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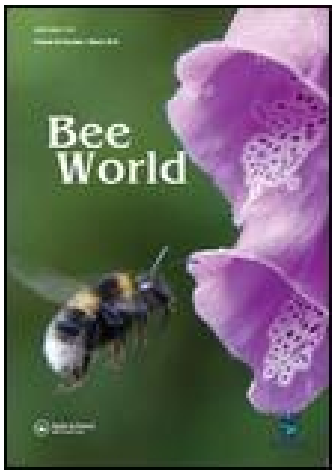

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Burzyan Wild-Hive Honeybee A.M. mellifera in South Ural

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> The sad-eyed justice, with his surly hum,
> Delivering o'er to executors pale
> The lazy yawning drone. I this infer,
> That many things, having full reference
> To one consent, may work contrariously:
> As many arrows, loosed several ways,
> Come to one mark…
> So may a thousand actions, once afoot,
> End in one purpose.[19]

This was written at the turn of the 17th century, hundreds of years before an understanding of the division of labour in a honey-bee colony. The final two lines are an especially good descriptor of the way a colony functions as a superorganism. Also, the phrase "busied in his majesty", makes one wonder if Shakespeare was just being poetic or if he had actually seen a comb with a queen bee surrounded by her retinue, I imagine a rare sight in those days.

Perhaps my favourite bee phrase in Shakespeare's works has little to do with bee biology, but nimbly stretches thoughts together with an Apis connection (see Figure 3):

> Nay, that I mean to do. Is not this a lamentable
> thing, that of the skin of an innocent lamb should
> be made parchment? that parchment, being scribbled
> o'er, should undo a man? Some say the bee stings:
> but I say, 'tis the bee's wax; for I did but seal
> once to a thing, and I was never mine own man since.[20]

Reading Shakespeare today can be a chore. In his era, audiences were familiar with the Bible and other classical antiquity, but I imagine most of us now have to use spark notes or the internet to understand all the references packed into his work. It seems the general level of knowledge has changed – my first instinct was to write lowered, but it has probably just shifted in time. Did the general public at that time have a better understanding of honey bees? Would people today understand the bee references written by Shakespeare? Or would they have to go running to the internet and watch a few YouTube videos before realising that Shakespeare was referring to a male bee, rather than an unmanned aerial vehicle? (see Figure 4).

Notes

1. Play [Act. Scene] Speaker Line – Romeo and Juliet [II, 4] Mercutio 1228.
2. Macbeth [IV, 3] Malcolm 1901.
3. Henry V [IV, 1] Henry V 1843.
4. Henry IV, Part II [IV, 5] Henry IV 2951.
5. Henry VI, Part II [IV, 2] Jack Cade 2380.
6. Henry V [I, 2] Archbishop of Canterbury 329.
7. All's Well That Ends Well [I, 2] King of France 294.
8. Henry IV, Part II [IV, 5] Henry IV 2951.
9. Titus Andronicus [V, 1] First Goth 2140.
10. Henry VI, Part I [I, 5] Lord Talbot/Earl of Shrewsbury 603.
11. Midsummer Night's Dream [III, 1] Titania 989.
12. All's Well That Ends Well [IV, 5] Lafeu 2465.
13. Midsummer Night's Dream [IV, 1] Bottom 1554.
14. Henry V [I, 2] Archbishop of Canterbury 329.
15. Pericles [II, 1] Third Fisherman 627.
16. Pericles [II, 4] Gower 531.
17. Comedy of Errors [II, 2] Luciana 582.
18. Henry VI, Part II [III, 2] Earl of Warwick 1804.
19. Henry V [I, 2] Archbishop of Canterbury 329.
20. Henry VI, Part II [IV, 2] Jack Cade 2380.

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Burzyan Wild-Hive Honeybee *A.M. mellifera* in South Ural

R. A. Ilyasov[a]*, M. N. Kosarev[b], A. Neal[c] and F. G. Yumaguzhin[d]

The European dark bee *Apis mellifera mellifera* – a unique subspecies of the honeybee *Apis mellifera*, is adapted to survive the long, cold winters in the continental climate of northern Eurasia (Farhutdinov et al., 2014; Ilyasov et al., 2007). Currently, this subspecies survives in only a few isolated reservation areas. The biggest areas are in Russia: about 300,000 colonies of pure *A.m. mellifera* avoided spontaneous hybridization in the South Ural area of the Republic of Bashkirostan; about 200,000 colonies in the Middle Ural area (Ilyasov, Petukhov, Poskryakov, & Nikolenko, 2006; Shurakov et al., 1999); and about 250,000 colonies in Volga region of the Republic of Tatarstan (Krivtsov & Grankin, 2004; Krivtsov 2011). We also have information about large populations of the European dark bee in the Volga region of the Republic of Udmurtia and Kirov Oblast (Brandorf et al., 2012; Ilyasov et al., 2007).

About 99% of European dark bees in the South Ural are kept in moveable

Figure 1. Apiaries in the State Nature Biosphere Reserve "Shulgan-Tash".

frame hives in apiaries (Figure 1) and about 1% in natural and man-made tree hollows. European dark bees evolved in synchrony with the widespread linden tree *Tilia cordata* and this remains the main forage crop for these bees (Kosarev, Sharipov, Yumaguzhin, & Savushkina, 2011) (Figure 2).

Scientists of the Biochemical Insects adaptation Laboratory in Ufa Scientific Centre of the Russian Academy of Science have been monitoring the gene pool of the Burzyan honeybees for the last 20 years using the polymorphism of loci COI-COII of mitochondrial DNA and the microsatellite loci ap243 and 4a110 of nuclear DNA. This extensive research confirmed the pureness of the gene pool and that this gene pool is a subspecies of *A.m. mellifera* (Ilyasov, Petukhov, Poskryakov, & Nikolenko, 2007; Nikolenko & Poskryakov, 2002; Sattarov, 2000).

In 2011, upon the request by the Institute of Beekeeping and State Reserve "Shulgan-Tash", bees from this population were classified as a separate breed and named the "Burzyan wild-hive bee". This breed was registered under patent No. 5956 from 14.06.2011 by the State Commission of the Russian Federation in the state register.

According to artefacts found at the burial site near Birsk of Bahmutin culture, beekeeping in the southern Ural started no later than 5–6 centuries BC among local Finno-Ugric tribes. Later beekeeping was adopted by Bashkir ancestors, who assimilated and drove away the Bahmutin people (Kosarev et al., 2011).

Beekeeping could occur without tools of iron of course and the accumulated skills were passed on by many generations of the tree hollow beekeepers (Figure 3(a)) (Kosarev, Yumaguzhin, & Nugumanov, 1999).

Bashkir beekeeping flourished in the eighteenth century. It took longer to develop than in Germany, Poland, Lithuania, Belarus, and central regions of Russia. With special land tenure rights, the Bashkirs could avoid compliance with the regulations of the Forest Service in Russia, which in 1882 had banned the beekeeping in state forests, to eliminate this source of forest fires.

In the nineteenth century, due to deforestation and the destruction of the cultural traditions by the migrant population, Bashkir beekeepers developed *Koloda* beekeeping. *Koloda*

Figure 2. Burzyan wild-hive honey bee *A.m. mellifera* (a) and their natural environment (b).

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Figure 3. Natural tree hollow hive (a) and artificial tree hollow hive (b).

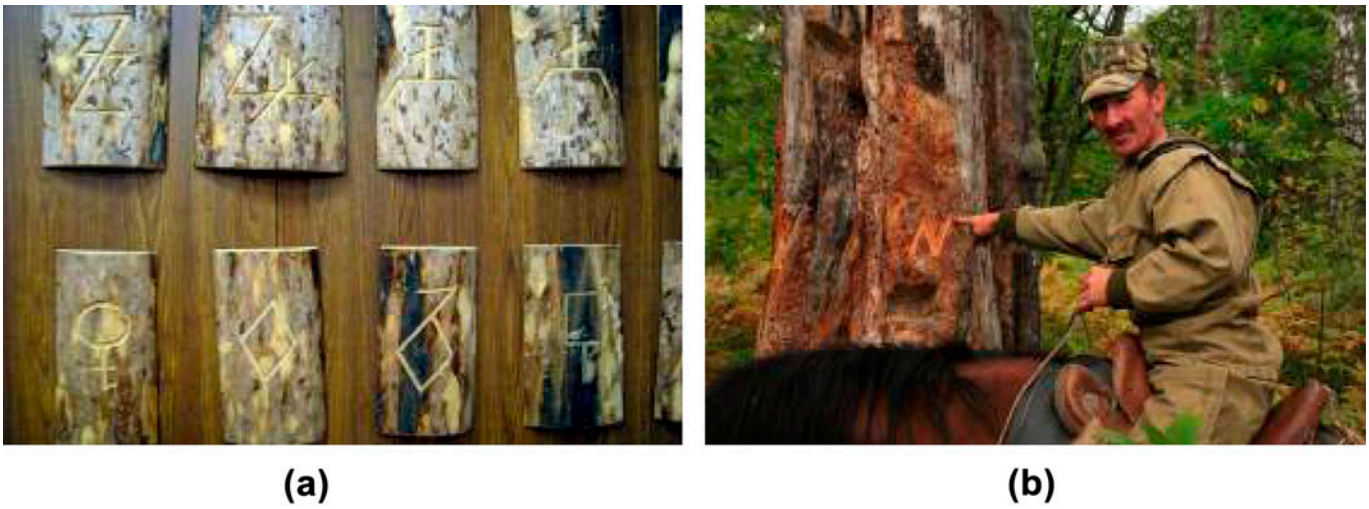

Figure 4. Boards with *tamga* signs from a local national museum (a) and a tree with a *tamga* sign (b).

creates handmade hollows inside tree trunks (Picture set 3.2), which are attached high on a tree (Kosarev, 2014). Trees with *Koloda* were considered by Bashkirs as personal property and were marked with *tamga* – distinctive signs of tribal affiliation (Figure 4). Every beekeeper knew his mark and did not touch the property of others. These *Koloda* and *tamga* marked trees were traditionally kept by a family for generations (Yumaguzhin, 2010).

In the second half of the twentieth century, Bashkir beekeepers started using movable-frame hives, giving rise to modern beekeeping. Despite the hard labor and low productivity, tree hollow apiculture in remote areas of the South Urals still continues. Inspections of hollow tree hive bees require working in trees as high as 16 meters, and because they are located away from populated areas, and the beekeeper has to travel on horseback a distance of 40–50 km per day (Figure 5) (Yumaguzhin, 2010). Tools used by Bashkir beekeepers are mostly handmade but are similar to tools used in other countries. Tools unique to the Bashkir wild-hive beekeepers are the *Kiram* and the *Lange*. A *Kiram* is a braided leather belt up to 5 m in length for climbing up a tree. A *Lange* is a small portable platform or footrest (Figure 6), which is affixed to the trunk with a rope (Kosarev, 2014).

In the past, when there are were plenty of natural hollows in the trees filled with bee colonies, Bashkirs, like beekeepers around the world, in the autumn took all the honey from the colony. The bees, left without honey reserves, died. In spring, beekeepers would check these tree hollows, clean them out, and prepare them for new occupants. Swarms moved in. This destructive colony system was used until the nineteenth century and in some areas until the 1950s. The advantage of this system is that new combs were created every year, tree hollows rot less and, as a result, bees were rarely sick, their body size did not decrease, and no inbreeding and degeneration happened.

When the number of natural tree hollows declined sharply, beekeepers were forced to carefully treat the wild-hive bees and leave the best of

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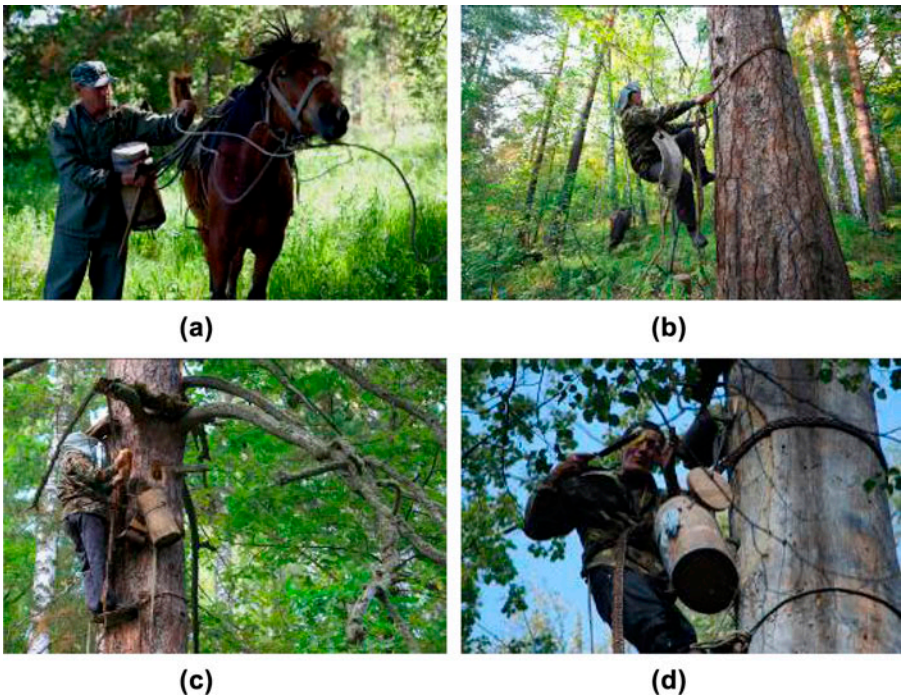

Figure 5. Tree hollow beekeeping is hard work: prepare a horse for the trip (a); climb up a tree; (b) work at hive level (c); extract honey (d).

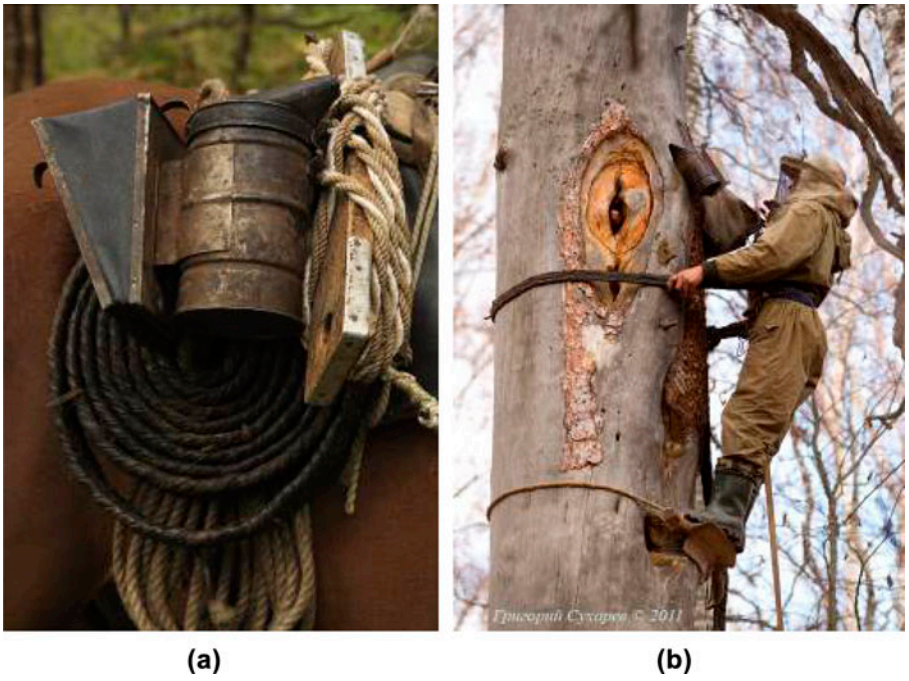

Figure 6. Beekeeper tools attached to a saddle (a) and tools in use (b).

them with sufficient honey stores for the winter. As a result, colonies were able to live a long time in the same places, hives had up to 18–25 years of continual habitation! Also, the beekeepers had to learn how to replace a comb. With long-term habitation, the life of the tree hollows suffered (Kosarev et al., 1999).

Wild-hive bees in the Ural area also have many natural enemies that weaken the colony and cause their death. These include: Brown bears *Ursus arctos,* Pine martens *Martes martes*, Forest mice *Apodemus uralensis*, Great spotted woodpeckers *Dendrocopos major*, European bee-eaters *Merops apiaster*, Greater wax moths *Galleria mellonella*, European hornets *Vespa crabro*, Red wood ants *Formica rufa*, and Red wasps *Dolichovespula rufa.*

The wild hives did not avoid modern honey bee diseases and parasites, such as: varroa mites *Varroa destructor* (Ilyasov, Farkhutdinov, & Shareeva, 2014), nosema *Nosema apis*, chalkbrood disease *Ascosphaerosis* (Farkchutdinov), American Foulbrood

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Paenibacillus larvae, and European Foulbrood *Melissococcus pluton* (Bakalova, 2010; Kosarev, 1987).

These diseases and parasites are more severe in modern, movable-frame hives than in tree hollow hives. The population of tree hollow bees has cyclical swings dependent on solar activity (Kosarev et al., 1999).

Currently, dark European bees exist in the southern Urals in the State Reserve "Shulgan-Tash" where they live in natural and handmade tree hollows. The reserve was established in 1958 and covers an area of about 54 thousand acres. The bees also live in the regional nature reserve "Altyn Solok", an area of 222 thousand acres, established in 1997, and the national park "Bashkiria", an area of 203 thousand acres, formed in 1986 (Kosarev, 2008).

At the end of 2014, these three national parks had about 1,200 trees with *Koloda* – handmade tree hollow hives, but sadly only 300 of them had bees. About 4,000 colonies were also kept in apiaries with modern movable-frame hives and 200–400 colonies lived in natural tree hollows. In 2012, these three reserves were listed as special protected areas, together with a number of others, and acquired the status of a biosphere by UNESCO called "Bashkir Ural" complex with a total area of 855,000 acres. The regional reserve "Altyn Solok" is also protected by the Ministry of Environment of the Republic of Bashkortostan. Currently, in order to preserve the Burzyan honey bee, it is planned to expand the "Shulgan-Tash" reserve in a northwest direction through undeveloped territory between the rivers Nugush and Uruk (Kosarev, Yumaguzhin, & Saifullina, 2002; Yumaguzhin, 2009).

The staff from Shulgan-Tash, Altyn Solok, and national park Bashkiria, together with local beekeepers, are constantly taking action to increase the bee population and carrying on selection work to improve immunity, winter hardiness, and the productivity of the Burzyan bees.

This policy of state protected reservations allows us to save a unique population of these bees – *A.m. mellifera* in Eurasia in the face of new threats of spontaneous hybridization and habitat destruction (Kosarev et al., 2011; Yumaguzhin, 2009).

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