J. Mountain Res. P-ISSN: 0974-3030, E-ISSN: 2582-5011 DOI:https://doi.org/10.51220/jmr.v17i1.20
Vol. 17(1), (2022), 159-166

Study of Drifting behaviour of aquatic mites in the snow fed river Alaknanda from Garhwal Himalaya: Density, Diversity and Diel Pattern

Pankaj Bahuguna[1] and A.K. Dobriyal[2]
[1]Aquatic biodiversity Lab, Department of Zoology, Govt. P.G. College Jaiharikhal-246193, Uttarakhand, India.
[2]Department of Zoology, H. N. B. Garhwal University (A Central University), B. G. R. Campus Pauri, Pauri Garhwal- 246001, Uttarakhand, India.

*Corresponding author: pankajpaurii@gmail.com

Received: 18.05.2022, Revised: 12.06.2022, Accepted: 17.06. 2022

Abstract: Hydrachnida or water mites are most diverse group amongst Acari and they play an important role as bio-indicator for their adjoining habitat. In the present study data for drift density, diversity and diel drift pattern was recorded from January 2018 to December 2018. Total 743 individuals belonging to 25 species were noted. Species *Atractides panesari, Feltria gereckei, Feltria rubra* and *Lebertia glabra* displayed nocturnal drift and species *Torrenticola turkestanica, Monatractides garhwalensis, Sperchon indicus and Sperchon garhwalensis* displayed both diurnal and nocturnal drift. Maximum 17 species exhibited diurnal drift throughout the course of the study. Presence of *Hygrobates fluviatilis*, a pollution tolerant species reflected the polluted condition of water.

Key words: Water mites, Drift, Snow fed river Alaknanda, Garhwal Himalaya

Introduction

Drifting refers to the downstream movement of water mites and other invertebrates along the stream current, and the record of their 24 hours movement is known as diel drift pattern. Water mites are powerful fauna of freshwater resources with bio indicator properties and also act as bio-control agent for aquatic insect pests (Namdari et. al., 2014). They are highly diverse, colorful arachnids that can be observed globally in most of the freshwater habitats. Water mites as bio-indicators were also studied by Kowalik and Biesiadka (1981), Biesiadka and Kowalik (1991), Cicolani and Di Sabatino (1991), Zawal (1992, 2003), Martin and Brinkmann (2003) and Martin and Brunke (2012). Though the water mites are an important meiobenthic group, however due to difficulties related to morphological analysis there are still many species yet to be discovered. On first encounter they seem like small water spiders but when deeply observed they are differently identified as aquatic mites. Hydrachnida distributed globally and creates the higher complexity of trophic networks as they act as both predator and parasite to many of aquatic invertebrates; but till date only over 6000 species were identified worldwide. As they are carnivorous in food habit, they are abundant in water bodies, those are rich in vegetation composition as well as having diverse animal life. Usually they are observed throughout all seasons in variable water temperature but there are some specific species which are found only in snow fed or spring fed river according to their suitability against ecological and habitat preferences. They are polyphyletic in origin as wide variation is noticed in larval stage (Wolcott, 1905). They are

brilliantly colored; some common colors are red, brown, yellow, scarlet and orange.

Water mites play an important role in regulating the population of other invertebrates and through this way play significant role in maintaining food chain. Pioneer work involving analysis of density, diversity, population structure and drifting patterns of aquatic mites from Randi Gad spring fed streams was carried out by Bahuguna *et al.* (2019), Bahuguna & Dobriyal (2020) and Negi et.al., (2021a,b) . Density and diversity of aquatic mites in a glacier-fed River Alaknanda from Garhwal Central Himalaya were also carried out by Bahuguna *et al.* (2020).

The objective of this study was to observe and assess the occurrence of aquatic mites in river Alaknanda and their distributional pattern.

Materials And Methods

Study Area

The present study was conducted on Alaknanda River which rises in the southern Himalayas and originates from the Satapanth Glacier. Two different locations were identified for sampling on Alaknanda River located between latitude 30° 22’ 45” to 30° 23’ 38” N and longitude 78° 78’ 36” to 78° 72’ 35” E at ITI Srinagar (A) and Maletha (B) (Fig 1).

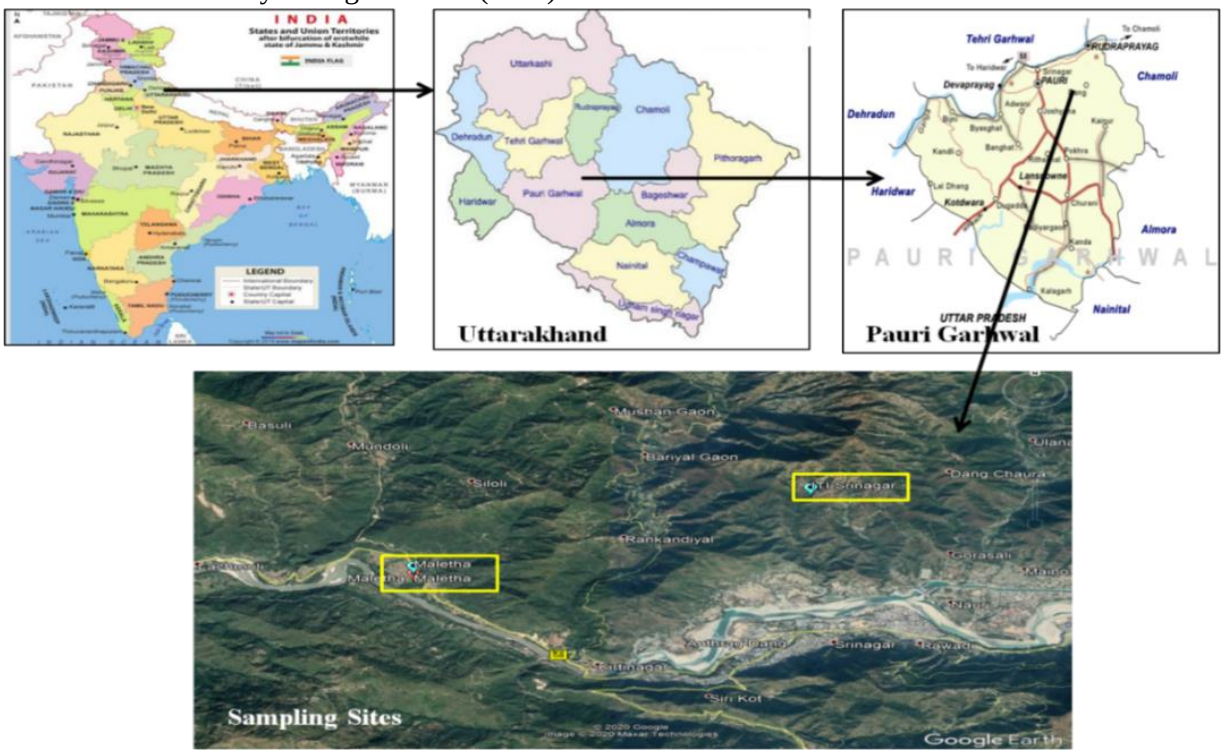

Figure 1: Location of sampling sites

Sampling Design and Analysis

Drifting sample of water mites were collected by using 1 m^2 diel drift net on substratum for repeated two-hours periods over 24 hours at each sampling site. All collected aquatic mites were preserved in 70% ethanol in the field and later on were transferred to Koenike’s fluid and dissected. Species identification was done with the help of various keys (Cook, 1967, 1974; Prasad, 1974; Gerecke, 2003; Kumar et.al., 2006, 2007; Pesic and Panesar, 2008; Pesic et.al., 2007a,b; 2019a,b; 2020a,b).

Result

Data related to the drifting density and diversity is presented the Table 1. Altogether 743 water mite individuals belonging to 25 species were

collected during the study. These 25 species belonged to 9 families (Torrenticolidae, Sperchontidae, Hygrobatidae, Aturidae, Arrenuridae, Feltriidae, Lebertiidae, Limnesiidae and Unionicolidae). It was found that drift density and diversity of aquatic mites were recorded highest during the month of February (130) and lowest during August (06). The maximum drift individual number were recorded 90 of *Hygrobates fluviatilis* and minimum of *Feltria rubra* with only 05 individuals.

Diel drift pattern of aquatic mites from January 2018 to December 2018 are presented in the Table 2. The observed pattern of diel periodicity of several aquatic mite species (*Torrenticola tetraporella, Torrenticola semisuta, Monatractides oxystomus, Monatractides tuzovskyi, Sperchon clupeifer, Atractides nodipalpis, Atractides indicus, Atractides garhwali, Hygrobates gangeticus, Hygrobates fluviatilis, Kongsbergia indica, Kongsbergia rucira, Aturus fontinalis, Arrenurus kurtvietsi, Arrenurus fontinalis, Limnesia lembangensis* and *Unionicola affinis)* drifts were during day time, few species (*Atractides panesari, Feltria gereckei, Feltria rubra* and *Lebertia glabra* during night and some species (*Torrenticola turkestanica, Monatractides garhwalensis, Sperchon indicus and Sperchon garhwalensis)* recorded a mixed drift pattern.

Discussion

During the course of whole study, a total number of 25 species were recorded. The maximum density of drifting mite individuals were noticed in February (130) and the lowest drift was observed in July (06) in the snow fed river Alaknanda. Graesser (1988) also reported decreasing drift densities with increasing discharge in flood-prone streams in south Westland, New Zealand. Chaston (1968), noticed maximum drift density in summer due to insect emergence as most life cycle stages can be found in the drift. Chaston (1968) has opined that correlations of feeding and drift may be due to the fish foraging. The drift periodicity differs among sites that varied in Ichthyofaunal composition (Elliott, 1970). Bahuguna et.al. (2019) also reported fish predation and invertebrate drift relation in the Kyunja Gad stream.

Table 1: Drifting Density and diversity of aquatic mites in snow fed river Alaknanda during January 2018 to December 2018

s.no	Name of species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total No. of individuals
1.	**Family – Torrenticolidae Piersig, 1904**													
	Genus - *Torrenticola* Piersig, 1904													
a	*Torrenticola turkestanica*	06	06	04	01	01	03	00	01	01	06	04	06	39
b	*Torrenticola tetraporella*	01	06	05	04	01	01	01	00	01	03	01	01	25
c	*Torrenticola semisuta*	05	05	06	04	04	05	00	01	01	04	04	06	45
	Total	**12**	**17**	**15**	**09**	**06**	**09**	**01**	**02**	**03**	**13**	**09**	**13**	**109**
	Genus - Monatractides K.Viets, 1926													
d	*Monatractides garhwalensis*	08	09	07	04	06	04	00	03	04	04	07	09	65
e	*Monatractides oxystomus*	04	06	04	01	01	01	00	00	01	01	04	01	24
f	*Monatractides tuzovskyi*	07	08	06	04	01	04	01	00	01	01	01	06	40
	Total	**19**	**23**	**17**	**09**	**08**	**09**	**01**	**03**	**06**	**06**	**12**	**16**	**129**
2.	**Family – Sperchontidae Thor, 1900**													
	Genus - Sperchon Kramer, 1877													
g	*Sperchon indicus*	05	08	04	06	04	06	01	00	04	06	05	06	55
h	*Sperchon clupeifer*	01	07	04	00	00	01	00	00	01	00	01	04	19
i	*Sperchon garhwalensis*	04	06	04	01	01	00	00	00	01	01	00	04	22
	Total	**10**	**21**	**12**	**07**	**05**	**07**	**01**	**00**	**06**	**07**	**06**	**16**	**96**
3.	**Family - Hygrobatidae Koch, 1842**													
	Genus - Atractides Koch, 1837													
j	*Atractides nodipalpis*	08	07	03	07	06	00	00	00	01	02	03	04	41
k	*Atractides indicus*	04	02	01	00	02	00	00	00	00	01	01	04	15
l	*Atractides garhwali*	06	04	01	01	01	01	01	00	01	04	01	04	25
m	*Atractides panesari*	02	04	00	00	01	00	01	00	00	01	00	00	09
	Total	**20**	**17**	**05**	**08**	**10**	**01**	**02**	**00**	**02**	**08**	**05**	**12**	**90**
	***Genus - Hygrobates* Koch, 1837**													
n	*Hygrobates gangeticus*	04	04	04	01	00	01	01	00	00	00	01	00	16
o	*Hygrobates fluviatilis*	10	14	08	12	08	06	05	01	04	06	07	09	90
	Total	**14**	**18**	**12**	**13**	**08**	**07**	**06**	**01**	**04**	**06**	**08**	**09**	**106**
4.	**Family - Aturidae Thor, 1900**													
	Genus - Kongsbergia Thor, 1899													
p	*Kongsbergia indica*	04	06	04	04	06	00	00	00	00	01	01	04	30
q	*Kongsbergia rucira*	01	04	00	01	04	01	01	00	01	04	06	04	27
	Total	**05**	**10**	**04**	**05**	**10**	**01**	**01**	**00**	**01**	**05**	**07**	**08**	**57**
r	*Genus – **Aturus*** **Kramer,1875**													
	Aturus fontinalis	**02**	**03**	**01**	**00**	**00**	**00**	**00**	**00**	**00**	**00**	**00**	**01**	**07**
5.	**Family - Arrenuridae Thor, 1900**													

	Genus - Arrenurus Dugès, 1834													
s	*Arrenurus kurtvietsi*	04	05	04	06	01	04	01	00	01	04	01	04	35
t	*Arrenurus fontinalis*	04	01	01	04	01	06	01	00	00	01	04	01	24
	Total	**08**	**06**	**05**	**10**	**02**	**10**	**02**	**00**	**01**	**05**	**05**	**05**	**59**
6.	**Family - Feltriidae K.Viets, 1926**													
	Genus - Feltria Koenike, 1892													
u	*Feltria gereckei*	04	03	01	02	01	01	01	00	00	04	01	01	19
v	*Feltria rubra*	02	01	00	02	00	00	00	00	00	00	00	00	05
	Total	**06**	**04**	**01**	**04**	**01**	**01**	**01**	**00**	**00**	**04**	**01**	**01**	**24**
7.	**Family - Lebertiidae Thor, 1900**													
	Genus - Lebertia Neuman, 1880													
w	*Lebertia glabra*	**06**	**01**	**04**	**04**	**04**	**04**	**06**	**00**	**06**	**04**	**01**	**04**	**44**
8.	**Family - Limnesiidae Thor, 1900**													
	Genus - Limnesia Koch, 1836													
x	*Limnesia lembangensis*	**04**	**06**	**01**	**01**	**01**	**00**	**00**	**00**	**00**	**00**	**01**	**01**	**15**
9	**Family - Unionicolidae Oudemans, 1909**													
	Genus - Unionicola Haldeman, 1842													
y	*Unionicola affinis*	**01**	**04**	**00**	**00**	**00**	**00**	**01**	**00**	**00**	**00**	**00**	**01**	**07**
	Total no of individual species	**107**	**130**	**77**	**70**	**55**	**49**	**22**	**06**	**29**	**58**	**55**	**85**	**743**

Table 2: Diel Drift pattern of aquatic mites in snow fed river Alaknanda

S.N	Name of species	Snow fed Alaknanda River											
A	Periodicity	Nocturnal drift					Diurnal drift						
B	Sampling Time	4.15.pm to 6.15pm	6.30pm to 8.30pm	8.45pm to 10.45pm	11.0pm to 1.30am	1.45am to 3.45am	4.0am to 6.00am	6.15am to 8.15am	8.30am to 10.30am	10.45am to 12.45pm	1.0am to 3.0pm	3.15pm to 4.15pm	Total no. of ind. mites drift in whole year
C	Category	Early evening	Late evening	Night period	Night period	Night period	Early morning	Late morning	Day Period	Day Period	Day Period	Day Period	
1	*Torrenticola turkestanica*	3	2	3	5	2	5	6	4	3	4	2	39
2	*Torrenticola tetraporella*	0	0	0	0	0	2	6	8	4	3	2	25
3	*Torrenticola semisuta*	0	0	0	0	0	5	7	9	11	9	4	45
4	*Monatractides garhwalensis*	4	6	10	5	4	6	5	7	5	6	7	65
5	*Monatractides oxystomus*	0	0	0	0	0	1	1	6	7	5	4	24
6	*Monatractides tuzovskyi*	0	0	0	0	0	5	9	11	6	4	5	40
7	*Sperchon indicus*	4	7	6	4	5	2	7	4	10	2	4	55
8	*Sperchon clupeifer*	0	0	0	0	0	0	6	10	1	1	1	19
9	*Sperchon garhwalensis*	1	2	2	3	1	1	2	4	2	3	1	22
10	*Atractides nodipalpis*	0	0	0	0	0	2	6	12	14	5	2	41
11	*Atractides indicus*	0	0	0	0	0	0	2	2	8	3	0	15
12	*Atractides Garhwali*	0	0	0	0	0	3	5	7	9	1	0	25
13	*Atractides panesari*	0	1	2	4	2	0	0	0	0	0	0	9
14	*Hygrobates gangeticus*	0	0	0	0	0	4	5	6	1	0	0	16
15	*Hygrobates fluviatilis*	0	0	0	0	0	7	12	21	19	17	14	90
16	*Kongsbergia indica*	0	0	0	0	0	2	5	3	14	2	4	30
17	*Kongsbergia rucira*	0	0	0	0	0	3	2	13	4	4	1	27
18	*Aturus fontinalis*	0	0	0	0	0	0	3	2	1	1	0	7
19	*Arrenurus kurtvietsi*	0	0	0	0	0	5	6	11	7	4	2	35
20	*Arrenurus fontinalis*	0	0	0	0	0	1	5	8	3	4	3	24
21	*Feltria gereckei*	2	4	6	5	2	0	0	0	0	0	0	19
22	*Feltria rubra*	0	3	2	0	0	0	0	0	0	0	0	5
23	*Lebertia glabra*	3	5	17	14	5	0	0	0	0	0	0	44
24	*Limnesia lembangensis*	0	0	0	0	0	1	2	5	6	1	0	15
25	*Unionicola affinis*	0	0	0	0	0	0	2	2	1	1	1	7
	Total	17	30	49	40	21	55	104	155	136	80	57	743

In the present work, diel periodicity of aquatic mites drift showed a distinctive pattern with high drift density values by dawn and decrease in drift through dusk.

Atractides panesari, Feltria gereckei, Feltria rubra and *Lebertia glabra* exhibited nocturnal drift while species *Torrenticola turkestanica, Monatractides garhwalensis, Sperchon indicus and Sperchon garhwalensis* exhibited both diurnal and nocturnal drift whereas rest of the all species *Torrenticola tetraporella, Torrenticola semisuta, Monatractides oxystomus, Monatractides tuzovskyi, Sperchon clupeifer, Atractides nodipalpis, Atractides indicus, Atractides garhwali, Hygrobates gangeticus, Hygrobates fluviatilis, Kongsbergia indica, Kongsbergia rucira, Aturus fontinalis, Arrenurus kurtvietsi, Arrenurus fontinalis, Limnesia lembangensis* and *Unionicola affinis e*xhibited diurnal drift during the course of the study.

This characteristic diel drift pattern had been explained in relation to different ecological conditions like visual predation, mites life histories and physico-chemical responses. It is assumed that it is an adaptation to avoid predation by visual macro predators such as carnivorous fish fries, crabs and macrozoobenthos. Our observations corroborates with similar other studies that have correlated drift with predator presence (Allan, 1978 and Flecker, 1992).The diurnal drift periodicity and high aquatic mites drift density might reflect interspecific relations between invertebrates and macro consumers. According to predation hypothesis by Flecker (1992) and Allan and Castillo (2007), benthic invertebrates

would be more active during night hours due to the presence of diurnal predators.

Drift sampling techniques provided important and often complementary information on stream mites diversity. The present work showed distributional as well as drifting pattern of mites in snow fed river Alaknanda. As water mites act as good bio indicators; the appearance of *Hygrobates fluviatilis* stipulated that the water quality was degraded due to pollution or human activity as this species is considered as one of the pollution tolerant species.

Acknowledgements

The First Author (PB) gratefully acknowledges the financial assistance rendered by Science and Engineering Research Board (SERB) as a major Project F. No.–ECR/2016/001291.

References

Allan, J. D. (1978). Trout predation and size composition of stream drift. *Limnology Oceanography*. 23: 1231-1237.

Allan, J. D. and Castillo, M. M. (2007). *Stream ecology*. *Structure and function of running waters*. 2nd edition, Dordrecht Springer, pp.436.

Bahuguna, P., Negi, S. and Dobriyal, A. K. (2019). Density and diversity of aquatic mites in a spring fed stream of Garhwal Himalaya, India. Journal of Mountain. Res. Vol. 14(2): 55-59.

Bahuguna, P., Joshi, H.K. and Kumar, K. (2019). A report on drifting behaviour of odonata (aquatic insects) in Kyunja Gad, a spring fed tributary of River Mandakini, Chamoli Garhwal, Uttarakhand. *Journal of Mountain Research* Vol. 14(2): 63-67.

Bahuguna, P., Rana, K. K., Rayal, R. and Khanduri, N. C. (2020). Density and diversity of aquatic mites in a glacier-fed River Alaknanda from Garhwal Central Himalaya, India. *Uttar Pradesh Journal of Zoology*, Vol.41(10): 1-8.

Bahuguna, Pankaj and Dobriyal, A. K. (2020). Population structure and drifting pattern

of aquatic mites in Randi Gad, a tributary of River Alaknanda in Garhwal Himalaya, Uttarakhand, India. *J. Mountain. Res.* Vol. (15): 63-70.

Biesiadka E. and Kowalik W. (1991). Water mites (Hydracarina) as indicators of trophy and pollution lakes. In: Dusbabek F, Bukva V. eds, *Modern Acarology*. Academia Prague, V, 1:475–481.

Chaston, I. (1968). Endogenous activity as a factor in invertebrate drift. *Arch. Hydrobiology* 64, 324-34.

Cicolani, B. and Di Sabatino, A. (1991). Sensity of water mites to water pollution. In: Dusbabek F, Bukva V. eds, *Modern Acarology*. Academia Prague, V, 1:465–474.

Cook, D. R. (1967). *Water mites from India.* Memoirs of the American Entomological Institute, *9: 1–411*.

Cook, D. R. (1974). *Water mite genera and subgenera*. Memoirs of the American Entomological Institute, 21: 1-860.

Elliott, J. M. (1970). Diel changes in invertebrate drift and the food of trout *Salmo trutta* L. *Journal of Fish Biology*.2: 161-165.

Flecker, A. S. (1992). Fish predation and the evolution of invertebrate drift periodicity, evidence from Neotropical streams. *Ecology*. 73: 438-448.

Gerecke, R. (2003). Water mites of the genus Atractides Koch, 1837 (Acari: Parasitengona: Hygrobatidae) in the western Palaearctic region: a revision. *Zoological Journal of the Linnean Society*, 138: 141-378.

Graesser, A. K. (1988). Invertebrate drift in three floodprone streams in South Westland, New Zealand. *Verhandlungen Internationale Vereinigung fur theoretische und angewandte Limnologie*, 23: 1422-1426.

Kowalik, W. and Biesiadka, E. (1981). Occurence of water mites (Hydracarina) in the river Wieprz polluted with domestic-industry sewage. *Acta Hydrobiologica* 23:331–348.

Kumar, N., Kumar, K., Kumar, S. and Pesic, V. (2006). Monatractides tuzovskyi sp. nov. (Acari: Torrenticolidae), a new water mite species from the Garhwal Himalayas (India). *Acarina*, 14(2): 81–83.

Kumar, N., Kumar. K. and Pesic, V. (2007). Two new species of Sperchon Kramer (Acari: Hydrachnidia: Sperchontidae) from the Garhwal Himalayas (India). *Systematic and Applied Acarology*, 12: 31–36.

Martin, P. and Brinkmann, R. (2003). Zur Eignung der Wassermilben als Bioindikatoren in Fließgewässern-vorläufige Befunde aus Baden-Württemberg. Tutzing: *Deutsche Gesellschaft für Limnologie (DGL)* – Tagungsbericht 2002 (Braunschweig), : 413–418.

Martin, P. and Brunke, M. (2012). Faunal typology of lowland springs in northern Germany. *Freshwater Science* 31:542–562.

Namdari, R., Vafaei, Shoushtari R. and Shakarami, J. (2014). Review article: Faunistic survey and distribution of water mites (Acari: Hydrachnida) in Khorramabad district. *Journal of Entomological Research*, Vol. 5: 403 - 413.

Negi, S., Bahuguna, P. and Dobriyal, A.K. (2021b). Drifting behaviour of aquatic mites and regulating ecological parameters in Khankra gad stream, a spring fed tributary of Alaknanda River, Rudraprayag Garhwal, Uttarakhand,

India. *J. Mountain. Res.* Vol. 16(1): 61-75.

Negi, S., Dobriyal, A. K. and Bahuguna, P. (2021a). Biodiversity and monthly density fluctuations of water mites in Khankra gad, a spring-fed tributary of river Alaknanda, Pauri Garhwal, Uttarakhand. Journal of Applied and Natural Sciences. Vol.13 (1): 258-267.

Pesic, V. and Panesar, A. (2008). Studies on water mites (Acari: Hydrachnidia) from the Himalayas, I. The water mites genus Feltria Koenike, with description of eight new species. *Zootaxa*, 2119:1-22.

Pesic, V., Kumar, N. and Kumar, K. 2007a. Two new species of water mites of the family Hygrobatidae (Acari: Hydrachnidia) from the Garhwal Himalayas (India). *Systematic and Applied Acarology*, 12: 161–166.

Pesic, V., Kumar, N. and Kumar, K. 2007b. A new species of Monatractides (Acari: Hydrachnidia: Torrenticolidae) and new records of other torrenticolid water mites from the Garhwal Himalayas (India). *Systematic and Applied Acarology*, 12(3–4): 205–212.

Pesic, V., Smit, H. and Bahuguna, P. (2019a). New records of water mites (Acari: Hydrachnidia) from the Western Himalaya with the description of four new species. *Systematic and Applied Acarology*, 24(1): 59– 80.

Pesic, V., Smit, H. and Bahuguna, P. (2019b). New records of water mites (Acari: Hydrachnidia) from the Western Himalaya and description of three new species from Asia. *Systematic and Applied Acarology*, 24(10): 1868–1880.

Pesic, V., Smit, H. and Bahuguna, P. (2020a). A new species of *Kongsbergia* from the Western Himalaya with a key to the species of the genus of India (Acari: Hydrachnidia). *Ecologia Montenergrina*, 27: 35-38.

Pesic, V., Smit, H., Negi, S., Bahuguna, P. and Dobriyal, A. K. (2020b).Torrenticolid water mites of India with description of three new species (Acari: Hydrachnidia, Torrenticolidae). *Systematic & Applied Acarology* 25 (2):255-267.

Prasad, V. (1974). *A catalogue of mites of India.* Indra Acarology Publishing House, Ludhiana, 1-320pp.

Wolcott H. (1905). A Review of the Genera of the Water-Mites. *The American Microscopical Society*, Vol. 26: 161-243.

Zawal A. (1992). Water mites (Hydracarina) of three small lakes in the neighbourhood of Poznań. *Acta Hydrobiologica* 34: 157-174.

Zawal A. (2003). The role of insects in the dispersion of water mites. *Acta Biologica* Universitatis Daugavpilensis 3:9–14.