogenic areas more than 55% of bees live in the peri-urban regions. Under such important programs, hedgerows, parks, roadsides, and urban gardens can constitute crucial environments for bee multiplication in quality and quantity, and transitional areas as beneficial environment (Hall et al., 2017; Nowakowski and Pywell, 2016; Gosselin et al., 2018; Crone et al., 2019). Such ecosystems can assist in building big specific diversity and an boosting factor for rare bees (Senapathi et al., 2017) and often pillar a great bee diverse ecosystem (Fortel et al., 2014). Bee-friendly plans using roof-top gardens, parks, and roadsides, has increased the populations of native bees in Amsterdam (Givetash, 2018) as this environmental interconnection proved important ecological segmentation could be harmful for little bee species. Tiny bees in segmented habitats, can be incompetent to approach the favorable landscapes and face difficulties in anthropogenic environments (Warzecha et al., 2016; Gérard et al., 2020; La Vie Sauvage, 2020; François and Féon, 2017).

It has been revealed largely that the strength of floral wealth is a key framework for native bee diversity, when renovating prairies as in Minnesota, USA (Lane et al., 2020; Ritchie and Roser, 2020). Agro-environment actions, as flower strips have been accepted in Europe to increase biodiversity in assiduously managed agro-landscapes (Grass et al., 2016; Cole et al., 2020) and beneficial for bumblebees, honeybees, and hoverflies in Germany, Belgium, and in England (Wood et al., 2015). More flower supplies mostly helped in the improvement of bumblebee population, size, density and young ones number (Wood et al., 2015; Vaudo et al., 2018). The impact of AES was determined rarely (Batáry et al., 2015) and Geppert et al. (2020) observed the effect of organic practices and floral strips for bee population survival and development. Both actions were positively corresponding to pollinators' strength and population and growth of bumblebee hives, but the efficiency of these actions relied firmly on the landscape around (Geppert et al., 2020). In England, (Wood et al., 2017) also assessed a Higher Level Stewardship farms—HLS to experiment if grown flowers helped the native solitary bee populations. For instance, as honeybees and bumble bees were positively influenced by the affair of *Phacelia* sp., solitary bees mostly foraged sunflower and seed mixes of wildblooms (Mallinger et al., 2020; Nichols et al., 2019). Still, a move in flower resources happened among the most environments of native bees facing stress and could result in the exhaustion of flower assets and alterations in the crop-pollinator web (Gérard et al., 2020; DEFRA, 2020). The restructuring of flower mixtures could also be effective in bee environments with maximum flower density in areas under crop and uncultivated land (Quinet et al., 2016; Moquet et al., 2017). Angiosperms should offer the flow of floral gifts throughout the flowering season for sufficient food needs (Vaudo et al., 2015; Filipiak et al., 2018) based on the floral phenology and specific behavior of bee species. Gresty et al., (2018) demonstrated that plants like *Rosa canina, Malvasylvestris, and Ranunculaacris* allured specifically those solitary bees living in cavities.

This framework is pivotal for bee multiplication and abundance but is often neglected during the selection of bee-friendly flowering plant cultivars. This is accurate for the brood nutritional needs, which vary from adult requirements (Filipiak et al., 2018). The strength and nutritional power of crops like *Brassica napus* for *Osmiabicornis*) can positively help in the development rate of bee abundance (Bukovinszky et al., 2017; Filipiak, 2019). In fact, the variety of proteins and essential amino acids required is important for the growth and development of bee population. This can help bee species health through nutritional needs using floral assets available in the habitats, particularly in flower resource-exhausted environments. Different agrotechnology could also be tested such as friendly planting, which can enhance the quantity and quality as in the strawberry *Fragariax ananassa* and the borage *Borago officinalis* (Griffiths et al., 2020) but the effect on pollinator abundance was not studied. So it is difficult to describe the chemical toxicity taken from reports on honeybees and generalize about bumble bees and solitary bee taxa, furthermore, solitary bee's sensitivity will be highly different. POSHBEE, European strategies could be beneficial in comprehending how pesticides can influence these native bee fauna and synergistic effect with other decline elements. Still, it has been demonstrated to also influence bee pollinators and is not a particular reaction to safeguard the bee world (Dicks et al., 2016; Egan et al., 2020). Egan et al., (2020) demonstrated a newly designed strategy that is known as Integrated Pest and Pollinators Management (IPPM; Biddinger and Rajotte, 2015) the same we propose to be called as, "Pollinator and integrated pest management technology (PIPMT)", as this is a technology, or holistic strategy to amalgamate crop pollinators, bio-control agents, minimum use of pesticides and various other IPM procedures, aiming at the management of the pests below economic injury levels for enhancing the agriculture food production (Tanda, 2019, 2021a-h). Applied management actions are also recommended, such as the choosing of varieties with great bee pollinator allurement and maximum pest resistance. In Ireland, The Protecting Farmland Pollinators plan is reliant upon the designing of a crop bee pollinator assessing campaign which can permit growers to determine simply which control processes on agro lands help to pollinators in decreased pesticides usage, offer little environments and floral resources for example, flowering pattern at the farmland level. Additionally, the Interreg-Sudoe Poll-Ole-GI project (2016-2019) focused recognizing and suggesting efficient practices as green infrastructures (GI) to positively effect on bee pollinator abundance and bee ecosystem amenity in the two most significant Mediterranean crops of arable farmland in the South-western European Space (SUDOE) which comprises Southern France, Spain, and Portugal, including sunflower and oilseed rape.

Bee hotels

To increase the accessibility of flower assets for pollinators in research, however, barely few studies have targeted the bee nesting sites (Fortel et al., 2016). Endangered bees could be settled in soil-nesting and other wild bees with special nesting behavior, nesting in cavities, subterranean, carder bees and in snail's shells. We recommend copious nesting provisions, including the development of Wild Bee Inns for little bee species for wide distribution areas (Fortel et al., 2016). Maclvor and Packer (2015) also established the newly protected environmental enhancement strategies for wild bee needs. They highlighted that about 50% of the bee population housed in the bee hotels were newly introducedalien bees, however 75% of them were lived in by wasps. Alarmingly, they found a negative interrelationship between the wild bees and the species present in bee hotels (Geslin et al., 2020). This study described the positive reaction of artificial devices for native bees nesting, and exhibits the role of developing nesting sites to multiply various bee species for the crop pollination (Maclvor and Packer, 2015; Fortel et al., 2016). In fact, aim should be on the present and bee hotels cavities hole diameter as needed by various bees for nesting, as small diameters could help many wild species and prevented by bigger exotic bees like *M. sculturalis* to adopt bee hotel lodging (Geslin et al., 2020). May this be the little patches of bare soil installations, bee inns or the bee hotels, the empirical use of their positive contribution should be thoroughly studied.

Alien plants and their role

Local plants can be managed by professionals using protection strategies, many alien species can invade and populate bee-friendly habitats, or even they are grown voluntarily. However, the effect of alien plants can depend upon various ecological factors or life history characteristics, resulting in some species to suffer from the invasions whereas for others it may be favourable (Davis et al., 2018; Drossart and Gerard, 2020). Incursion only happens when an exotic species is having invasive power andsufficiently suitable environment to survive. Generally such plant species have been developed in habitats closely associated with human existence. Pretentious habitats related to humans, alien plants can offer food resources for some bee pollinators and improve crop production via cross pollination (Hobbs et al., 2013; Drossart et al., 2017; Jachuła et al., 2020). They may have detrimental effects on specific bees with small diet flexibility. However, some unwanted alien plants contend with local vegetation and can oust plants that are visited byspecific pollinators. Few non-indigenous species also show resources that are inaccessible to most wild bees such as, *Petunias* sp., (Lowenstein and Minor, 2016). Majewska and Altizer (2018) described in a meta-analysis that no organized positive or negative effect on pollinator population could be attributed to exotic species and that their influence is case-specific. It can be hypothesized that all exotic species are harmful and thus as detrimental to the knowledge magnification as is the principle that these species are fully protected (Boltovskoy et al., 2018). In the future, the Asian hornet *Vespa velutina*, for example, could be a threat for wild or managed bee pollinators (Arca et al., 2014; Keeling et al., 2017; Laurino et al., 2020). In importation programs, planned international measures to prevent bio-invasions of alien species should thus be a main important matter (Sutherland et al., 2016). Observing invasive species should be kept on top of the activities, it could allow acquiring the data required to carry out the population dynamics research and test their potential effect on native species and eco-environments (Le Féon et al., 2018; Aizen et al., 2019). A law to prevent and alleviate the harmful effects of alien species in the European Union entered in 2015 (EU Regulation (EU) No.). Assessing the IUCN Red Lists, a parallel program called as "Black List" has been recommended for invasive alien species and contemplates the extent of climatic effect for the species assessed. The IUCN Invasive Species Specialist Group (ISSG) gathers specialists in minimizing challenges developed by aliens to native habitats and the species they restrain by increasing awareness, elimination, management, or removal pertaining to them. Each group is accountable and adapted nationally, making and improving invasive species list in their respective country.

Building bee populations

The effectiveness of preservation actions, from the scientific knowledge and liaising more efficiently and correctly with scientific data to a large audience is a base to set up a solid conservation starting point. Few precedents in education, training and communication can be explained to strengthen the bee conservation technology (Saunders et al., 2019). In various taxa, maximum use of citizen sciences in bee conservation procedures encouraged monitoring population studies over a long time period (Gardiner and Didham, 2020; Ubach et al., 2020). Many people have paid attention to wild bee pollinator's conservation in the last decade. Despite notable biases in records, such as observing the most striking and colorful species, cryptic species incorrect identification, using this tool, permits to effectively note a large number of specimens in large area, showing an important part of the species in an environment and assessing the species dynamics for scientific research (Duchenne et al., 2020) and Red Lists program. Silva and Minor (2017) observed that the degree of education and knowledge about wild bees were directly related to the positive attitudes of the respondents towards the native bee abundance, encouraging the pivotal role of people's awareness. This information should be exchanged largely among scholars, and social media groups and also true in demonstrating the geographic and taxonomic extent of reports (Saunders et al., 2019). Scientific information favouring different concepts prior to the pesticides, mowing/pruning agenda constitutes a main action to efficiently integrate bee groups pollinators in the management system of all parks, gardens, and flowering patches (Schonfelder and Bogner, 2017; Folschweiller et al., 2019;Turo and Gardiner, 2019). Austria designed several research projects targeting the positive impact on wild pollinators for the renovation of flowering areas in 20ha using 18 local officials by monitoring native bee populations (Underwood et al., 2017). Apart from this pilot project, they also established many acceptable green habitats in orchards, road edges, schools, nurseries, and along waterways for bee conservation (Underwood et al., 2017). An alliance was established between an NGO and a supermarket chain for bee conservation actions. Similar collaborative programs are initiated between fruit growers and local city municipalities in Flanders (Belgium) or between a beer brewer, NGO, and public officials to boost bee conservation schemes (Underwood et al., 2017).

Wild bee populations are decreasing globally for the last few decades, mostly by the human interferences. The people interest for their protection increased greatly, through scientific publications communicated through various media sources. Despite this large interest, due to the shortage of knowledge and subject comprehension is flagrant and describes a space between consciousness and apprehension. As bee disappearance is studied, knowledge on conservation actions is still scattered in literature. We lack bee preventativeconcepts and scientists are working for efficient tools for enhancing native bee populations and the improvement of bee environment. In this review, we present a recent new analysis of the wild bee conservation methods, and their utilization in habitats and the advance scientific programs that fill up the gaps in literature and reframe new applied conservation strategies. Focusing on wild bee pollinators, we applied our main information on (i) the modern protection methods in anthropogenic environments, (ii) the preservation and renovation of native bee habitats, (iii) implementation of newly designed tools, (iv) actions to control exotic species, and (v) how to educate public with the new concepts efficiently for maximum bee pollination benefits. This review can be beneficial to implement a factual and experimental native bee protection strategy for the enhanced and sustainable food production globally.

Wild bee conservation -challenges and threats

The importance of wild bee conservation requires bee scientists to transmit new concepts and guidance relying on the research observations in bee diversity protection and tools used (Primack et al., 2012). Bee protection actions are carried out research on honeybees or bumblebees, but, conclude such reports and can rarely be considered as an alternative for local solitary bees (Schmitt et al., 2020; Wood et al., 2020). The recent naming visited flowering plants (Gresty et al., 2018) liking the foraging period of selected wild bee and the food necessities of adults and immature stages (Filipiak, 2019). This subjectis roughly investigated at the time of designing new strategies of bee protection. Besides, there is an important imbalance between the investigations regarding the bee flora, favorable habitats and safe nesting site provisions. Such studies have to be handled in reframing the bee conservation plans, further investigations needed to study such crucial subjects more thoroughly, especially in assessing a large area of bee dwellings than only bee resorts, and hotels. The globe which is progressively anthropogenically-moving forward, different bee flora habitats could be, promptly, an answer to the deficit world food problem. In habitats having little native bee-flora, few alien invaded species can assist bee abundance to recuperate. Such topics should be considered depending upon proofs as in New-York a new report described that exotic species could help honeybees better than the native wild bee populations (Urbanowicz et al., 2020). In such anthropogenic habitats, the method to run bee-friendly environments have also to be re-consider, in particular by discovering options to pesticide applications. Dealing with such circumstances, the influence of techniques like IPPMT could be enormouslyexplored for the maximum safety of pollinator's world. Additionally, the overwhelming most environment renovation research is carried out in North America and Europe, which constitute only a little portion of worldlyenvironments occupied by native bees. Similar bee restoring methods could not be prototypical of what should be adopted in other bee habitat having dissimilar landscapes (Tonietto and Larkin2018; Drossartand Gerard, 2020;Tanda, 2019, 2021) also needs attention. Further studies should be carried out to assess conservation methods extensively in rainforest and arctic environments. The transmission of education about wild bees have to be redesigned in gathering facts. It is a fact that we do not preserve birds by offering hen homes, so we will have to maximize our attempts so that the beautiful world of bees does not go around the hives,for honeyand waxes. To handle this, we should not disregard to involve work packages in our research work about the communication of knowledge to various schools and those who are realistically employed to implement conservation activities. These plans are often the ones that are rejected while they should be the acme of scientific work. In spite ofgathering information about bee population threatening elements, we should share, import, away from the preventativeideas as they are generally studied, established, recognized and at least assessed in part (Folschweiller et al.,2019;Tanda, 2019, 2021;Penn, 2021). Now specialists are inviting for measures, which need the immediate main attention (Folschweiller et al., 2019). Research strategies as the Interreg SAPOLL project, designing a strategy for wild bee conservation as the chief target or the biodivERsA NUTRIB2 project could support to fill thegaps. Designing of such actions and combine the various beeconservation players would further strengthen the public awareness to bee biodiversity and environmental services in bio-ecosystems where people are more disconnected from the natural bee world for instance, the house tops, commercial buildings, roadsides, near bridges, and railway track sides etc. (Fortel et al., 2016; Penn, 2021). Some actions which can conserve the bee populations are described below;

- Promise to protect the bee pollinators and join BEE-SAFE on your piece of land, garden, and the backyard of your company and your rooftops. Towns, schools, corporations, and individuals lands can be used.
- Say no tochemical uses on your flowering plants to prevent any insecticidal harm to bee fauna. Inspect plants bought are not pre-treated with neonics.
- Grow bee pollinator's preferred flowering plants as they are a big asset for bees and butterflies providing nectar and pollen.
- Keep away from lawnsas they desert for bee pollinators, so plant prairies.
- In early spring don't weed your gardens as dandelions are best source of bee food and medicine.
- Install water basins in summer with pebbles or floating corks on water to prevent bees from drowning in every balcony.
- To get enlightened and sign regular petitions to pressurise the world countries to pass laws to conserve the bees banning neonicotinoids, keep in touch with the Facebook page of New York Bee Sanctuary and Instagram account.
- In your back yard or your rooftops, install a bee hive and modified handmade tools for wild bee conservation and protection. It's an excellent and wonderful strategy to offer home and nesting sites to many bee populations.
- Train the public and educateyour families by showing bee documentaries. Native bees are harmless, and visit flowers. Know about the valuable bee services in food production globally and respect them.

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