Biomics, 2016, Vol. 8, No 1, 65-68

БИОМИКА/BIOMICS

http://biomics.ru

RESCUE PROJECT FOR THE NATIVE BEE, (*APIS MELLIFERA MELLIFERA* L.) IN SWEDEN

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ABSTRACT

Until mid 1800 *Apis mellifera mellifera*, the black bee, was the absolutely dominant bee in Sweden. It is well adopted for the climate with long winters. It can fly at somewhat lower temperature and uses less food during the winter than other races. Unfortunately, a massive import of *Ligustica* and *Carnica* led to hybridisation of the black bee. The hybrid between *mellifera* and *Carnica* does not differ much in colour from a pure *Mellifera* but has a temperament that is bad. It was therefore said that the *Mellifera* was an aggressive bee and it lost its popularity. In 1990 a project started for saving the *Mellifera* bee. A message was sent to the bee-keepers asking them if they believed they had pure *Mellifera* in their hives. Around 150 persons gave a positive answer and were asked to send samples of their bees. By using morphological values 10 colonies were considered pure. Over the years some more colonies were found that seem to be pure. By using mtDNA we can see 30 different lines. The main characteristics used in the selection are colour and wing pattern where we look mostly at cubital index and the discoidal angle. To secure pure mating we have some islands and remote areas where only *Mellifera* exists but apart from that artificial insemination is also used. The Swedish government and WWF supported the project at the start but without the efforts from enthusiastic bee-keepers it would have failed.

Keywords: *Apis mellifera mellifera*, rescue project, the native bee.

INTRODUCTION

My presentation will start with the situation in Sweden 20 thousand years ago. Stockholm was then covered by 2 km of ice. A big part of Northern Europe was also covered. Plants and animals could live in the southern part of France, north of the Pyrenees and west of the Alps. When the ice started to melt some 5000 years later, plants and animals followed the melting ice to the north (Fig 1).[Whittow, 2014].

The bee that spread was the race that the Swedish botanist Carl von Linné in the year 1758 named *Apis mellifera*. At that time he did not know about the other subspecies of *A. mellifera*. Today we call it the Black Bee, in Latin *Apis mellifera mellifera*, *A.m.*m., to distinguish it from the other subspecies. In the following I will just call it *Mellifera*.

Figure 1. Situation in Sweden 20 thousand years ago. The glacial period in Europe.

The origin of some of the subspecies can be seen on fig 1 where professor Dorian Pritchard has marked the isotherms for the mean temperature in July. The 15-20 degree area corresponds well with natural habitat for the *Mellifera* bee (figure 2) [Personal contacts with Prof Dorian Pritchard UK].

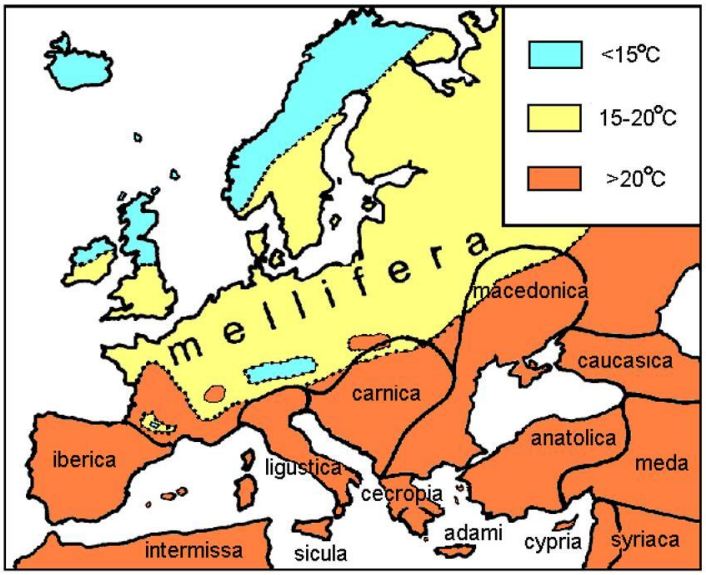

Figure 2. The 15-20 degree area corresponds well with natural habitat for the *mellifera* bee.

Until mid 1800 *A. m. mellifera*, was the absolutely dominant bee in Sweden. It is well adapted to the climate with long winters. It can fly at somewhat lower temperature and uses less food during the winter than other subspecies. Unfortunately, a massive import of *Ligustica* and *Carnica* led to hybridisation of the black bee. In the 1970-ties a Swedish sales company of bee-keeping equipment offered a queen, free of charge if you purchased equipment for 50 USD. Those queens were a hybrid of *Carnica* and *Caucasica* called Midnite. The hybrid between *Mellifera*, *Caucasica* and *Cacrnica* does not differ much in colour from a pure *Mellifera* but has a temperament that could be very bad. It was therefore said that the *Mellifera* was an aggressive bee and it lost its popularity. Some people tried however to breed pure *Mellifera*.

In the Swedish Bee magazine it was many discussions about advantages and disadvantages of the black bee during the 40-ties and 50-ties.

MATERIALS AND METHODS

In 1984 it was a meeting with interested bee-keepers where it was decided to establish a mating station on an island in the lake Vänern [Personal discussions with Ingvar Arvidsson and Ingvar Pettersson Proj Nordbi, Sweden].

In 1990 a project started for saving the *Mellifera* bee. A message was sent to the bee-keepers in Sweden asking them if they believed they had pure *Mellifera* in their hives. Around 150 persons gave a positive answer and were asked to send samples of their bees. By using morphological criteria 10 colonies were considered pure. Over the years more colonies were found that seem to be pure.

By using Mt-DNA we can see 30 different lines. [Pedersen, 1995]

Strategy for the rescue project

Create a large population of pure *Mellifera*.

Test colonies.

Select colonies with desirable properties for breeding.

Distribute pure queens.

Create and maintain geographical areas with only *Mellifera*.

How to recognise a pure *Mellifera* colony?

The main characteristics used in our selection are colour, behaviour and wing pattern, where we look mostly at cubital index, Ci, and the discoidal angle, Da.

The following series of questions could also be used.

Yellow segments of the abdomen?	White (dry) capping of honey?	"Flowing" on the honeycombs?	Wing pattern
No = *Carnica*, *Caucasica* or *Mellifera*	Yes = *Mellifera* or *Carnica*	Yes = *Mellifera*	Ci<1.9. and Da negative = *Mellifera*
Yes = influence from *Ligustica*	No = *Caucasica*	No = *Carnica*	

Professor Ruttner has said that the cubital index for worker bees could be as high as 2.1. [Alpatov, 1929; Ruttner, 1988].

When we from Mr John Dews, in UK, got images of ancient wings from bees found in York and Oslo, 1000 and 800 years old, none of the wings had a higher index than 1.89. We therefore have chosen 1.9 as the upper limit for our bees when we select breeding

queens.

We also look at the width of the hairy segment of the abdomen. A pure *Mellifera* has a thin segment. The hair on a *Mellifera* is also much longer than on a *Carnica*.

HOW TO MEASURE THE CUBITAL INDEX AND DISCOIDAL ANGLE.

We started to measure cubital index in the 1980-ties. We projected the wings on the wall and used a calliper to measure the lengths of the veins. One person measured and one wrote the values. The Ci was calculated later. It was a time and labour consuming method. As I worked at that time with optics I made a reticle with concentric circles to use in a microscope. I moved the wing so the crossing of the veins was in the origo and counted how many rings each vein covered. The accuracy was not very high but enough for sorting out hybrids. I also made a reticle we called a broom for measuring the discoidal angle.

When looking at a photo on the computer in the early 90-ties I saw numbers in the lower left corner on the monitor. The numbers changed when I moved the cursor. I realized that they were the coordinates for the pixels. After scanning the wings it was possible to get the coordinates for some vein crossings and from them to calculate the values. It was time consuming to write down the coordinates for 7 points and then enter them in an Excel sheet, so I asked a computer expert if it was possible to store the numbers direct by clicking on the mouse. It was and the programs CooRecorder and CBeeWing were born. The measuring of the wings were not so difficult any longer. Today there are even better programs.

Unfortunately no Swedish university has used DNA to select the sub-species of the honey bee. It should be a more accurate method than morphological measurements but much more expensive.

SELECTION FOR BREEDING

In the project it was decided to breed only from queens where 90% or more of their workers had wings within our limits, Ci < 1.9 and a negative discoidal angle. At the beginning it was only a small numbers of bee-keepers that measured the colonies, most of the breeders sent samples of their bees to one man. When we had a good number of pure colonies professor Bo Vest Pedersen in Copenhagen and his team analysed the Mt-DNA of them. [4]

Apart from measuring bee-wings we also evaluate some other properties of the colonies. Swarming tendency, docility, honey production and health are important. As *Varroa* is one of the most important threats to our bees we have included *Varroa* tolerance in our selection properties.

VARROA

There are reports that colonies will survive in spite of *Varroa* infestation without treatment. An the moment we do not have any experience of that but testes are running. One method is to measure the downfall of mites after treatment by oxalic acid sublimation for finding colonies with the right properties. Breeding will be done from them.

MATING

To secure pure mating we have some islands and remote areas where only *Mellifera* exists. In a mating station only drones from sisters are used. Mating areas have drones from different non related queens. Apart from that artificial insemination is also practised.

RESULTS

Some small areas in Sweden has a dominating population of pure *Mellifera*. But there are still a large influence of hybridisation in the colonies within our project. It has not improved in all areas where we breed *Mellifera* over the years. From one area we have the following results. The percentage of colonies where 90 % of the wings of the workers fall within our limits for pure *Mellifera* is shown in the following table 1. The reason for the poor result is probably that the breeding material is not 100% pure (table 1).

Table 1

Number of pure *Mellifera* colonies from 2000-2015

Year	Number of tested colonies	Number of colonies with purity > 90%	Percentage of colonies with purity > 90%
2000	22	13	59
2001	27	9	33
2002	19	11	58
2003	22	9	41
2004	22	13	59
2005	5	0	
2006	15	2	13
2007	37	6	16
2008	15	10	67
2009	17	14	82
2010	16	15	94
2011	5	4	80
2012	0		
2013	7	4	57
2014	36	20	56
2015	9	6	56

THE FUTURE

There is a growing interest to start bee-keeping in Sweden and many of the beginners like to go for *Mellifera*. The bottle-neck is to get pure queens. In the

year 2014 more than 700 queen were mated but the need is larger. The summer 2015 was not good for bee-keeping but still more than 500 queen were produced.

ACKNOWLEDGEMENT

The Swedish government and the WWF gave initial support to the project, but without the efforts from enthusiastic bee-keepers it would have failed. We still get a small financial support for the project from the government and EU. A special tank's to Ingvar Arvidsson and Ingvar Pettersson who have given data about measurements.

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ПРОЕКТ СПАСЕНИЯ НАТИВНОЙ ПЧЕЛЫ (*APIS MELLIFERA MELLIFERA* L.) В ШВЕЦИИ

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АННОТАЦИЯ

До середины 1800-х годов темная лесная пчела *Apis mellifera mellifera* была доминирующим подвидом пчелы в Швеции. Эта пчела была хорошо приспособлена к климату с продолжительными зимами. Она может летать при более низкой температуре и меньше употреблять пищи по сравнению с другими подвидами. К сожалению, массовый завоз южных подвидов *A.m.ligustica* и *A.m.carnica* привел к гибридизации темной лесной пчелы.

Гибриды между *A.m.mellifera* и *A.m.carnica* не сильно отличается по окраске от чистой *A.m.mellifera*, но имеют горячий темперамент, что не очень хорошо. Поэтому стали считать, что *A.m.mellifera* является агрессивной пчелой, в результате чего к ней потеряли интерес, и она стала непопулярной.

С 1990 года был создан проект по сохранению местной пчелы *A.m.mellifera*. Был проведен опрос пчеловодов о породном составе пчел на их пасеках. Около 150 пчеловодов сообщили, что на их пасеках содержится темная лесная пчела и отправили образцы своих пчел для исследований. На основе морфометрических исследований 10 семей были отнесены к чистым *A.m.mellifera*. В дальнейшем было обнаружено еще несколько семей *A.m.mellifera*.

При анализе мтДНК было обнаружено 30 различных линий. Основными критериями при отборе семей темной лесной пчелы являются цвет и рисунок крыла, где учитывается в основном кубитальный индекс и дискоидальный угол (смещение). Для обеспечения чистопородного скрещивания у нас есть несколько островов и отдаленных районов, где темные лесные пчелы *A.m.mellifera* не только обитают, но также искусственно оплодотворяются. Правительство Швеции и WWF поддержали этот проект в начале, но без помощи и энтузиазма пчеловодов мы не смогли бы добиться положительных результатов.

Ключевые слова: *Apis mellifera mellifera*, проект спасения, родные пчелы.