

## THE INFLUENCE OF GLOBAL WARMING REGARDING SOME BIOLOGICAL AND ECOLOGICAL ASPECTS OF INSECTS FROM TINCA AREA BIHOR COUNTY (NORTH-WESTERN PART OF ROMANIA)

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**Abstract.** This paper presents biological and phenological anomalies observed at the insects from the Tinca area, Bihor county (north-western part of Romania) due to the consequences of global warming. These anomalies were observed during 2010-2019 in 105 species of insects. These climate changes caused the extension of the activity or flight period, the appearance of additional generations or the hibernation in another development stage, sometimes simultaneously with the stage known in the scientific literature, precocious appearances in nature, some resistance of some species to dryness and heat, copulation and even the laying down of eggs in November – December.

**Keywords:** phenological anomalies, insects, Tinca area.

**Rezumat. Influența încălzirii globale privind unele aspecte biologice și ecologice ale insectelor din zona Tinca, județul Bihor (partea nord-vestică a României).** În această lucrare sunt prezentate anomalii biologice și fenologice observate la insectele din zona Tinca, județul Bihor (partea nord-vestică a României) datorate consecințelor încălzirii globale. Aceste anomalii au fost observate în perioada 2010-2019 la 105 specii de insecte. Aceste schimbări climatice au cauzat prelungirea activității sau a perioadei de zbor, apariția de generații suplimentare sau hibernarea în alt stadiu de dezvoltare, uneori simultan cu stadiul cunoscut în literatura științifică, apariții precoce în natură, o anumită rezistență la secetă și caniculă ale unor specii, împerechere și chiar depunerea ouălor în perioada noiembrie-decembrie.

**Cuvinte cheie:** anomalii fenologice, insecte, zona Tinca.

### INTRODUCTION

Precocious and short springs, droughty summers, autumns with high temperatures and thermic shocks, mild winters, the replacement of snow with rain are the effects of global warming observed in the seasons structure (CIOBOIU, 2005; 2014).

The extension of the activity or flight period, the premature beginning of the activity of flight period, the appearance of additional generations, hibernation in another development stage, sometimes with the stage known in the scientific literature, copulation and even lay eggs in November-December, are phenological changes observed in insects, due to the consequences of global warming. Researches were undertaken in Romania regarding the effects of the global warming over different groups of insects (DYJKSTRA, 2006; ILIE, 2012; 2014a, b, c; 2015a, b; 2016a, b; 2017; ILIE L. C., 2017; ILIE, 2018; ILIE & MARINESCU 2018; ILIE et al., 2018).

This paper, a premiere at a national level, is a synthesis of the observations performed by authors regarding the influence of global warming over the insects from the Tinca area (Bihor county, north-western part of Romania). These phenological anomalies must be attentively supervised because some species of insects are pests for forestry and agriculture and protection treatments are performed depending on the activity and development stage of insects.

The Tinca area is located in the north-western part of Romania, in the south-western part of Bihor county having a hilly relief. The climate is temperate-continental, the hydrographic system is represented by the Crișul Negru river and some lakes, the average altitude is 110 m. The vegetation belongs to the oak stage. Tinca village is formed by five villages: Tinca, Râpa, Belfir, Girișu-Negru and Gurbediu.

### MATERIAL AND METHODS

The researches were performed during 2010-2018, in the Tinca area. Insects were captured with entomological nets or manually. Species were identified in the laboratory, using sources mentioned in specialized literature (CÂRDEI & BULIMAR, 1965; KIS, 1984; PÂRVU et al., 1985; RAKOSY, 1996; WARCHALOWSKY, 2003; SZEKELY, 2008, 2010; RAKOSY, 2013; PANIN et al., 2015).

### RESULTS AND DISCUSSIONS

In the Tinca area, during 2010-2019, phenological anomalies were observed in 105 species (Table 1).

Table 1. The phenological anomalies at the species of insects.

Species	Specimens, period, village, temperature	Flight period
<i>Maculinea arion</i> Linnaeus 1758	2 M, Tinca, 10. XII. 2018, t=6 <sup>o</sup> C	15. IV – 15. VI
<i>Polypogon tentacularia</i> Linnaeus 1758	1 M, Tinca, 15. II. 2018, t=5 <sup>o</sup> C;	15. V – 15. VII

	1 M, Tinca, 23. XI. 2018, t=5 <sup>0</sup> C; 1 M, Tinca, 8. XII. 2018, t=4 <sup>0</sup> C	
<i>Hyles euphorbiae</i> Linnaeus 1758	1 M, Tinca, 24. I. 2018, t=5 <sup>0</sup> C; 1 M, Tinca, 13. XI. 2018, t=17 <sup>0</sup> C; 1 M, Tinca, 7. XI. 2018, t=20 <sup>0</sup> C; 1 ex ♂, Tinca, 8. XI. 2018, t=27 <sup>0</sup> C	15. IV – 15. VI
<i>Lasiommata megera</i> Linnaeus 1767	1 M, Tinca, 3. XI. 2015, t=15 <sup>0</sup> C; 2 F, Tinca, 21-22. X. 2017, t=16,5 <sup>0</sup> C; 1 M, Tinca, 8. XI. 2018, t=18 <sup>0</sup> C; 1 M, Tinca, 9. XI. 2018, t=15 <sup>0</sup> C	15. IV – 7. X
<i>Melitaea phoebe</i> Denis 1775	1 F, Râpa, 1. XI. 2015, t=14 <sup>0</sup> C; 1 M, Tinca, 7. XI. 2018, t=20 <sup>0</sup> C	V – IX
<i>Melitaea athalia</i> Rottemburg 1775	1 F, Tinca, 4. XI. 2018, t=25 <sup>0</sup> C	V – 15. IX
<i>Pyronia tithonus</i> Linnaeus 1758	1 F, Tinca, 2. XI. 2018, t=25 <sup>0</sup> C	15. VI – VIII
<i>Maniola jurtina</i> Linnaeus 1758	1 F, Tinca, 4. XI. 2018, t=25 <sup>0</sup> C	VI – VIII
<i>Lycaena virgaureae</i> Linnaeus 1758	1 F, Tinca, 11. X. 2018, t=24 <sup>0</sup> C; 1 M, Tinca, 20. X. 2018, t=17 <sup>0</sup> C	15. VI – 15. VIII
<i>Brintesia circe</i> Fabricius 1775	1 M, Tinca, 28. XI. 2018, t=23 <sup>0</sup> C; 1 M, Tinca, 12. XI. 2018, t=27 <sup>0</sup> C	15. VI – 15. VIII
<i>Neptis sappho</i> Pallas 1771	1 F, Tinca, 6. X. 2018, t=24 <sup>0</sup> C	15. IV – VIII
<i>Pieris brassicae</i> Linnaeus 1758	2 M, Tinca, 15. XI. 2010, t=19 <sup>0</sup> C; 1 M, Tinca, 19. II. 2014, t=20 <sup>0</sup> C; 2 M, Râpa, 14. I. 2015, t=9,5 <sup>0</sup> C; 3 M, Tinca, 25. X-7. XI. 2017, t=15-17 <sup>0</sup> C; 1 M, Tinca, 28. III. 2018, t=9 <sup>0</sup> C; 2 M, Tinca, 3-4. XI. 2018, t=25 <sup>0</sup> C.	20. IV – 15. X
<i>Pieris rapae</i> Linnaeus 1758	1 M, Râpa, 6. III. 2016, t=12 <sup>0</sup> C; 1 M, Tinca, 4. XI. 2015, t=14 <sup>0</sup> C; 1 M, Tinca, 12. X. 2015, t=16 <sup>0</sup> C; 1 M, Tinca, 4. I. 2018, t=7 <sup>0</sup> C.	IV – 15. X
<i>Pieris napi</i> Linnaeus 1758	1 M, Tinca, 23. II. 2017, t=11 <sup>0</sup> C	20. III – X
<i>Colias croceus</i> Focroy 1785	1 M, Tinca, 16. X. 2010, t=21 <sup>0</sup> C; 25 specimens, Râpa, 2. XI. 2013, t=16 <sup>0</sup> C; 1 M, Tinca, 16. XI. 2015, t=16 <sup>0</sup> C; 1 M, Tinca, 22. XI. 2016, t=14 <sup>0</sup> C	V – X
<i>Colias hyale</i> Linnaeus 1758	1 M, Tinca, 15. XI. 2015, t=14 <sup>0</sup> C	V – X
<i>Colias alfaccariensis</i> Ribbe 1905	3 M, Râpa, 21. I. 2015, t=13 <sup>0</sup> C	V – X
<i>Gonopteryx rhamni</i> Linnaeus 1758	1 M, Râpa, 13. II. 2014, t=17 <sup>0</sup> C	20. III – IX
<i>Zerynthia polyxena</i> Dennis 1775	1 M, Râpa, 12. III. 2018, t=16 <sup>0</sup> C	V – 15. VI
<i>Lycaena phleas</i> Linnaeus 1761	1 M, Râpa, 4. II. 2014, t=16 <sup>0</sup> C; 1 M, Belfir, 18. II. 2014, t=18 <sup>0</sup> C; 1 M, Râpa, 2. III. 2014, t=20 <sup>0</sup> C	15. IV – X
<i>Cupido alcetas</i> Hoffmannsegg 1804	1 M, Râpa, 2. XI. 2013, t=16 <sup>0</sup> C	20. IV – 7. X
<i>Polymmatius icarus</i> Rottenburg 1775	Resistant species at the drought during 2015 and 2016	20. IV – X
<i>Vanessa atalanta</i> Linnaeus 1758	1 M, Râpa, 6. III. 2016, t=12 <sup>0</sup> C; 1 M, Tinca, 14. XII. 2011, t=11 <sup>0</sup> C; 1 M, Tinca, 22. I. 2015, t=12 <sup>0</sup> C; 1 M, Tinca, 6. I. 2014, t=14 <sup>0</sup> C; 1 M, Tinca, 20. I. 2014, t=14 <sup>0</sup> C; 1 M, 2 F, Râpa forest, 26. X. 2014, t=12 <sup>0</sup> C; 11 specimens, Tinca, 20. X. 2017- 25. I. 2018, t=8-17 <sup>0</sup> C; 1 F, 1 M, Tinca, 10. XII. 2018, t=6 <sup>0</sup> C	IV – IX
<i>Inachis io</i> Linnaeus 1758	1 M, Tinca, 18. XII. 2012, t=2 <sup>0</sup> C; 1 F, Râpa, 2. XI. 2013, t=16 <sup>0</sup> C; 1 F, Tinca, 9. XI. 2015, t=12 <sup>0</sup> C; 1 M, Râpa, 4. XII. 2016, t=4 <sup>0</sup> C; 1 M, Tinca, 8. I. 2018, t=13 <sup>0</sup> C; 1 M, Tinca, 4. XI. 2018, t=25 <sup>0</sup> C; 1 M, Tinca, 30. X. 2018, t=24 <sup>0</sup> C; 1 F, Tinca forest, 5. X. 2018, t=20 <sup>0</sup> C	III – IX
<i>Polygonia c-album</i> Linnaeus 1758	1 M, Râpa, 24. I. 2017, t=14 <sup>0</sup> C; 1 M, Tinca, 17. II. 2016, t=16 <sup>0</sup> C	III – X
<i>Aglais urticae</i> Linnaeus 1758	1 M, Râpa, 26. I. 2017, t=14 <sup>0</sup> C; 1 M, Tinca, 7. I. 2018, t=13 <sup>0</sup> C; 1 M, Tinca, 24. I. 2018, t=13 <sup>0</sup> C	III – VIII
<i>Nymphalis antiopa</i> Linnaeus 1758	1 F, Belfir, 17. XI. 2013, t=16 <sup>0</sup> C; 1 F, Tinca, 28. XI. 2013, t=15 <sup>0</sup> C	IV – VIII
<i>Nymphalis polychloros</i> Linnaeus 1758	1 F, Râpa, 2. XI. 2014, t=19 <sup>0</sup> C	III – IX
<i>Pararge aegeria tircis</i> Godat 1821	1 F, Râpa, 2. XI. 2013, t=16 <sup>0</sup> C; 1 F, Tinca, 6. XI. 2017, t=15 <sup>0</sup> C	IV – IX
<i>Erebia medusa</i> Denis 1775	2 M, Tinca, 5. III. 2017, t=18,5 <sup>0</sup> C; 1 F, Tinca, 22. III. 2017, t=20 <sup>0</sup> C; 1 caterpillar, Tinca, 3. II. 2017, t=7 <sup>0</sup> C	V – VII
<i>Minois dryas</i> Scopoli 1763	1 F, Tinca, 29. X. 2015, t=15 <sup>0</sup> C;	VII – 7. IX

	1 F, Râpa, 2. XI. 2014, t=19 <sup>0</sup> C	
<i>Apatura ilia</i> Denis 1775	1 M, Râpa, 2. XI. 2014, t=19 <sup>0</sup> C	VI – VIII
<i>Apatura iris</i> Linnaeus 1758	1 F, Râpa, 3. XI. 2014, t=19 <sup>0</sup> C	VI – VIII
<i>Hesperia comma</i> Linnaeus 1758	1 M, Râpa, 25. III. 2018, t=10 <sup>0</sup> C	15. IV – IX
<i>Pyrgus alveus alveus</i> Hubner 1803	1 M, Râpa, 5. X. 2014, t=16 <sup>0</sup> C	VI – VIII
<i>Parnasius apollo jaraensis</i> Kertesz 1922	1 F, Râpa, 20. V. 2015, t=19 <sup>0</sup> C; 1 F, Râpa, 15 VI 2015, t=21 <sup>0</sup> C	15. VII – VIII
<i>Iphiclides podalirius</i> Linnaeus 1758	1 M, Râpa, 4. III. 2016, t=10 <sup>0</sup> C; 1 F, Râpa, 25. XI. 2016, t=8 <sup>0</sup> C; 1 M, Tinca, 7. I. 2018, t=13 <sup>0</sup> C	15. IV – VIII
<i>Papilio machaon</i> Linnaeus 1758	1 M, Gurbediu, 6. XI. 2013, t=14 <sup>0</sup> C; 1 M, Gurbediu, 15. XI. 2013, t=15 <sup>0</sup> C; 1 M, Râpa, 8. III. 2016, t=12 <sup>0</sup> C; 1 M, Tinca, 8. I. 2018, t=13 <sup>0</sup> C; 1 M, Belfir, 13. III. 2016, t=12 <sup>0</sup> C	15. IV – VIII
<i>Leptidea sinapis</i> Linnaeus 1758	1 M, Râpa, 2. XI. 2014, t=19 <sup>0</sup> C	IV – 7. XI
<i>Anthocaris cardamines</i> Linnaeus 1758	2 F, Tinca forest, 30. VIII. 2011, t=28 <sup>0</sup> C; 1 M, Râpa, 2. XI. 2014, t=19 <sup>0</sup> C	III – VI
<i>Trachys troglodytiformes</i> Obenberg 1918	2 F, 1 M, Tinca, 2. XI. 2018, t=25 <sup>0</sup> C	IX
<i>Psyllobora 22-punctata</i> Linnaeus 1758	1 F, Tinca, 17. XI-21. XII. 2017, t=6-17 <sup>0</sup> C	IV – X
<i>Coccinella 7-punctata</i> Linnaeus 1758	6 specimens, Tinca, 12. XII. 2017-19. I. 2018, t=6-17 <sup>0</sup> C	IV – X
<i>Otiorrhynchus fuscipes</i> Olivier 1790	1 M, Tinca, 17. I. 2018, t=5 <sup>0</sup> C	IV – X
<i>Anthrenus scrophulariae</i> Linnaeus 1758	1 F, Tinca, 21. II. 2017, t=7,5 <sup>0</sup> C	IV – X
<i>Rhynchites bacchus</i> Linnaeus 1758	1 M, Tinca, 24. X. 2017, t=12 <sup>0</sup> C	IV – X
<i>Harmonia axiridis</i> Pallas 1773	1 M, Tinca, 28. XII. 2017, t=13 <sup>0</sup> C; 1 M, Tinca, 8. XII. 2016, t=1 <sup>0</sup> C	III – X
<i>Chrysolina fastuosa</i> Scopoli 1763	2 M, 4 F, 50 larva specimens, Tinca, 1. XI. 2017-12. I. 2018, t=0-17 <sup>0</sup> C; Two larva specimens, Tinca, 28. XI. 2016, t=3,5 <sup>0</sup> C	IV – X
<i>Chrysolina herbacea</i> Duftschmidt 1825	One larva specimen, Tinca, 27. XI. 2011, t=4 <sup>0</sup> C; 4 larva specimen, Tinca, 11. XII. 2011, t=7 <sup>0</sup> C; One larva specimen, Tinca, 31. I. 2012, t=8,5 <sup>0</sup> C; One larva specimen, Tinca, 28. XI. 2016, t=4 <sup>0</sup> C	IV – X
<i>Podagrica menetriesii</i> Faldermann 1837	One pair in copula, Tinca, 3. XI. 2013, t=16 <sup>0</sup> C; 2 M, Tinca, 23. XII. 2015, t=13 <sup>0</sup> C	IV – IX
<i>Longitarsus tabidus</i> Fabricius 1775	One pair in copula, Tinca, 12. XI. 2014, t=18 <sup>0</sup> C; One pair in copula, Tinca, 13. XII. 2014, t=12,5 <sup>0</sup> C;	IV – IX
<i>Phaedon laevigatus</i> Duftschmidt 1825	3 specimens, 27. XII. 2015, Râpa forest, t=12 <sup>0</sup> C; 8 specimens, Tinca 25. XI-26. XII. 2014; 4. XI. 2016, t=3-11 <sup>0</sup> C; One pair in copula, Tinca, 13. XII. 2014, t=12,5 <sup>0</sup> C	IV – IX
<i>Phyllotreta diademata</i> Foudras 1860	3 F, 1 M, Tinca, 15. XII. 2012, t=11 <sup>0</sup> C;	IV – IX
<i>Psylliodes chrysocephalus</i> Linnaeus 1758	2 F, 4 M, Tinca, 15.-21. XII. 2012, t=3 - 11 <sup>0</sup> C;	IV – IX
<i>Longitarsus minimus</i> Kutchera 1863	1 M, Tinca, 10. XII. 2017, t=2 <sup>0</sup> C	V – IX
<i>Longitarsus minusculus</i> Foudras 1860	2 M, Tinca, 28. XII. 2017, t=13 <sup>0</sup> C; 29 specimens, Tinca, 24. XI-15. XII. 2012; 20. XI. 2014-28. II. 2015; 23. XI. 2015, t=3,5-13 <sup>0</sup> C; 1 M, Tinca, 11. XI. 2016, t=8,5 <sup>0</sup> C	IV – IX
<i>Chrysolina limbata</i> Linnaeus 1758	One larva specimen, Tinca, 21. XII. 2017, t=8 <sup>0</sup> C	IV – IX
<i>Podagrica malvae</i> Illiger 1807	20 specimens, Tinca, 11. I.-29. I. 2018, t=4-10 <sup>0</sup> C	IV – IX
<i>Altica oleracea</i> Linnaeus 1758	86 specimens, Tinca, 20. X. 2017-24. II. 2018, t=4-21 <sup>0</sup> C; 19 specimens, Tinca, 17. XI. 2014-28. II. 2015; 27. XII. 2015; 22. XI. 2016; 30. I. 2016, t=4-14 <sup>0</sup> C; 6 specimen, Râpa, 28. XI.-7. XII. 2014, t=10-11 <sup>0</sup> C	III – IX
<i>Galeruca rufa</i> Germar 1824	1 F, Tinca, 18. XII. 2017, t=7 <sup>0</sup> C	IV – X
<i>Galeruca tanacetii</i> Linnaeus 1758	1 F, Tinca, 21. XI. 2012, t=3 <sup>0</sup> C;	IV – X
<i>Longitarsus longipennis</i> Kutchera 1863	1 M, Râpa forest, 6. XII. 2014, t=11 <sup>0</sup> C	IV – IX
<i>Longitarsus brisouti</i> Heikertinger 1912	1 M, Tinca, 25. XI. 2015, t=6 <sup>0</sup> C	V – IX
<i>Longitarsus holsaticus</i> Linnaeus 1758	5 specimens, Tinca, 25. XI.-27. XII. 2012, t=6-16 <sup>0</sup> C	IV – IX
<i>Longitarsus pratensis</i> Panzer 1794	2 M, 2 F, Tinca, 24.-25. XII. 2014, t=10 <sup>0</sup> C	IV – IX
<i>Longitarsus brunnaeus</i> Duftschmidt 1825	1 M, Râpa forest, 24. XI. 2014, t=7 <sup>0</sup> C; 15 specimens, Tinca, 25. XI. 2014-5. II. 2015, t=5-13 <sup>0</sup> C	IV – IX
<i>Longitarsus ballotae</i> Marsham 1802	2 F, 3 M, Tinca, 9-27. XII. 2015, t=5,5-13 <sup>0</sup> C	IV – IX
<i>Longitarsus aeneicollis</i> Faldermann 1837	19 specimens, Tinca, 23. XI.-27. XII. 2015, t=5,5-16 <sup>0</sup> C; 2M, 1 F, Râpa forest, 27. XII. 2015, t=12 <sup>0</sup> C	IV – IX
<i>Longitarsus fuscoaeus</i> Redtenbacher 1849	2 M, 2 F, Tinca, 9-27 XII 2015, t=5,5 - 16 <sup>0</sup> C;	IV – IX
<i>Hispa atra</i> Linnaeus 1758	2 M, Tinca, 13-23. XII. 2015, t=13-16 <sup>0</sup> C	IV – IX
<i>Chaetocnema tibialis</i> Illiger 1807	3 M, 27. XII. 2015, Tinca, t=12 <sup>0</sup> C	IV – IX
<i>Chaetocnema clorophana</i> Duftschmidt 1825	2 M, 3 F, Tinca forest, 27. XII. 2015, t=12 <sup>0</sup> C	IV – IX
<i>Sympecma fusca</i> Van der Linden 1823	2 F, 20. X. 2017, Tinca forest, t=17 <sup>0</sup> C;	III – IX
<i>Libellula depressa</i> Linnaeus 1758	1 F, Tinca, 23. IX. 2018, t=25 <sup>0</sup> C	V – VIII
<i>Gomphus vulgatissimus</i> Linnaeus 1758	1 M, Tinca, 16. X. 2018, t=23 <sup>0</sup> C; 1 F, Tinca, 12. X. 2018, t=25 <sup>0</sup> C;	V – VIII

	1 M, Tinca, 11. X. 2018, t=24 <sup>o</sup> C; 1 M, Tinca, 25. IX. 2018, t=24 <sup>o</sup> C	
<i>Lasius niger</i> Linnaeus, 1758	1 specimen, Tinca, 25. XI. 2017, t=13 <sup>o</sup> C; 1 specimen, Tinca, 26. XII. 2017, t=8 <sup>o</sup> C; 1 specimen, Tinca, 11. XII. 2016, t=8,5 <sup>o</sup> C	IV – X
<i>Mantis religiosa</i> Linnaeus 1758	6 F, Tinca, 20. XI. 2017, t=6 <sup>o</sup> C	IV – X
<i>Vespa germanica</i> Linnaeus 1758	6 specimens, Tinca, 14. XI.-28. XII. 2017, t=5-13 <sup>o</sup> C; One specimen, Tinca, 5. XII. 2016, t=3 <sup>o</sup> C	III – X
<i>Tetramonium caespitum</i> Linnaeus 1758	2 specimens, Tinca, 15. XII. 2017-12. I. 2018, t=10 <sup>o</sup> C 11 specimens, Tinca, 16. II. 2019, t=18 <sup>o</sup> C	III – X
<i>Lygaeus equestris</i> Linnaeus 1758	3 specimens, Tinca, 3. II.-17. II. 2018, t=7-8 <sup>o</sup> C	III – X
<i>Pentatoma rufipes</i> Linnaeus 1758	5 specimens, Tinca, 20. XI. 2017-4. II. 2018, t=6-18 <sup>o</sup> C 1 specimen, Tinca, 15. II. 2019, t=12 <sup>o</sup> C	IV – X
<i>Aphrophora alni</i> Fallen 1805	1 specimen, Tinca, 3. II. 2017, t=7 <sup>o</sup> C	IV – IX
<i>Pyrrhochorus apterus</i> Linnaeus 1758	15 specimens, Tinca, 22. XI. 2017-3. II. 2018, t=6-13 <sup>o</sup> C 26 specimens, Tinca, 1. II. 2019, t=7 <sup>o</sup> C	III – X
<i>Palomena praxima</i> Linnaeus 1758	9 specimens, Tinca, 14. XI. 2017-7. I. 2018, t=3-17 <sup>o</sup> C	III – X
<i>Lucilia sericata</i> Meigen 1826	8 specimens, Tinca, 7. I.-17. II. 2018, t=8-13 <sup>o</sup> C	IV – X
<i>Culex pipiens</i> Linnaeus 1758	32 specimens, Tinca, 20. XI. 2017-3. II. 2018, t=3-13 <sup>o</sup> C; One specimen, Tinca, 2. II. 2017, t=7,5 <sup>o</sup> C 3 specimens, Tinca, 27. I. 2019, t=1 <sup>o</sup> C 6 specimens, Tinca, 1. II. 2019, t=7 <sup>o</sup> C	III – X
<i>Calliphora erythrocephala</i> Macquart 1834	53 specimens, Tinca, 30. XI. 2017-24. II. 2018, t=(-5)-17 <sup>o</sup> C One specimen, Tinca, 27. I. 2019, t=1 <sup>o</sup> C	III – X
<i>Muscina stabulans</i> Fallen 1817	2 specimens, Tinca, 7. I. 2018, t=13 <sup>o</sup> C	IV – X
<i>Musca domestica</i> Linnaeus 1758	3 specimens, Tinca, 30. XI. 2017-6. I. 2018, t=7-17 <sup>o</sup> C	III – X
<i>Calliphora vomitoria</i> Linnaeus 1758	3 specimens, Tinca, 13. XI. 2016, t=2 <sup>o</sup> C; 1 specimen, Tinca, 29. XI. 2016, t= - 5 <sup>o</sup> C; 4 specimens, Tinca, 13. XII. 2016, t= - 3 <sup>o</sup> C; 3 specimens, Tinca, 27. XII. 2016, t=3 <sup>o</sup> C; One pair in copula, Tinca, 26. XI. 2016, t=12 <sup>o</sup> C	III – X
<i>Apis mellifera</i> Linnaeus 1758	1 specimen, Tinca, 9. II. 2016, t=15 <sup>o</sup> C; 1 specimen, Tinca, 17. II. 2016, t=17 <sup>o</sup> C; 3 specimens, Tinca, 3. II. 2017, t=7 <sup>o</sup> C; 1 specimen, Tinca, 23. II. 2017, t=11 <sup>o</sup> C 1 specimen, Tinca, 3. II. 2019, t=15 <sup>o</sup> C	III – X
<i>Melolontha melolontha</i> Linnaeus 1758	1 M, Tinca, 28. III. 2016, t=20 <sup>o</sup> C	20. IV – VI.
<i>Anax imperator</i> Leach 1815	1 F, Tinca, 12. XI. 2013, t=12 <sup>o</sup> C	VI – IX
<i>Sympetrum flaveolum</i> Linnaeus 1758	1 M, Tinca forest, 6. XII. 2014, t=11 <sup>o</sup> C	VII – X
<i>Brachytron hafniense</i> Muller 1764	2 F, Tinca, 7. X. 2015, t=21 <sup>o</sup> C	V – VI
<i>Agriotes nitidulus</i> Marsham 1802	1 M, Tinca, 3. II. 2017, t=7 <sup>o</sup> C	III – IX
<i>Clytra laeviuscula</i> Ratzeburg 1837	1 M, Gurbediu forest, 14. IV. 2017, t=14 <sup>o</sup> C	15. V – VIII
<i>Longitarsus gracilis</i> Kutchera 1864	2 M, 1 F, Tinca forest, 27. XII. 2015, t=12 <sup>o</sup> C	IV – IX
<i>Longitarsus parvulus</i> Paykull 1799	1 M, Tinca forest, 27. XII. 2015, t=12 <sup>o</sup> C	V – IX
<i>Altica saliceti</i> Weise 1888	1 M, Tinca, 2. II. 2016, t=12 <sup>o</sup> C	III – X
<i>Otiorrhinchus ligustici</i> Linnaeus 1758	1 M, Tinca, 6. XII. 2016, t=2 <sup>o</sup> C	IV – IX
<i>Colias erate</i> Esper, 1805	1M, Râpa, 9. II. 2019, t=18 <sup>o</sup> C	15. V – 7. XI
<i>Chelis m. maculosa</i> Gerning, 1780	2M, Râpa, 4.-5. IV. 2019, t=21 <sup>o</sup> C	15. V – 15. VI
<i>Leptidea morsei major</i> Grund, 1907	1M, Tinca, 22. III. 2019, t=15 <sup>o</sup> C	25. IV – 7. IX
<i>Hipparchia fagi</i> Scopoli, 1763	1F, Tinca spa, 13. III. 2019, t=19 <sup>o</sup> C	15. VI – 7. IX
<i>Melanargia galathea satnia</i> Linnaeus, 1758	1F, Tinca, 4V 2019, t=24 <sup>o</sup> C	15. VI – 7. IX

Legend: M – male, F – female, t=temperature, C=Celsius, I – XII – months of year (I-January - XII-December)

During the analysed period, phenological anomalies were recorded in 105 species of insects in the Tinca area. Inside the Insecta class, concerning the number of species collected by orders, the situation is the following: the Lepidoptera order with a total of 44 species (41.90%), followed by the Coleoptera order with 39 species (37.14%), Odonata order with 6 species (5.71%), Heteroptera order with 5 species (4.76%), Hymenoptera order with 3 species (2.85%), Mantodea order with 1 species (0.95%). It is interesting to note the presence of a very rare species at national level: *Parnasius apollo jaraensis* Kert., the species being accidental, even vagrant in the Tinca area.

Precocious appearances in nature were observed in the following species: *Colias erate* Esp., *Chelis maculosa* Ger., *Leptidea morsei major* Gr., *Hipparchia fagi* Scop., *Melanargia galathea* L., *Polygona tentacularia* L., *Hyles euphorbiae* L., *Pieris rapae* L., *Pieris napi* L., *Colias alfajariensis* Rib., *Gonopteryx rhamni* L., *Zerynthia polyxena* Den., *Lycaena phleas* L., *Vanessa atalanta* L., *Inachis io* L., *Polygonia c-album* L., *Aglais urticae* L., *Erebia medusa* Den., *Hesperia comma* L., *Parnasius apollo jaraensis* Kert., *Iphiclides podalirius* L., *Papilio machaon* L., *Otiorrhynchus fuscipes* Ol., *Anthrenus scrophulariae* L., *Chysolina herbacea* Duft., *Podagricina malvae* L., *Altica oleracea* L., *Longitarsus brunnaeus* Duft., *Lygaeus equestris* L., *Pentatona rufipes* L., *Aphrophora alni* Fall., *Pyrrhochorus apterus* L., *Lucilia sericata* Meig., *Culex pipiens* L., *Calliphora erythrocephala* Marq., *Muscina stabulans* Fall., *Apis mellifera* L., *Melolontha melolontha* L., *Agriotes nitidulus* Marsh., *Clytra laeviuscula* Ratz., *Altica saliceti* Wse.

The extension of the activity or flight period was observed for almost all species, additional generations in *Vanessa atalanta* L., *Chrysolina fastuosa* Scop., *Chrysolina herbacea* Duft. Hibernation in another development stage, sometimes simultaneously with the stage known in the scientific literature: *Pieris napi* L., *Papilio machaon* L., *Chrysolina fastuosa* Scop., *Chrysolina herbacea* Duft., *Chrysolina limbata* L., *Hyles euphorbiae* L.

Some species revealed some resistance to heat and drought: *Pieris brassicae* L., *Polyommatus icarus* Rott. Other species were observed in copula during November-December: *Calliophora vomitoria* L., *Culex pipiensis* L., *Longitarsus tabidus* Fabr., *Phaedon laevigatus* Duft., *Podagrica menetriesii* Fald., and some species were observed laying eggs late in autumn: *Galeruca tanacetii* L., *Chrysolina fastuosa* Scop., *Chrysolina herbacea* Duft.

## CONCLUSIONS

During nine seasons, 2010 – 2019, phenological anomalies were observed in the Tinca area in 105 species of insects. These anomalies, due to consequences of global warming, recorded in a big number of insect species, represent a premiere at national level.

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