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Продовольственная и сельскохозяйственная организация Объединенных Наций
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منظمة الأغذية والزراعة للأمم المتحدة

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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GLOBAL SURVEY OF HONEYBEES AND OTHER POLLINATORS

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I. INTRODUCTION

Honeybees and other pollinators play critical roles in food security and nutrition. Given that these animals are not traditional livestock, they have not to date been considered in the intergovernmental process for management of animal genetic resources for food and agriculture. The Commission on Genetic Resources for Food and Agriculture (Commission) at its Sixteenth Regular Session[1] requested FAO to consider including domesticated honeybees and potentially other pollinators into DAD-IS,[2] the Domestic Animal Diversity Information System, a communication and information tool for the management of animal genetic resources. DAD-IS is the public interface to the Global Database for Animal Genetic Resources and is the Clearing House Mechanism of the Convention on Biological Diversity (CBD) for monitoring of animal genetic resources for food and agriculture. DAD-IS provides its users with searchable databases of breed-related information and images, management tools, and a library of references, links and contacts of Regional and National Coordinators for the Management of Animal Genetic Resources (National Coordinators). It also provides countries with a secure means to control the entry, updating and accessing of their national data on livestock breed populations.

When requesting FAO to develop a draft work plan on microbes and invertebrates, the Commission reiterated the importance of pollinators, specifically honeybees, and of micro-organisms of relevance to ruminant digestion, food processing and agro-industrial processes, as well as biological control agents and soil organisms, and requested that these key groups be reflected in the draft work plan.[3]

In response to the requests of the Commission, the FAO developed and distributed a global survey to collect data on the status of world-wide honeybee and pollinator populations and current programmes for their monitoring and conservation.

II. THE SURVEY

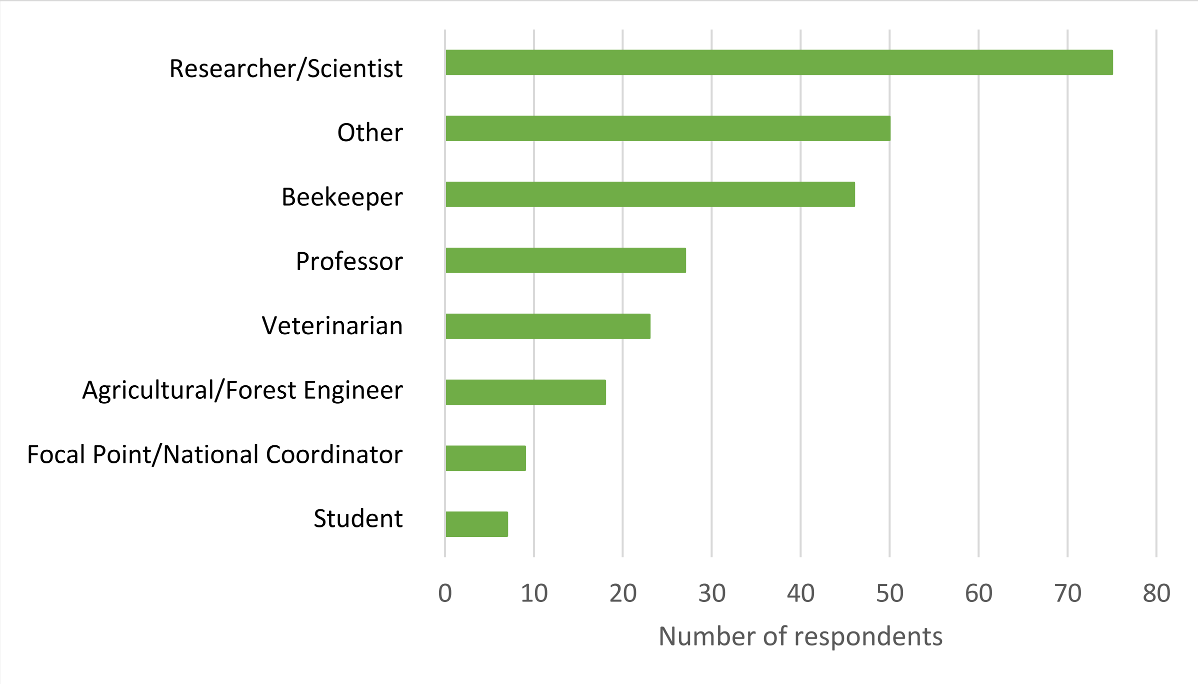
The survey[4] was Web-based and was open for submissions from 28 February to 31 July 2017. English and Spanish versions of the survey were distributed to (i) the Domestic Animal Diversity Network (DAD-Net): (ii) the Beekeeping Exchange Group of FAO's "Technologies and practices for small agricultural producers" platform (TECA;[5] (iii) the International Federation of Beekeepers Associations (Apimondia);[6] the Intergovernmental Platform on Biodiversity and Ecosystem Services (IBPES),[7] the Convention on Biological Diversity (CBD); and all National Coordinators. In addition, in countries where no response was received in the first two months of the survey, scientists with recent scientific publications on honeybees were contacted directly and invited to respond.

The survey comprised 28 questions and was divided into three sections: (i) General Information, (ii) Honey Bees, and (iii) General Pollinators. The first section requested information about the respondents and the country about which they were reporting, whereas the subsequent two sections requested information on main honeybee and pollinator species, their contributions to food and agriculture and threats to their survival, their known or perceived population status, and existing systems for population monitoring conservation.

A total of 256 responses from 104 different countries were received, with 47 percent of responses coming from a government representative. The average number of responses per country was two, with 50 countries submitting a single response; 30 percent of countries submitted more than two responses. The largest number of responses received from a single country was 12, from Ecuador, followed by Argentina, Chile and Ethiopia, each submitting 11 responses.

[1] CGRFA-16/17/Report/Rev.1, paragraph 46.
[2] http://www.fao.org/dad-is
[3] CGRFA-16/17/Report/Rev.1, paragraph 79.
[4] https://goo.gl/forms/veNe0krWGcFjmT752
[5] http://teca.fao.org
[6] http://www.apimondia.com
[7] https://www.ipbes.net

Figure 1: **Occupations of survey respondents.**



The distribution of occupations of respondents are shown in Figure 1. Respondents were grouped under similar umbrella terms for their respective profession (e.g. a respondent identifying him or herself as a "biologist" would be grouped into the "scientist/researcher" category along with entomologists, chemists, etc.). The most common professions responding were scientists and researchers, accounting for 29 percent of survey submissions. Beekeepers were the next largest defined category with 18 percent of the total submissions.

The goal of the survey was to obtain a country-wide consensus response whenever possible. For yes/no questions about the existence of something, such as a pollinator monitoring system, "yes" was assumed to be correct, even if some respondents indicated "no" or "I don't know". The assumption was that the persons responding negatively were simply unaware about the object in question. For questions regarding the presence of various pollinator species or subspecies, all responses were accepted. When questions involved asking for the most common or important answer, the most frequent response was taken as the correct one. For questions that requested a list of multiple responses (e.g. the three main threats to pollinators), the frequency of each response was counted within a given country and then ranked according to frequency. When a ranked list was requested, responses were weighted according to rank (e.g. 1^{st} = 3 points, 2^{nd} = 2 points, 3^{rd} = 1 point), summed across all respondents within a country, and then ranked according to this sum.

The survey sought to determine what species of honeybee were utilized in global apiculture and pollination practices. Ten different species of honeybees were reported to be present in the respond countries, six of which were reported to be managed in some form. "Managed" in this definition encompasses the act of caring for and interacting with the species in some form, from commercial beekeeping operations to hobby beekeeping. The six species were *Apis mellifera*, *A. cerana*, *A. florea*, *A.* dorsata, *A. laboriosa* and *A. nigrocincta*. These species represent all three subgenera of honeybee: Apis – the cavity nesting bees (*mellifera*, *cerana*, and *nigrocincta*); Micrapis – the dwarf honeybees (*florea*); and Megapis – the giant honeybee (*dorsata* and *laboriosa*). The other four honeybee species that survey respondents reported as present in their respective countries were *Apis andreniformis*, *A. binghami*, *A. breviligula*, and *A. nuluensis*.

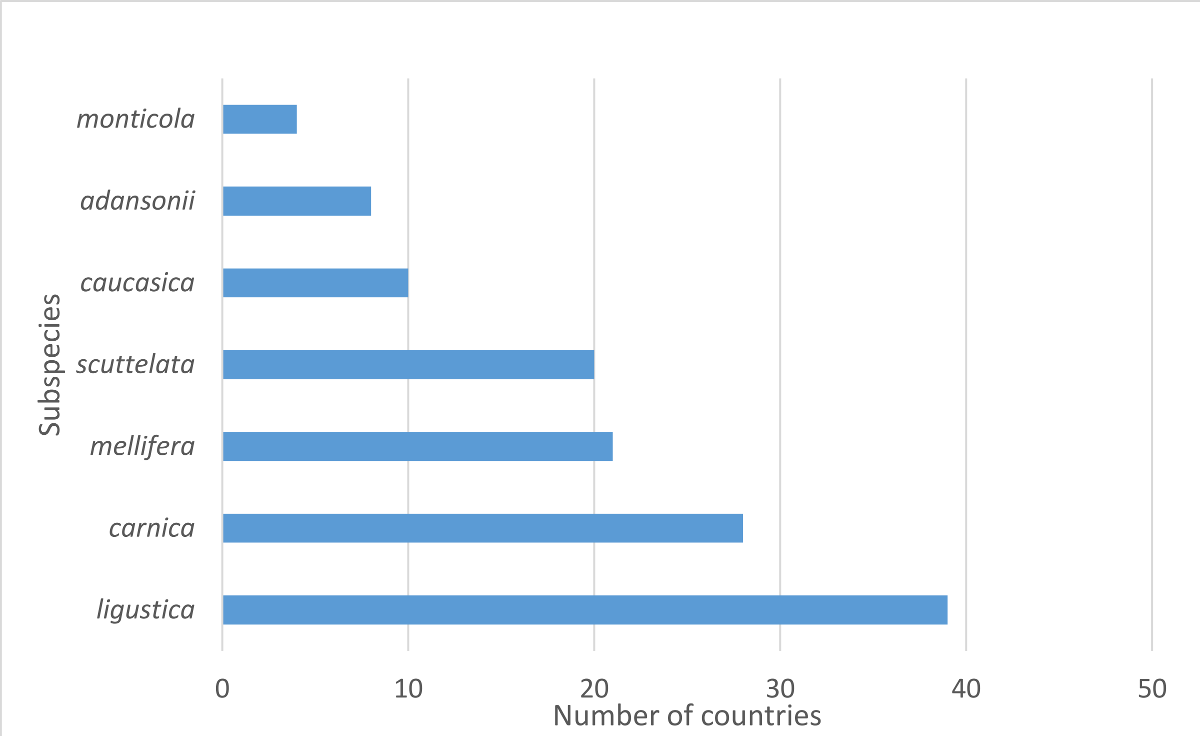
The European or Western honeybee, *Apis mellifera*, was reported to be present in 100 responding countries, and is managed in 94 of them. The next most abundant species of honeybee is the dwarf honeybee, *Apis florea*, present in 19 countries, followed by the Asian honeybee, *Apis cerana*, managed in 12 of the 14 countries where it was reported.

Survey respondents were asked to identify prominent subspecies of any honeybee species that were commonly used in their country. Thirty-eight (38) subspecies in total were identified – 34 for *A. mellifera* (including named hybrids), three for *A. cerana* and a single subspecies reported for *A. dorsata*. The respondents from 25 countries did not report or know what subspecies of honeybee were used in their countries' apiculture practices. Repondents from 11 countries reported using hybrids of honeybee subspecies, which may have been either crosses that occurred naturally where subspecies have overlapping territories or intentional crosses bred by beekeepers. Eight countries specified the use of the hybrid "Buckfast", a popular intentional hybrid strain of honeybee that features crosses of a multitude of honeybee subspecies and is bred at Buckfast Abbey in the United Kingdom.

The 34 subspecies and main hybrids of *A. mellifera* reported in the survey are given in Table 1. The three subspecies of *A. cerana* that were identified included *A. cerana cerana*, *A. cerana indica*, and *A. cerana japonica*. *A. cerana indica* was the most commonly reported subspecies, in four countries. The single subspecies of *A. dorsata* reported was *A. dorsata dorsata*. Frequencies (number of countries) of the seven most popular *A. mellifera* subspecies are summarized in Figure 2. The subspecies *ligustica* was the most widespread, reported in 39 countries. *Carnica* and *mellifera* were the second and third most widespread subspecies, in 28 and 21 countries respectively.

Table 1: **Reported *Apis mellifera* subspecies and major hybrids**
adami
adansonii
anatoliaca
bandasii
capensis
carnica
carpatica
caucasica
cecropia
iberiensis
indica
intermissa
iranica
jemenitica
lamarckii
ligustica
litorea
macedonica
meda
mellifera
monticola
nubica
rhustica
ruttneri
sahariensis
scutellata
siciliana
sicula
simensis
syriaca
unicolor
woygambela
Buckfast hybrid
other hybrids

Figure 2: **Frequencies (numbers of countries) of the seven most commonly reported *Apis mellifera* subspecies**



III. HONEYBEE POPULATION DATA AND GENETIC DIVERSITY

With regard to the potential incorporation of information about honeybee populations into DAD-IS, the survey asked respondents if their respective countries systematically collect population data on honeybees and the extent of this activity. Such information is the most important data for the monitoring of the status of national populations of the 38 species of livestock currently recorded in DAD-IS. Nearly 80 percent of respondent countries reportedly collect population data on their honeybees to some extent, and 67 percent collect population data on all species of honeybees present in their country. Among the countries that do not collect population data on honeybees, lack of political will was indicated as the principal reason for such inaction. However, (i) lack of awareness regarding the importance of such information; (ii) low national priority for collection of honeybee population data; and (iii) a lack of funding; in that order, closely follow a lack of political will. Given the similarity of these reasons, the inability to collect honeybee population data is likely the result of a low importance of the honeybee sector in countries where data is not collected. Respondents were also asked to identify the responsible authority for the collection of honeybee population data in their respective countries (Figure 3). While the government was most often cited, respondents often chose more than one body as responsible for this collection of data. The collection of honeybee population data is seemingly cooperative and collaborative. Only 18 percent of countries that collect population data on honeybees rely on a single type of group (government, beekeeping associations, etc.).

The respondents were asked to describe the population trends of their countries' honeybees. Respondents from 58 percent of the countries stated their honeybee populations were steady to increasing, with respondents from 38 percent of the countries describing their honeybee populations as increasing. 24 percent of survey countries did not know or were inconclusive on the population trends of their honeybees (no table shown). The trends of honeybee populations are shown in Figures 4 (all participant countries) and 5 (those that collect population data); the figures are colour-coded to the countries' honeybee population trends and include all countries that participated in the survey.

Figure 3: **Responsible parties for the collection of honeybee population data (multiple responses possible)**

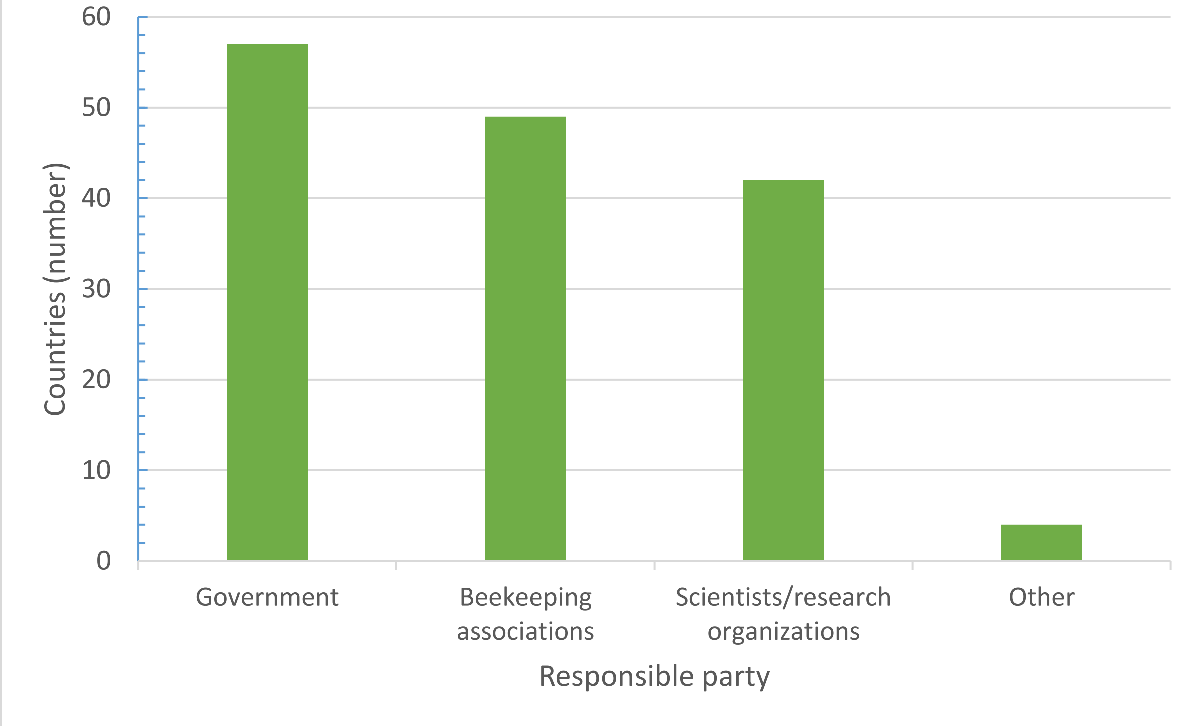


Figure 4: **Estimated trends of honeybee populations in all participant countries (light grey = no response)**

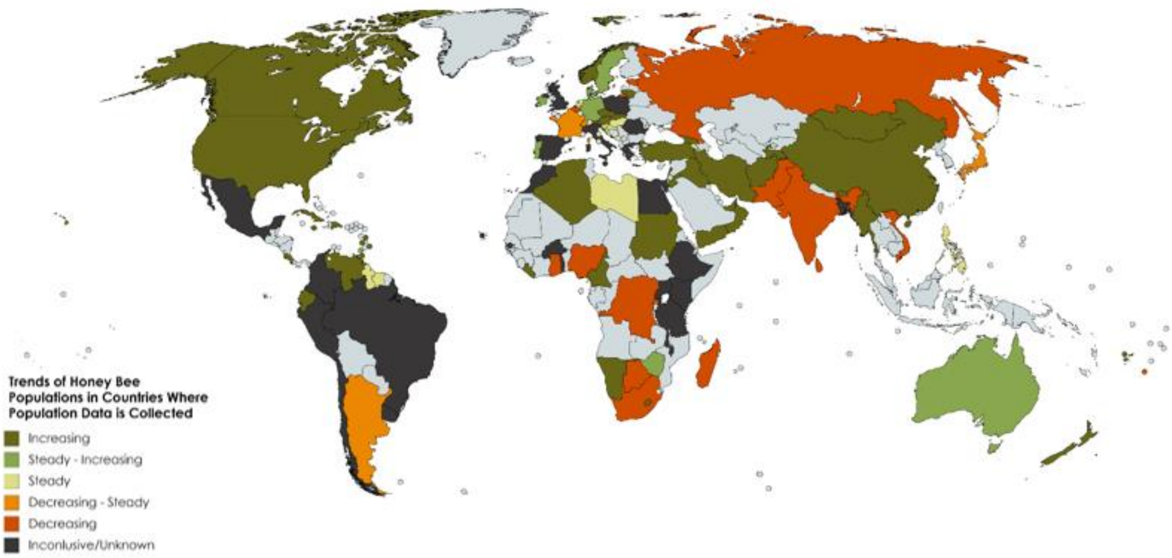
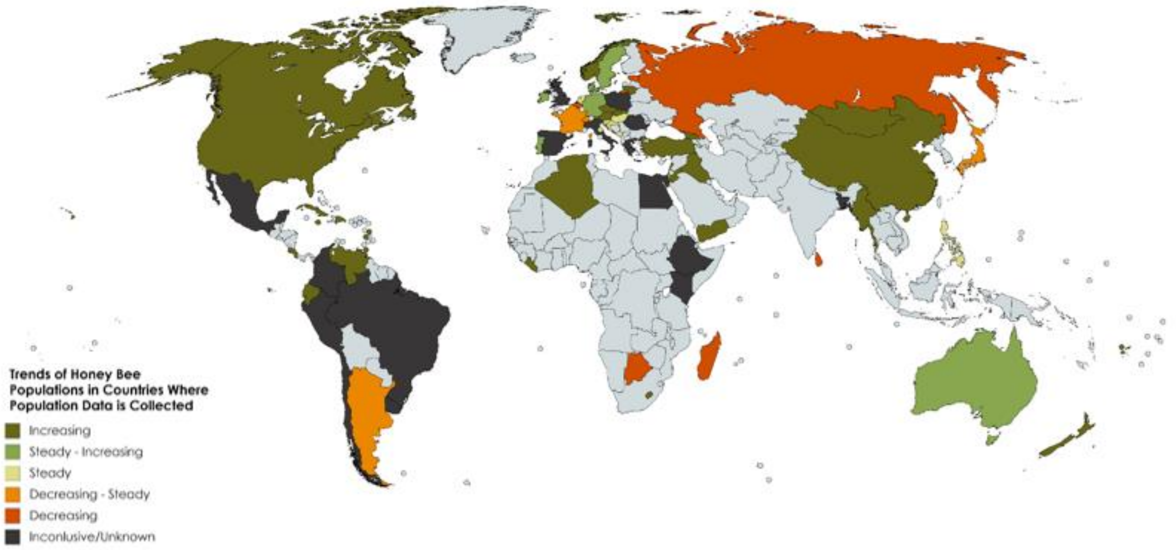
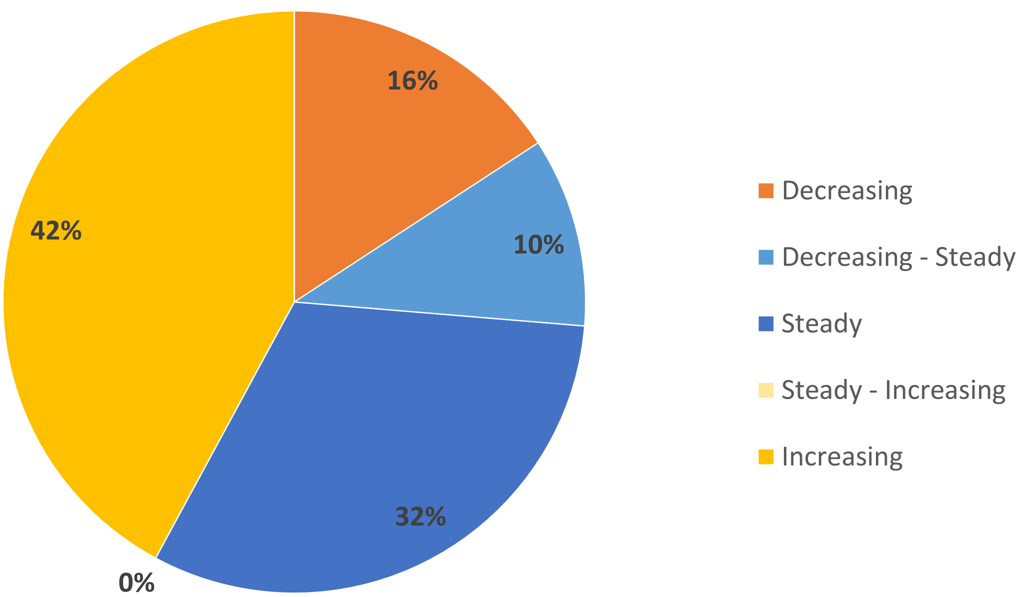


Figure 5: **Trends of honeybee populations in countries where population data is collected (light grey = no collection of population data)**



The genetic diversity of honeybee populations was monitored in only 27 countries (26 percent). Among the countries that monitored diversity, 74% stated that the genetic diversity of their honeybee populations was steady or increasing (Figure 6). Respondents reported using controlled queen rearing, DNA/morphometric analysis, marketing locally adapted breeds as well as implementing protections of native subspecies to monitor and maintain genetic diversity.

Figure 6: **Trends of genetic diversity of honeybee populations in monitored countries**



IV. HONEYBEE SERVICES AND TRADE

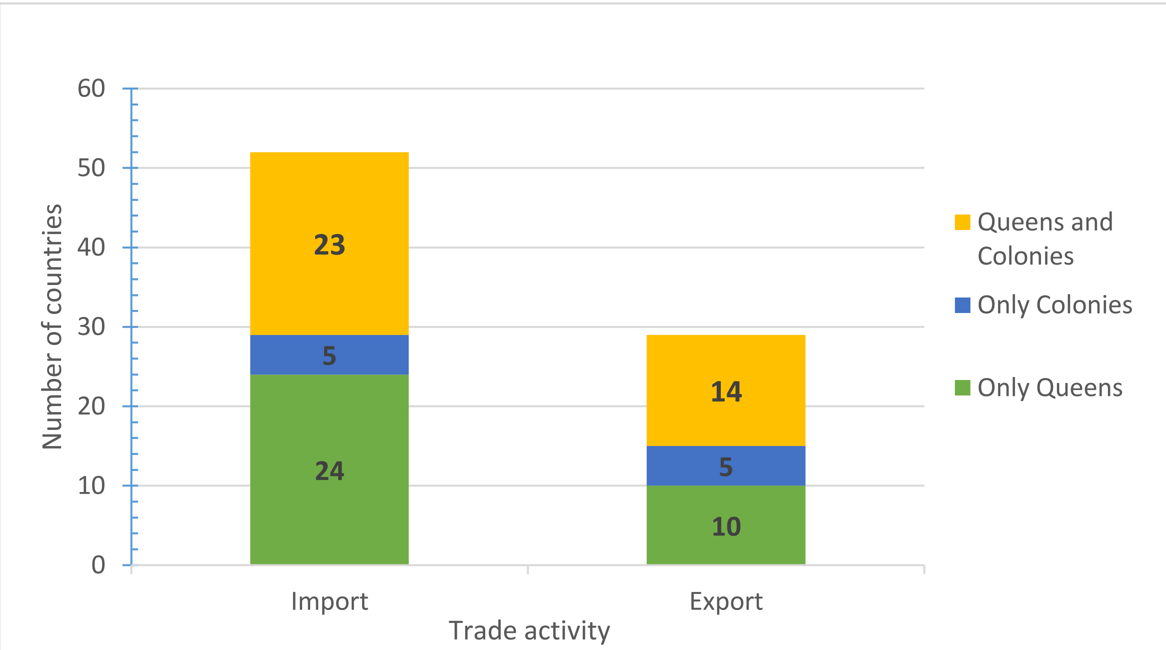
Survey respondents were asked to rank the three most important services honeybees provide within their country. Pollination services and production of other honeybee products (beeswax, propolis, etc.) were ranked as the second and third most important services respectively. Scientific research, medical and therapeutic practices, and cultural or religious customs followed in fourth, fifth and sixth place, respectively.

Honey bees were dispersed from their original range throughout the globe during the European colonization, and now can be found in almost every country in the world. Honeybee trade continues today, with 61 percent, of respondent countries participating. Eighty-seven percent of trading countries import honeybees and 49 percent export honeybees, with more than 75 percent of all participating countries restricting the transfer of honeybee pests and pathogens across provinces, regions and borders.

Information about regulations to control movement of bees within or between countries was collected. Many countries require health inspectors or veterinarians to declare that hives transferred between provinces are free of disease. Without certification they are not permitted to pass from one province to another. Often, specific pests and pathogens must be declared if found within a country, and the hives must be either quarantined or eradicated to restrict disease transmission. Many countries stated that imports of honeybees are only allowed from specific countries, and used bee-related equipment is often not allowed to be transferred over national borders and is regulated across provincial borders. Beekeepers may have to register their hives with a designated authority and often are required to have a licence to rear queens.

Figure 7 breaks summarizes the trade activities of countries that participate in international honeybee trade. Honeybees can be traded as colonies, called “packages” or “nucs”, as single queens, or both. Queens are more commonly traded than nucs or packages; 85 percent of countries importing honeybees and 77 percent of countries exporting honeybees trade queens.

Figure 7: **Honeybee trade activities of respondent countries.**



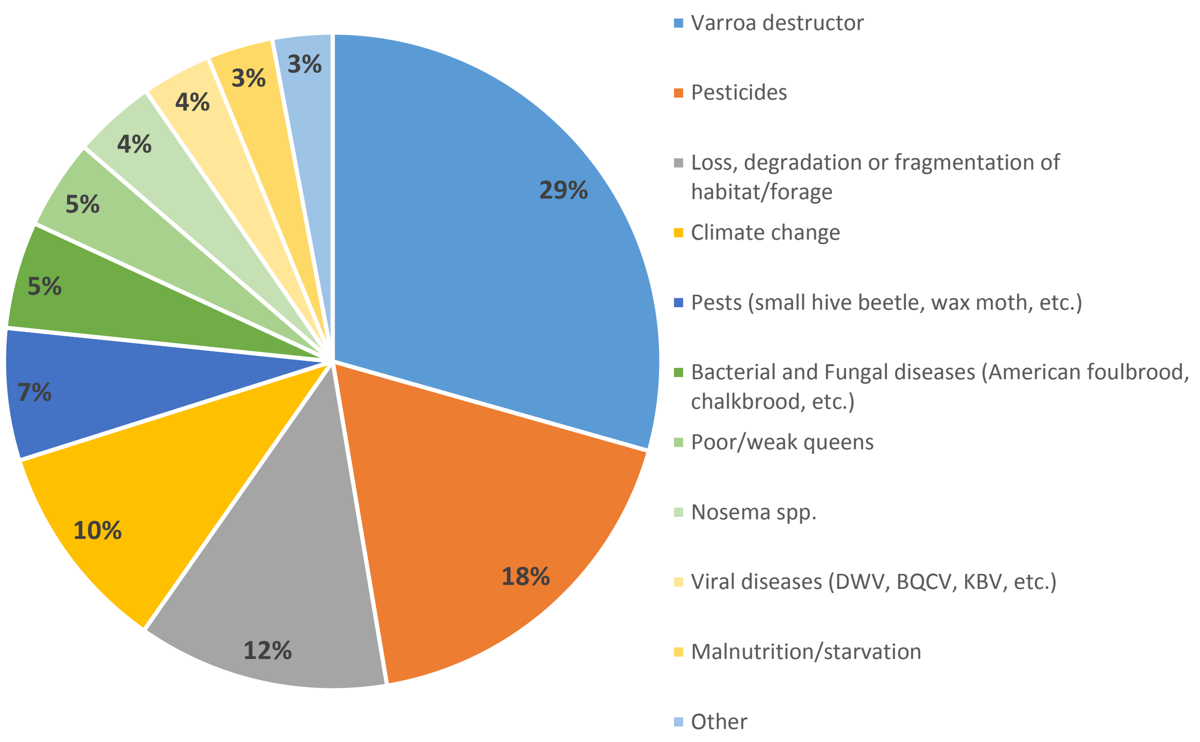
V. THREATS TO HONEYBEE POPULATIONS AND THEIR GENETIC DIVERSITY

When asked to rank the top three threats to their countries honeybee populations, respondents selected a great variety of factors, demonstrating the complexity of maintaining and increasing the world's honeybee genetic diversity and population. Figure 8 shows potential threats and their global ranking, with (i) *Varroa destructor* (a parasitic mite), (ii) pesticides, and (iii) loss, degradation or fragmentation of habitat and forage cited as the top three pressures on honeybee populations and their genetic diversity. Regionally, the top threats varied (Table 2). *Varroa destructor* was the most important threat in the greatest number of regions (four) and was second in another, but was not considered a major problem in Africa and the Southwest Pacific. Pesticides were important all regions, ranking second in six and first in one. Loss, degradation or fragmentation of habitat/forage was the most important threat in Africa and third in North America, but not among the top three for the other five regions. Bacterial and fungal diseases were the greatest threat in the Southwest Pacific and the third most important in Asia and the Near East. Climate change ranked third in three regions (Africa, Latin America and the Southwest Pacific.

Table 2: **The three most important threats to honeybees by region**

Threat	Africa	Asia	Europe and the Caucasus	Latin America	Near East	North America	Southwest Pacific
1	Loss, degradation or fragmentation of habitat/forage	*Varroa destructor*	*Varroa destructor*	Pesticides	*Varroa destructor*	*Varroa destructor*	Bacterial and Fungal diseases (American foulbrood, chalkbrood, etc.)
2	Pesticides	Pesticides	Pesticides	*Varroa destructor*	Pesticides; Poor/weak queens	Pesticides	Pesticides
3	Climate change	Bacterial and Fungal diseases (American foulbrood, chalkbrood, etc.)	Viral diseases (DWV, BQCV, KBV, etc.)	Climate Change	Bacterial and Fungal diseases (American foulbrood, chalkbrood, etc.)	Loss, degradation or fragmentation of habitat/forage; Poor/weak queens	Climate change; Pests (small hive beetle, wax moth, etc.)

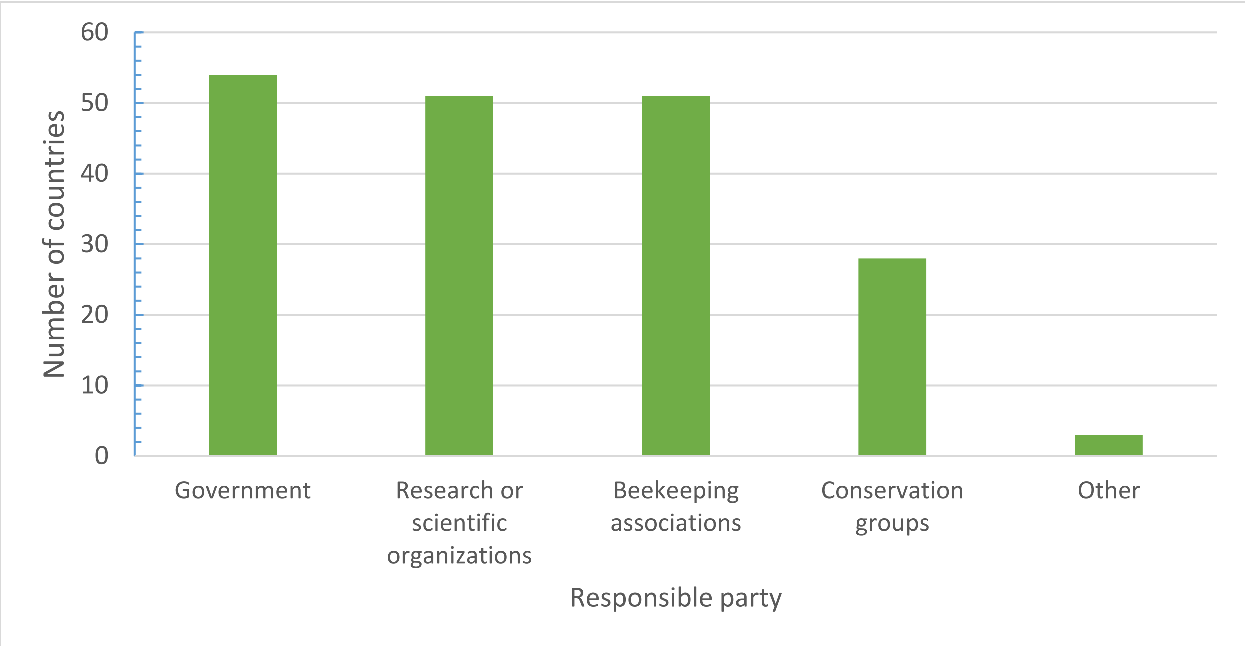
Figure 8: **Greatest threats reported to honeybee populations (multiple answers possible, 250 repondents)**



VI. HONEYBEE CONSERVATION EFFORTS

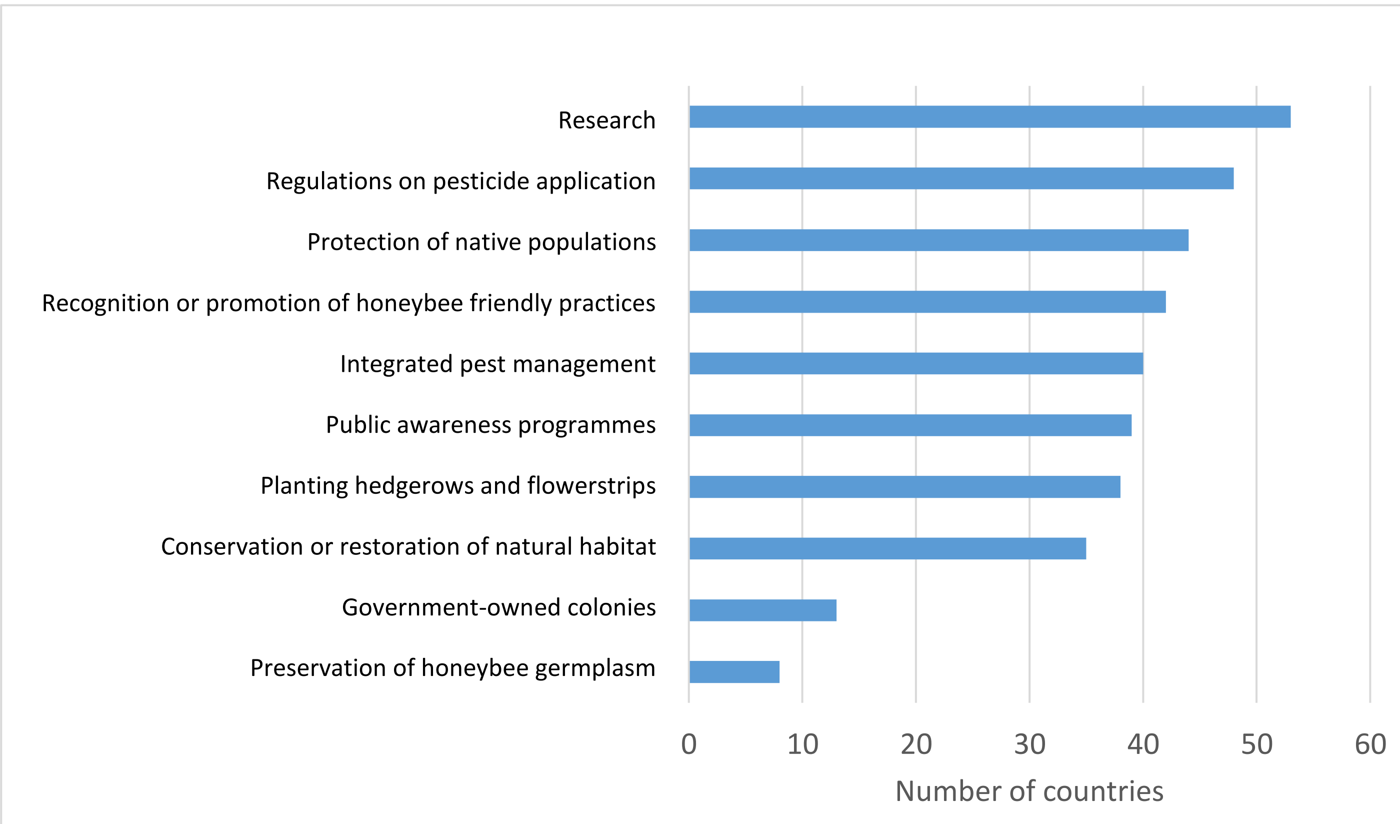
Sixty-three percent of respondent countries reported having initiatives in place for the conservation of honeybees and their genetic diversity. The government was found to be the main body responsible for heading conservation efforts, active in 83 percent of these countries. Figure 9 demonstrates the collaborative effort that is involved in honeybee conservation, with research or scientific organizations and beekeeping associations also active in 78 percent of countries, and conservation groups following with 43 percent participation.

Figure 9: **Responsible parties for national conservation of honeybees (multiple answers possible per country)**



Participants described how their responsible parties conserved their nations honeybees, summarized in Figure 10. Scientific studies and research was reported to be the top implemented method, employed by 53 of the 65 honeybee conserving countries. It was followed by regulations on pesticide applications (48 countries) and protection of native/locally adapted populations (44 countries) as methods to conserve honeybees and their genetic diversity.

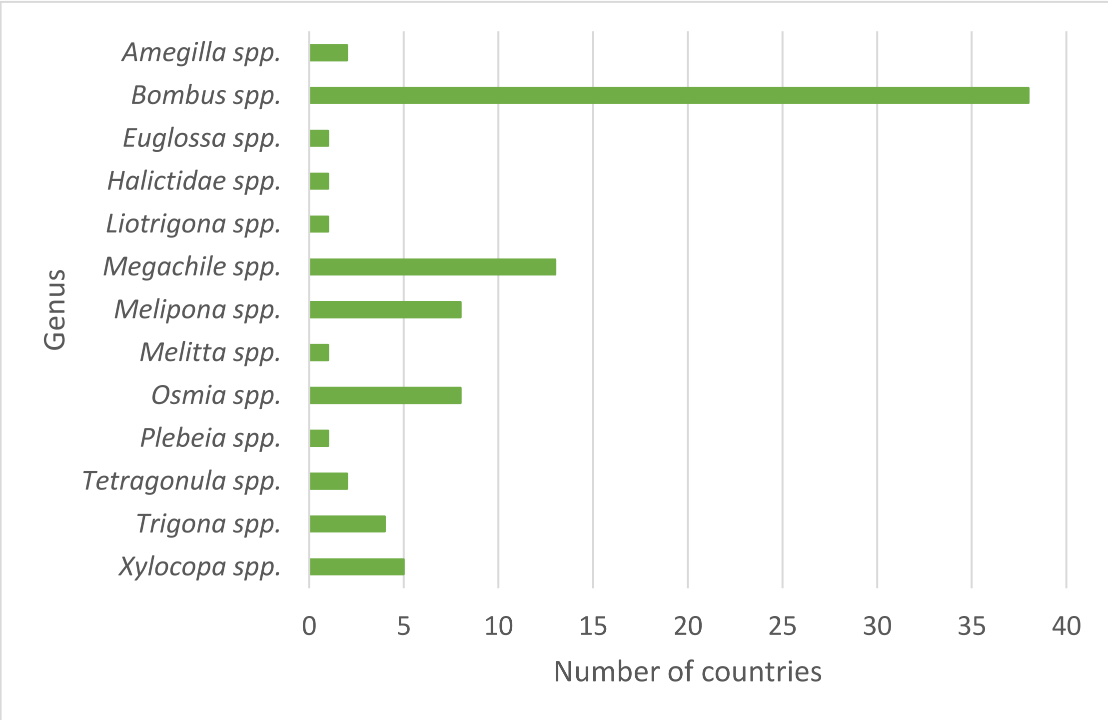
Figure 10: **Conservation of honey bees and their genetic diversity (multiple answers possible per country)**



VII. GENERAL POLLINATORS

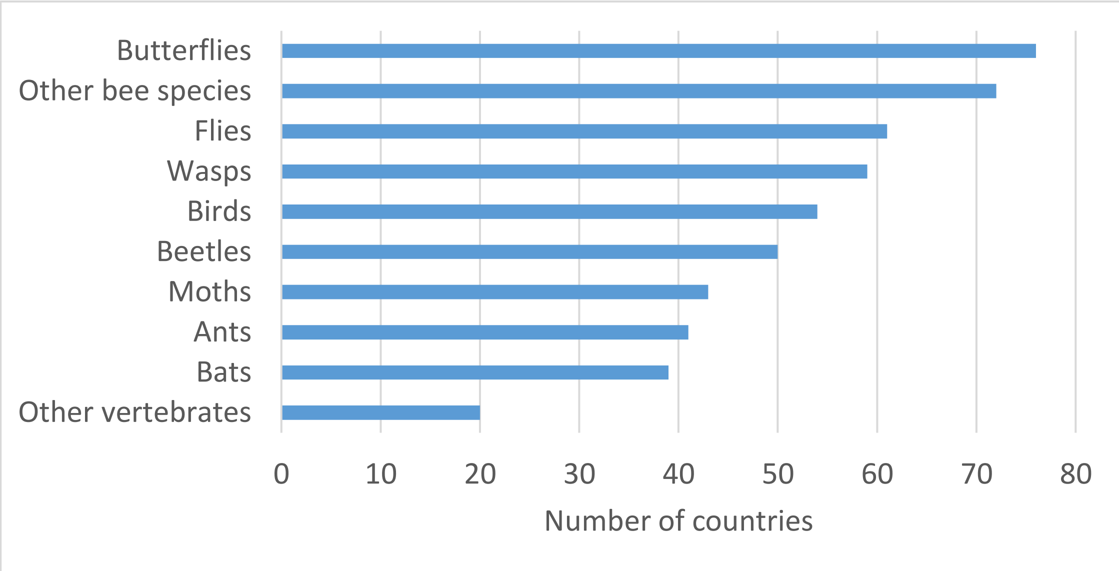
While honeybees are the most widely managed bee species, utilized for their honey production and in pollination services, 76 countries reportedly use other types of bees in their countries' pollination services. Respondents were asked to cite any specific species of bees that were managed for pollination services and 14 genera, 18 species and 4 subspecies were reported (Figure 11). *Bombus terrestris* (14), *Megachile rotundata* (11), *Bombus impatiens* (4), *Osmia cornifrons* (2), *Osmia lignaria* (2), and *Osmia rufa* (2) were the most commonly reported species.

Figure 11: **Genera of bees reportedly managed for pollination services (multiple answers possible per country)**



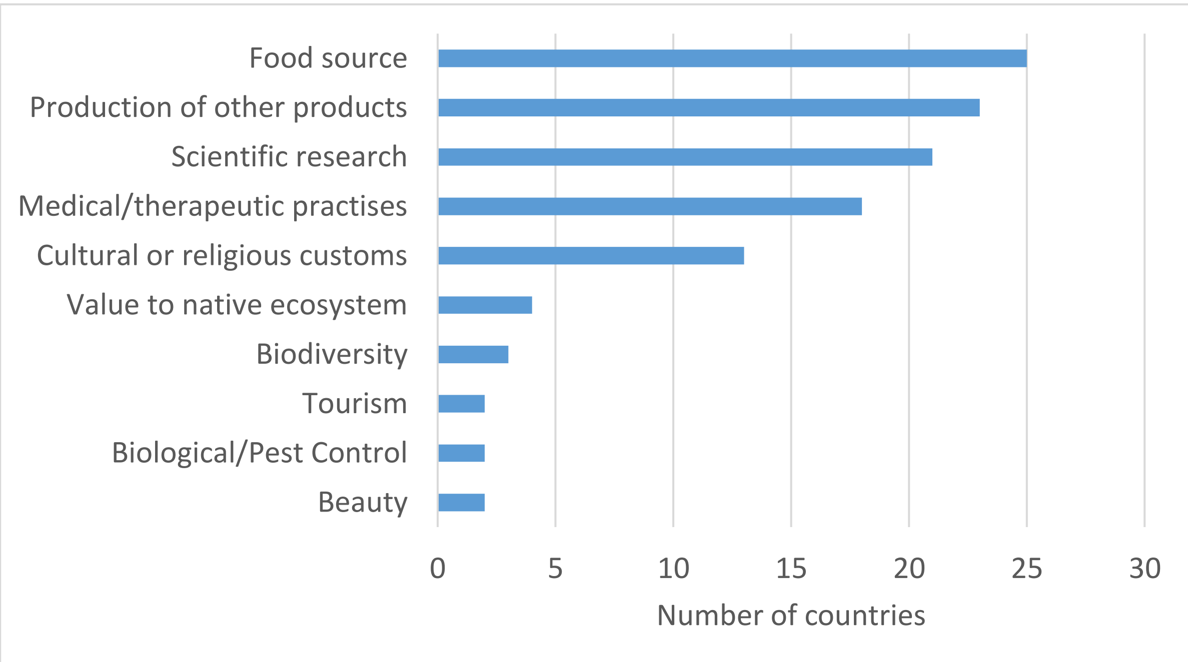
Respondents were asked to indicate any other general pollinators that are not managed but are valued for their individual pollination services in their respective country (Figure 12). The three most commonly indicated general pollinators were butterflies (76 countries), other bee species (72 countries) and flies (61 countries).

Figure 12. **Other animals valued in pollination services (multiple answers possible per country)**



The survey asked respondents to state any other valuable services provided by their countries' general pollinators and provide specific examples and species (Figure 13). In 41 percent of the countries, at least one respondent valued pollinators for services other than pollination. The most commonly cited service was as a food source (25 countries), followed by production of other products (23 countries) and scientific research (21 countries) (Figure 13). Some reported examples of valuable services provided by general pollinators include stingless bee species (*Meliponini tribe*) for their production of pot honey, the Mexican free-tailed bat (*Tadarida brasiliensis*) for its pest control services in crop systems, and the monarch butterfly (*Danaus plexippus*) for its beauty in nature and tourism purposes.

Figure 13: **Valuable services of general pollinators (multiple answers possible per country)**



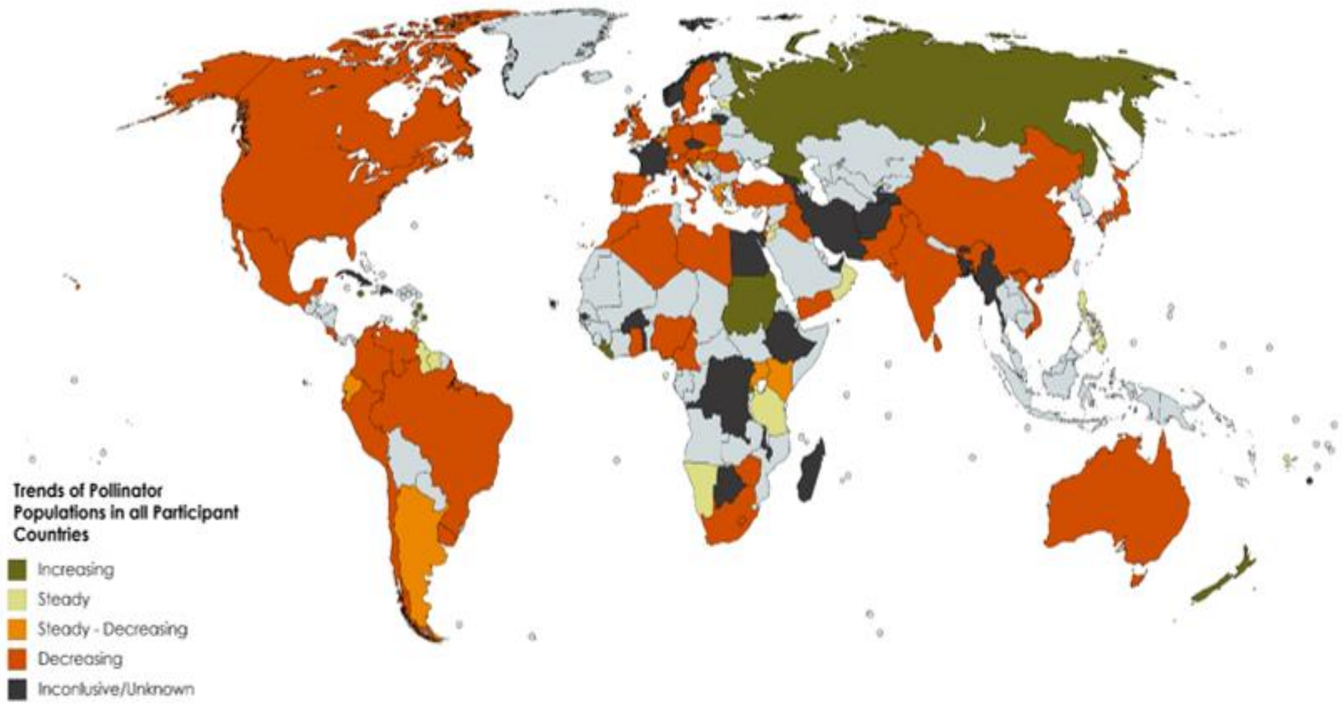
VIII. MONITORING OF POPULATION OR STATUS OF GENERAL POLLINATORS

In 55 percent of countries the population status is not monitored for any species of general pollinator, according to the respondents. In a further 9 percent of countries, the respondent(s) did not know if monitoring takes place. The remaining 36 percent (37 countries) monitor the population or status of their general pollinators, and 11 of those reported that they use the FAO *Protocol to detect and monitor pollinator communities*.[8] The FAO protocol was created as part of the Global Environment Facility (GEF) supported project "Conservation and Management of Pollinators for Sustainable Agriculture, through an Ecosystem Approach", which was implemented in seven countries - Brazil, Ghana, India, Kenya, Nepal, Pakistan and South Africa. The project was coordinated by FAO with implementation support from the United Nations Environment Programme (UNEP). The publication provides guidance on using a common methodology for monitoring pollinator diversity and abundance. Bumble bee species such as *Bombus affinis* and *Bombus terricola* are monitored, as well as butterflies such as *Danaus plexippus*. Species of solitary, mining and stingless bees, as well as moths, bats and hummingbirds are also reportedly monitored in some countries.

IX. GENERAL POLLINATOR POPULATIONS TRENDS

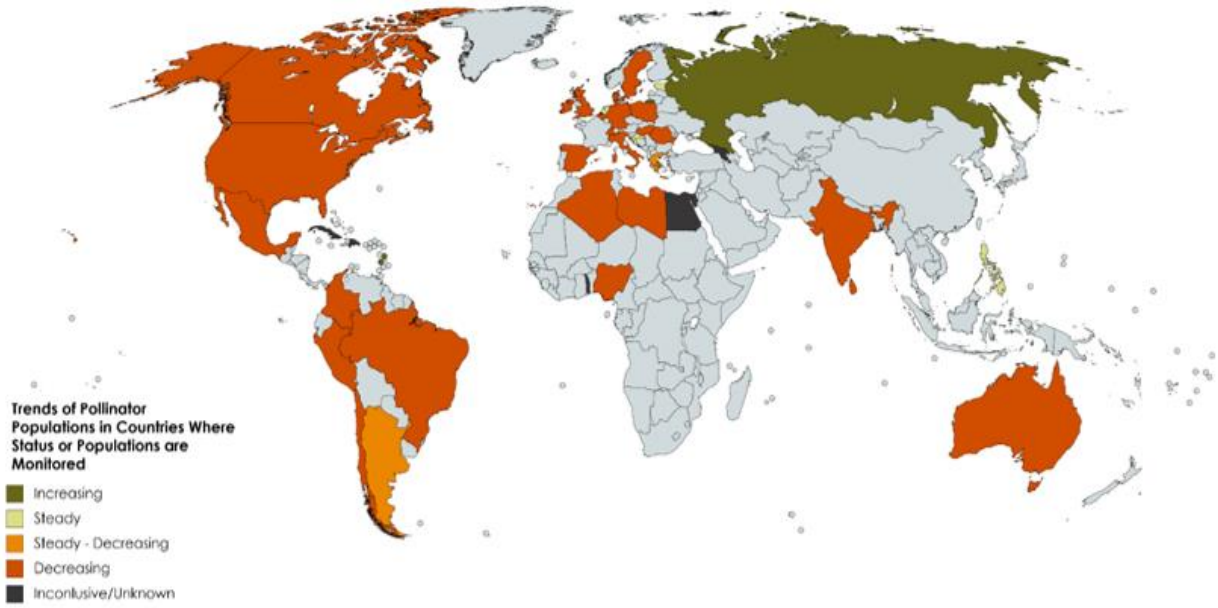
Survey respondents were asked to estimate the current trends of their general pollinator populations in their country, regardless if pollinators were monitored; 49 percent of countries stated that their general pollinator populations were steady to decreasing (46 percent strictly decreasing) and in 27 percent of countries the trends were unknown or inconclusive (Figure 14). Of countries that have implemented protocols to monitor their countries general pollinators, 60 percent stated that their pollinator populations are decreasing (5 percent steady to decreasing, 11 percent steady, 8 percent increasing, and 16 percent inconclusive/unknown). This is summarized in the colour coded Figure15.

Figure 14: **Estimated trends of pollinator populations in all participant countries (light grey = no response)**



[8] http://www.fao.org/3/a-i5367e.pdf

Figure 15: **Trends of pollinator populations in countries where status of populations are monitored (light grey = no monitoring)**



X. GREATEST THREATS TO GENERAL POLLINATOR POPULATIONS

Similar to honeybees, respondents were asked to select the three greatest threats to their nation's pollinators (Figure 16). Loss, degradation or fragmentation of habitat/forage, pesticides, and agricultural intensification were generally viewed to pose the greatest threats globally. The regional differences on pollinator concerns can be observed in Table 3. The top threat of loss, degradation or fragmentation of habitat/forage was almost unanimous across regions, with only the Near East differing. Pesticides were ranked among the three most important threats in every region except the Southwest Pacific.

Commonalities can be struck across honeybees and general pollinators, both listing pesticides and loss, degradation or fragmentation of habitat/forage in their top three concerns globally (*Varroa* is not listed as a threat to pollinators as it is a pest exclusive to honeybees). This reveals the potential for any conservation efforts targeting these threats to possibly be of benefit to both groups.

XI. THREATENED AND EXTINCT GENERAL POLLINATORS

The survey asked if respondents were aware of any pollinators within their country that are currently threatened, near extinction or have gone extinct in the last 50 years. Respondents from 46 percent of countries reported that some of their pollinators are currently threatened or near extinction. The lists of extinct and threatened pollinators specified by survey respondents is summarized in Table 4. Respondents from 13 different nations indicated a total of 63 specific pollinators as threatened or near extinction in their country. In 24 percent of countries the respondents reported that some pollinators have gone extinct in the last half century and 16 different species of pollinators were reported extinct in 8 countries.

Figure 16: **Greatest threats to respondent countries general pollinator populations**

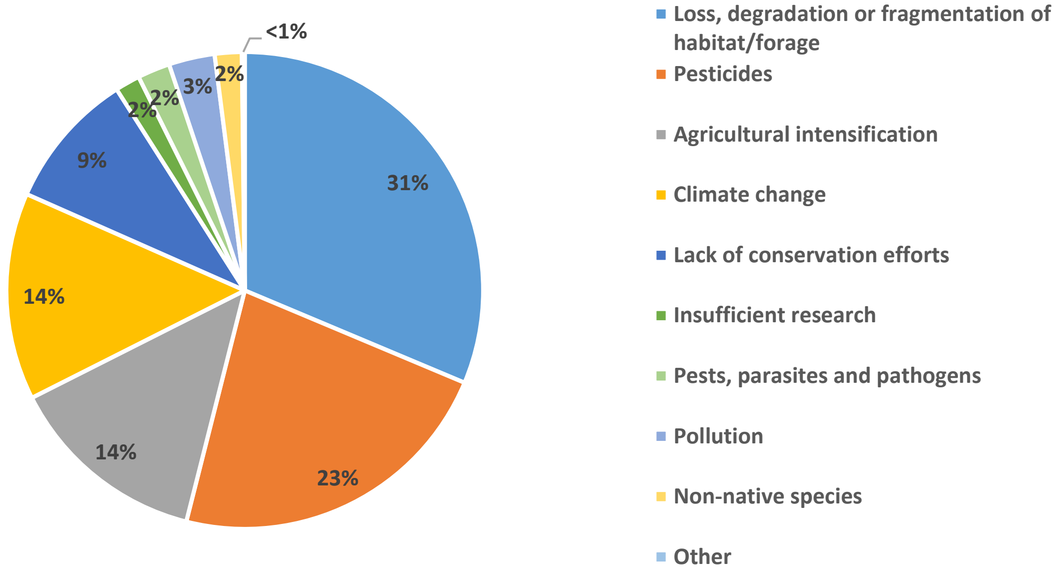


Table 3: **The three most important threats to pollinators by region**

Threat	Africa	Asia	Europe and the Caucasus	Latin America and the Caribbean	Near East	North America	Southwest Pacific
1	Loss, degradation or fragmentation of habitat/forage	Loss, degradation or fragmentation of habitat/forage	Loss, degradation or fragmentation of habitat/forage	Loss, degradation or fragmentation of habitat/forage	Pesticides	Loss, degradation or fragmentation of habitat/forage	Loss, degradation or fragmentation of habitat/forage
2	Climate change	Pesticides	Agricultural intensification	Pesticides	Climate Change	Pesticides	Climate change; Lack of conservation efforts
3	Pesticides	Insufficient research	Pesticides	Climate change	Insufficient research	Agricultural intensification; Pests, parasites and pathogens	Agricultural Intensification; Non-native species; Pesticides

Table 4: **Threatened and extinct general pollinators reported by respondents**

Extinct	Threatened or near extinction	
Anthophora bimaculata (Slovenia) *Andrena fulva* (Ireland) *Andrena rosae* (Ireland) *Bombus affinis* (Canada) *Bombus bellicosus* (Brazil) *Bombus cullumanus* (Denmark, Sweden) *Bombus distinguendus* (Denmark, Netherlands) *Bombus franklini* (USA) *Bombus pomorum* (Denmark) *Bombus quadricolor* (Denmark) *Bombus ruderatus* (Netherlands, Sweden) *Halictus sextinctus* (Netherlands) *Lycaeides melissa samuelis* (Canada) *Melitta dimidiate* (Slovenia) *Nomada sheppardana* (Ireland) *Tetralonia dentate* (Slovenia)	*Andrena angustior* (Ireland) *Andrena coitana* (Ireland) *Andrena denticulate* (Ireland) *Andrena fuscipes* (Ireland) *Andrena gelriae* (Sweden) *Andrena humilis* (Ireland) *Andrena marginata* (Ireland) *Andrena nasuta* (Lithuania) *Andrena nigroaenea* (Ireland) *Andrena nitida* (Sweden) *Andrena praecox* (Ireland) *Andrena rugulosa* (Lithuania) *Andrena trimmerana* (Ireland) *Anthidium montanum* (Slovakia) *Anthocopa moscary* (Slovakia) Arrhysosage cactorum (Brazil) *Bombus (P.) barbutellus* (Ireland) *Bombus (P.) campestris* (Ireland) *Bombus (P.) rupestris* (Ireland) *Bombus affinis* (USA) *Bombus bellicosus* (Argentina) *Bombus confuses* (Lithuania) *Bombus dalhbombii* (Chile, Argentina) *Bombus distinguendus* (Ireland, Norway) *Bombus funebris* (Chile) *Bombus muscorum* (Norway) *Bombus occidentalis* (Canada) *Bombus pomarum* (Lithuania) *Bombus reinigielllus* (Spain) *Bombus ruderarius* (Ireland, Norway) *Bombus ruderatus* (Denmark)	*Bombus semenoviellus* (Lithuania) *Bombus sylvarum* (Ireland) *Bombus terricola* (Canada) *Bombus tucumanus* (Argentina) *Coelioxys elongate* (Ireland) *Colletes caspicus* (Lithuania) *Colletes floralis* (Ireland) *Danaus plexippus* (Canada) *Dasypoda argentata* (Lithuania) *Hylaeus brevicornis* (Ireland) *Hylaeus hyalinatus* (Ireland) *Lasioglossum aureopilosum* (Australia) *Lasioglossum lativentre* (Ireland) *Lasioglossum nitidiusculum* (Ireland) *Lasioglossum rufitarse* (Ireland) *Lasioglossum rufitarse* (Ireland) *Lasioglossum victoriae* (Australia) *Leioproctus douglasiellus* (Australia) *Melipona (M.) rufiventris* (Brazil) *Melipona (M.) scutellaris* (Brazil) *Melipona (Michmelia) capixaba* (Brazil) *Neopasiphae simplicior* (Australia) *Nomada argentata* (Ireland) *Nomada goodeniana* (Ireland) *Nomada obtusifrons* (Ireland) *Nomada striata* (Ireland) *Partamona littoralis* (Brazil) *Sphecodes ferruginatus* (Ireland) *Sphecodes gibbus* (Ireland) *Sphecodes hyalinatus* (Ireland) *Xylocopa areata* (Australia) *Xylocopa valga* (Lithuania)

XII. GENERAL POLLINATOR CONSERVATION EFFORTS

Forty-five percent of respondent countries have initiatives in place for the conservation of their general pollinator populations. Similar to honeybee conservation, respondents selected government as the most important party to implement conservation initiatives for pollinators, followed closely by research organizations and conservation groups (Figure 17). The most often implemented initiatives are regulations on pesticide applications, employed in 81 percent of countries that conserve pollinator populations. Regulation of pesticides was followed by integrated pest management and conservation or restoration of natural/semi-natural habitat as the second and third most popular methods for the conservation of pollinators (Figure 18).

Figure 17: **Responsible parties for the national conservation of pollinators (multiple answers per country possible)**

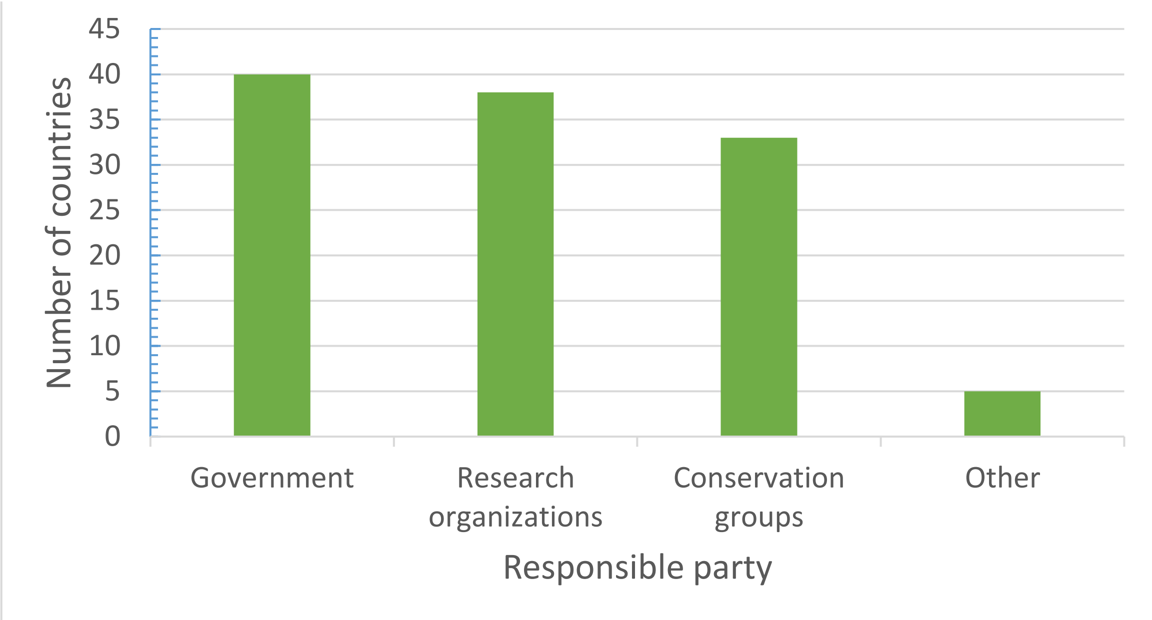
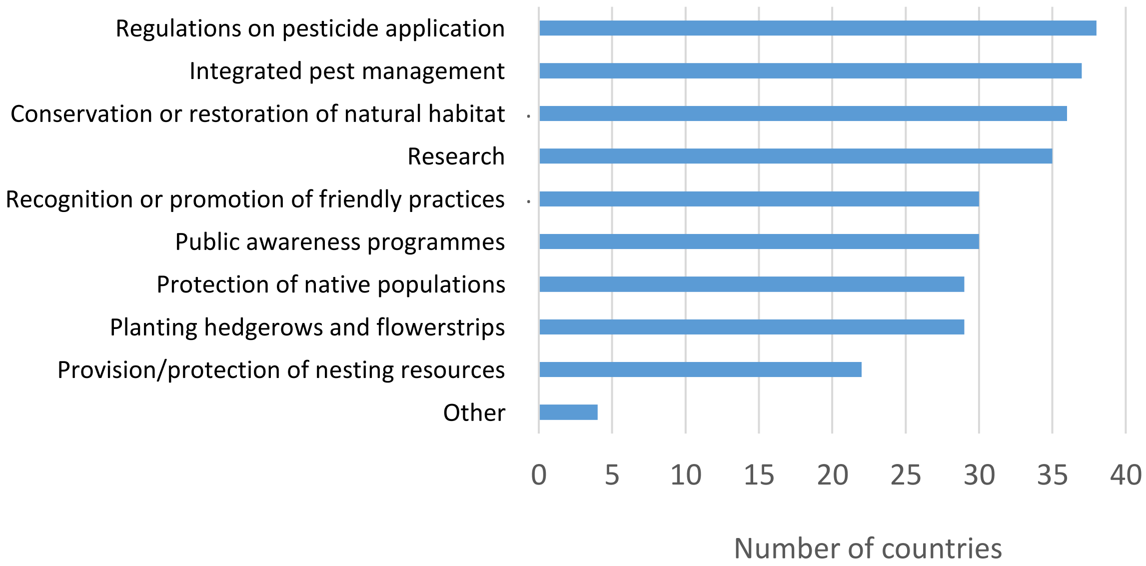


Figure 18: **Conservation efforts implemented for pollinators (multiple answers per country possible)**



XIII. CONCLUSIONS

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) noted that Pollination is an ecosystem service that around 20 000 different species do freely and coincidently (IPBES, 2016). Pollination is estimated to be worth USD235 to USD577 billion annually to global crop production. Globally, 90 percent of wild flowering plants and 75 percent of the leading food crops are dependent to varying extents on pollinator-mediated fertilization (IPBES, 2016). Not only is animal pollination invaluable to agriculture and ecosystems, the presence of animal pollinators is interlinked with the livelihoods of millions of people. The world's most important cash crops provide employment and income to people of both developing and developed countries, who often rely on pollination services for their crop yield and quality.

Aside from their quantifiable benefits to ecosystems, pollinators are interwoven with human culture– integral to art, music, customs and religions globally. They have provided the inspirations for compositions such as Rimsky-Korsakov's *Flight of the bumblebee* and Van Gogh's *Butterflies and poppies*; they are symbolic within religions, featured in prominent passages of the Quran and the Bible. Pollinators undeniably add beauty to this world, and the services they provide are not a provision easily replaced.

This survey revealed that the European honeybee, *Apis mellifera,* is overwhelmingly the most commonly used of all managed pollinators. A large number of countries collect population data on *Apis mellifera*, and are largely in consensus about honeybees' main threats with some variation across regions. Conservation methods are in place to protect *Apis mellifera* and honeybee populations and, in a large part of the world, honeybee populations are steady and increasing in numbers. However, the survey also reveals the disparity in resources and information dedicated between honeybees and all other pollinators. While some general pollinators are utilized and managed, they are almost completely all bee species, and less knowledge is available about other pollinators. They are less likely to be monitored and conserved than their bee, and specifically honeybee counterparts. In countries that do monitor their general pollinators, the trends are largely decreasing.

The main threats reported are similar in honeybee and other pollinators, with pesticides and loss, degradation or fragmentation of habitat/forage as largest threats, in line with findings of IPBES (2016). Climate change also appears to be an emerging threat for both groups. This result implies that many conservation initiatives, if managed correctly, will benefit both groups, even if the intention is only to bolster honeybee populations.

Recommendations include further taxonomic and genetic research into a greater variety of pollinators and the implementation of monitoring programmes to better understand population trends of both honeybees and general pollinators. There is currently little focus on pollinator genetic diversity, even in honeybees, although in other livestock systems genetic diversity is generally accepted to be vital to their long-term propagation and health (e.g. Notter, 1999; FAO, 2015).

The greatest revelation to come out of this survey is the necessity to increase awareness in all aspects of pollination and pollinators, particularly in their importance for food security and livelihoods and in the major threats to their survival. Pollinators are crucial to the environment, and a the greater appreciation of their importance globally is key to increasing their populations and maintaining their genetic diversity.

XIV. REFERENCES

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