

Locusts of the Genus *Ecliphleps* Serg Tarb. Distributed in High Mountainous Rangelands of Mongolian Altai and Biological Control of Them

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Abstract – Locusts belonging to the genus *Ecliphleps* Serg Tarb, which are distributed in the valleys of Mongolian Altai range and its branch mountains, decreases plant production rate of rangelands by 1.5 to 2.4 centner per ha in an year the aridity index decreased slightly below 0.005. It becomes pre-booster of rangeland desertification and natural loss of livestock on these areas decreases by 20.1 to 25%. Although locusts are harmful to rangelands, their body contains 16 non-essential and essential amino acids and vitamins B and C. chemical composition and nutritive values of dried tissues and organs of locust were measured. Contents of minerals in the body of locust are shown citing from publications of some authors. Analysis of our samples in the laboratory of nutrition at Research institute of animal husbandry in 2012, demonstrated that one kg locusts of the genus *Ecliphleps* Serg Tarb has 1.14 feed unit nutritive value, 395 g/kg digestible protein and 3405 kcal/kg metabolizable energy, and contains 8.3% moisture, 49.15% proteins, 31.35% non-nitrogen extractable matters (NEM) and 7% fibers. Every chicken kept daily for 11 hours on open pasture lands drinks 250 to 300 g water and eats 300 to 350 g or 3000 to 4500 individuals of locusts of the genus *Ecliphleps* Serg Tarb and it was determined by estimating the counts of locusts eaten daily by 10 chickens under the control. The present study revealed that hens with decreased egg production and to be shifted for meat production were easily adapted to open pasture area and after feeding with locusts only for 60 to 70 days the hens had more active movements, restored external appearance, and increased body weight by 1.0 to 1.2 kg. It has been established that technical outcome of biological control using chicken against locusts ranged from 88.4% to 96.4%.

Keywords – *Ecliphleps* Serg Tar, Hen, Distribution, Biological Control.

I. INTRODUCTION

A. Expedition of commission on Mongolia at Academy of Sciences of Russia and former Soviet Union during late 19th and early 20th centuries played an important role in the studies of locusts of the genus *Ecliphleps* Serg Tar, adapted to rangelands of some areas of Bayan-Ulgii, Khovd and Uvs aimags, situated across Mongolian Altai ranges in northern west of Mongolia and high mountains along Gobi-Alta mountains. S.P.Tarbinsky and G.Y.Bey-Bienko analyzed materials on insects collected by the expedition, study on locust of the genus *Ecliphleps* Serg Tar was conducted, S.P.Tarbinsky (1933) discovered this genus and included into taxonomic unit. The first definition of the species *Ecliphleps bogdanovi* was made as a scientific contribution. G.Y.Bey-Bienko (1933)

made new definition and recorded the species *Ecliphleps glacialis*. L.L.Mistshenko (1951) made the first definitions of species *E. similis* and *E. confinis*, and subspecies *E. confinis confinis* and *E. confinis levis* belonging to above genus from insects collected in western Mongolia. L.Chogsomjav investigated and recorded more than 130 species of order Orthoptera in Mongolia. As a result of sending by the author the collection of locusts of the genus *Ecliphleps* Serg Tar, distributed in western Mongolia to L.L.Mistshenko, Zoology Institute, Academy of sciences of former Soviet Union, the species belonging to the genus *Ecliphleps* Serg Tar, including *E.bogdanovi* Serg Tarb., *E.tarbinskii* Oristch., *E.kerzhneri* L. Mistshenko, *E.confinis* L., *E.confinis levis* L.Mistsh., *E.carinata* L. Mistsh., and *E.similis* L. Mistsh were described in the world entomological treasury as the endemic species in Mongolia. B.Batkhuayg investigated insects of order Orthoptera by stationary survey methods in the territories of Bayan-Ulgii and Khovd aimags in 1991-1996, and established distributions of locusts and relict katydid, including 56 species of 15 genera belonging to two families of Caelifera suborder, and 12 species of 10 genera belonging to two families of Ensifera suborder. B. As a measure of controlling harmful locusts of rangelands by chemical method of plant protection, the bait with sodium salt was distributed by expedition led by A.V.Vitovtov on 2000 ha rangeland along the northern border in 1926, and this measure organized in the country was the start of plant protection activities. As well, expedition for investigation harmful locusts and rodents of rangeland and controlling them, which was led by K.A.Kazanskii, used 1248 kg toxic bait on 2382 ha rangeland along the northern border and territory of Khentii aimag in 1928 and 1929. In Mongolian Altai in northern west areas and central regions of Mongolia, hexachloran isomers of chlorine containing compounds were used for controlling harmful locusts in the rangelands in 1965-1989.

Aim of the study: The study aimed to investigate importance and technical outcome of biological method of plant protection measure by using birds such as hens and rosy starling, which have no adverse effects on ecology for controlling locusts of the genus *Ecliphleps* Serg Tar.

II. MATERIALS AND METHODS

In the study, 50 to 1000 hens, which ceased to produce eggs, were kept on open pastures, where distribution was

dense and infestation foci of locusts of the genus *Eclipophleps* Serg Tar was broader, for 11 hours during daytime and in the tent, which had battery cages of hens and covered with cotton padded cloth during night time in 2004, 2006 and 2008. Locust distribution and infestation foci were estimated by 50 and 100 swinging of standard insect catching net and using Petluc box method. Nutritive value and amino acid contents of locusts were measured according to classic zootechnical method, which is used to analyze plant compositions in RIAH, contents of some minerals were determined by using atomic absorption spectrometer (Varison AAC-10) and ash was measured by weighing method. Number of locusts eaten by hens or technical outcome was determined by method of I.Y.Polyakov.

III. RESULTS

Measures of controlling locusts of the genus *Eclipophleps* Serg Tar distributed in rangelands were implemented by keeping hens on the pastures in Duut, Buyant, Must, Munkhkhairkhan and Tsetseg soums of Khovd from June to the first decade of August yearly during 2004, 2006 and 2008. Because rural herders in Mongolia knew the nutritive values of locusts and use it for curing animals diseases feeding since ancient time, nutritive values of locusts of the genus *Eclipophleps* Serg Tar were compared to those of bone and meat flour (Figure1). It was demonstrated that contents of six essential amino acids, including histidine, phenylalanine and threonine were two times greater than contents of nonessential amino acids.

Table 1. Nutritive values of locusts of the genus *Eclipophleps* Serg Tar.

Д/д	Amino acids (non-essential, essential)	Feed from locusts only		Bone flour
		Contents of proteins 49,15/100	Result of analysis 491,5 g/kg	Amino acids of flour (g/kg) M.F.Tomme
1.	Cysteine (ne)	3,72	18,3	7,3
2.	Lysine (e)	5,52	27,1	29,1
3.	Histidine (e)	5,86	28,8	12,5
4.	Arginine (ne)	3,79	18,6	33,1
5.	Aspartic acid (ne)	6,99	34,3	54,7
6.	Serine (ne)	5,85	28,7	10,5
7.	Glutamic acid (ne)	8,69	42,7	54,7
8.	Glycine (ne)	8,27	40,6	43,2
9.	Threonine (e)	8,69	42,7	18,1
10.	Alanine (ne)	4,91	24,1	21,1
11.	Proline (e)	5,86	27,9	-
12.	Tyrosine (ne)	2,28	11,2	10,0
13.	Methionine (e)	5,49	26,7	11,0
14.	Valine (e)	3,93	19,3	23,1
15.	Phenylalanine (e)	4,73	23,2	17,1
16.	Leucine (e)	9,84	48,4	45,6

Table. Chemical compositions of organs and tissues of locusts of the genus *Eclipophleps* Serg Tar, (%), 2010

The genus of locusts	Sampling places	Moisture	Dry matter (%)	Ash (%)	Organic matter (%)	Proteins (%)	Fat (%)	Carbohydrates (%)	Fiber (%)	Alkali detergent fiber (%)	Acid detergent fiber (%)	Potassium (g/kg)	phosphorus (g/kg)	Metabolizable energy (MJ)
<i>Eclipophleps</i> Serg. Tarb	Ulaangovi, 15.June.2009	0	100	5.6	94.4	53.6	4.8	36.1	18.4	35.6	36.8	5.1	8.3	15.3

Chemical compositions of locusts organ and tissues were analyzed as described in MNS 4961-66-1995 and determination of its nutritive value revealed they are good quality feed with high contents of proteins (53.6% in absolute dry). Contents of moisture, fat, proteins, NEM,

and fiber are 8.3%, 4.2%, 49.15%, 31.35% and 7% respectively. Nutritive value of each kilogram locusts is 1.14 feed unit, digestible proteins are 395 g/kg and metabolizable energy is 3405 kcal/kg.

Table 3. Trace minerals contained in organs and tissues of locusts of the genus *Eclipophleps* Serg. Tarb. (mg/kg), 2012

No	Chromium (Cr)		Cobalt (Co)		Iron (Fe)		Zinc (Zn)		Copper (Cu)		Manganese (Mn)	
	AAC	mg/kg	AAC	mg/kg	AAC	mg/kg	AAC	mg/kg	AAC	mg/kg	AAC	mg/kg
1	0,010	0,0725	0,10	1,137	0,076	11,9	0,484	7,6	0,13	5,98	0,035	2,233
2	0,020	1,145	0,12	1,365	0,106	16,67	0,582	9,2	0,14	6,44	0,042	2,677
Average	0,015	0,108	0,11	1,251	0,091	14,28	0,533	8,4	0,135	6,21	0,038	2,455

As cited from publications on contents of minerals of locust body by other authors: Ash measured by Ya.Ganbold (1993) is 6.5%, Ch.Avdai (1990) 7.00%, B.Tsend 7.64%, while averages of minerals, including sodium, potassium, calcium, magnesium, iron, manganese, copper, zinc, and cobalt were 228 mg/kg, 319 mg/kg, 975 mg/kg, 57 mg/kg, 381 mg/kg, 23 mg/kg, 8.9%, 142 mg/kg and 0.32 mg/kg respectively. Because locusts of the genus *Eclipophleps* Serg. Tarb. and locusts of the other genera are rich in proteins, fat, carbohydrates, vitamins, minerals and trace elements, they become raw materials for human and veterinary drugs and good quality, cheap feed resources in the nature. Therefore, culled and lean hens to

be shifted to meat production were used for biological control of harmful to rangeland and non-flying locusts of the genus *Eclipophleps* Serg. Tarb. in order to use such resource for the animals in its need. As well, in the experiments using locusts as supplemental feed for hens in battery cages of stationary poultry farming, the following results were obtained: Each of both experimental and control groups had 20 hens and complete, combined feed as main feed ration and locusts in 0.3% as proteinaceous feed supplement were used for feeding laying, mature hens in battery cages of stationary farming (according to S.Gerelee and our study).

Table 4. Changes of live weights of laying hens (n=20)

Groups	n	Live weight		Daily weight gain, g	Relative growth rate, %
		Wo	W1		
Control	20	1646,0±6.4	1742.25±6.6	2.7	5.9
Locusts	20	1633,8±6,1	1727,2±5,8	2,6	5,7

Table 5. Egg production by laying hens in experimental group

Groups	n	Egg production									
		Week 1		Week 2		Week 3		Week 4		Week 5	
		n	%	n	%	n	%	n	%	n	%
Control	20	120	85,7	121	86,4	123	87,8	123	87,8	126	90
Locusts	20	128	91,8	128	91,8	128	91,8	131	93,58	132	94,1

Table 6. Weight of eggs of experimental group hens

Groups	No.of hens	Week 1	Week 2	Week 3	Week 4	Week 5
Control	20	58,04	58,1	58,2	59,7	59,4
Locusts	20	59,2	59,4	60,0	60,6	60,5

Above table shows egg weights of hens fed locusts as supplement were greater than control group hens or they ranged from 57.6 to 62.3 g. Demonstration experiments with pastured hens in the study were performed by using 50 to 500 hens in Duut soum of Khovd aimag during June of 2004, 2006 and 2008. One ha pasture, where locusts of

the genus *Eclipophleps* Serg. Tarb. distributed to be 26.4 individuals density per one square meter area, was fenced and when above mentioned hens were kept on the pasture, they fully ate all locusts within 40 minutes and technical outcome accounted for 96.8%.

Table 7. Experimental result: Biological control of locusts *Eclipophleps* in Duut soum, Khovd aimag.

Genus of locust	Number of plot	Locations								
		Shar jalga		Bayanbulag		Shagdariin bulag		Yalaatiin bulag		
				Adag	Ekh	Shar khad	Khar khad	Ekh	Dund	Adag
		18.June	23.June	24.June	9.July	19.June	31.June	6.July	7.July	14.July
<i>Eclipophleps</i> Serg. Tarb	1	120	15	125	5	195	12	15	173	1
	2	108	9	133	10	273	15	10	215	2
	3	97	11	177	7	249	21	13	196	6
	4	112	19	141	13	95	10	21	158	4
	5	125	11	193	7	119	7	11	210	3
Per square meter		449	52	615	34	745	25	56	842	13
Technical outcome		-	88.4	-	94.5	-	92.8	-	-	96.4

500 poultry Pastured:

- Poultry can eat 1750 locusts per day;
- To save cost of feed production by 245.0-280.0 thousand ton (poultry pastured for 70-80 days).
- Use of natural protein resource by producing egg and poultry meat . In the present study, 50 to 500 individual hens to be shifted for meat production were kept on the pastures from June to August in 2004-2008 in the territories of Duut, Must, Buyant and Tsetseg soums of Khovd aimag to control locusts by biological method. As well, rosy starling (*Sturnus roseus* L.,) a migratory bird eats locusts only was studied and its migration timing or arrival and leaving, patterns and topography of nesting and flocking areas, and biological characteristics were investigated at stationary points and distribution studied by trip route method.
- We conducted observation on distribution of Rosy starling (*Sturnus roseus* L.,) from 2008 to 2010 in the Khovd and Govi-Altai aimags.
- During mid May, a flock of Rosy starling was migrating (12-1500 number) in the Must, Tsetseg, Munkh-Khairkhan, Zereg and Buyant soums of Khovd aimag and the Bugat, Tonhil souma of the Govi-Altai aimag. This bird is found to nest on rock cliff and stone fence of livestock.
- To lay 2 to 4 eggs.
- To habitat in above places for about 45-60 days.
- To migrate back from mid August.
- A flock of rosy starling is able to eat locusts within 20 km radius.

IV. CONCLUSIONS

1. Eleven genera of *Eclipophleps* *Serg. Tarb.* locust are distributed in Bayan-Ulgii, Khovd, Uvs, Govi-Altai, Bayankhongor, Umnu-Gobi and Tuv aimags of Mongolia.
2. Density of *Eclipophleps* *Serg. Tarb.* locust was 26.4 to 73.8 per 1 square meter (measured by *petluc* box method) and 449 to 745 locusts were caught by insect sweep net (measured by).
3. *Eclipophleps* *Serg. Tarb.* locust is broadly distributed in Khangai branch mountains, Tsagaan Khairkhan and Togtokhiin Shil mountains and pasture plant production decreased by 150-250 kg/hà due to locusts.
4. We analyzed and identified 16 amino acids from *Eclipophleps* *Serg. Tarb.* that is distributed in Mongol-Altai mountains.
5. Controlled technical outcomes are 88.4 to 96.4 percent when 500 chickens were kept for 1-5 days in the pasture. Density of locusts was 84 to 615 numbers per square meter.
6. Chickens ate 5290 locusts in average per day (7 to 20 hour).

7. Feeding, distribution and biological and ecological features of a migratory bird Rosy starling (*Sturnus roseus* L.,) were investigated in the present study.

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