

MECHANICAL CONTROL OF BLUE PINE DEFOLIATOR *BISTON*  
*REGALIS* MOORE (GEOMETRIDAE, LEPIDOPTERA) IN MURREE  
AND AZAD KASHMIR

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**Introduction:** For the first time *Biston regalis* Moore appeared in epidemic form in the blue pine (*Pinus wallichiana*) forests of Murree and Azad Kashmir in August, 1980, causing defoliation over about 3175 acres. The insect has an annual life cycle with moths emerging in May. These have brownish grey wings with thick black and white strips, exhibiting close mimicry with tree trunks. They hide under plant debris during day and become active at dusk and dawn. Moths spend the night sitting on tree trunks and on fresh needles.

Mating starts immediately after emergence and is performed with the male and the female facing in opposite directions. One male fertilizes one female and dies thereafter. Oviposition starts six to eight hours after mating, on needles and crack and crevices of the bark. The female moth fasten two needles together and start egg laying in lines. The eggs of female were counted in laboratory under natural conditions at Azad Kashmir and Murree and were found to range between 571-2735 per female studied average being 1531. In Peshawar laboratories, blackish tiny caterpillars hatched out from 8 to 10 days. The mean maximum temperatures on these dates ranged from 37°C to 40°C, mean minimum from 22°C to 25°C with relative humidity from 20-60%.

Caterpillars are light grey in colour, have two distinct horns on the head, and the full-grown measure 10 cm in length. They feed on needles and even on terminal shoots. Their body wall is rough and strong, closely resembling the grey colour of twigs. After feeding till September-October, they hibernate as pupae, 10-15 cm below ground, around tree base and in loose soil all over the forest floor. Pupae range from 2.5 to 3 cm in length and 1 to 1.5 cm in diameter and weight about 1.3 g. The pupal stage is seven months during which they remain immobile under ground. Mechanical control can concentrate on their physical collection and destruction between snowmelt and emergence of moths, from about 25th of March to about the same date in May as haphazard use of toxicants cause natural imbalance, new pest problems and environmental pollution. In the very recent years forest pest managers of the world have reverted to combat insect pests with measures other than the use of toxicants as far as possible after experiencing great threat to the environment and mankind.

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Mechanical control method is the measure which is very simple and most effective remedy in some cases, as bagworms on ornamental trees may be controlled by hand picking. The logging and milling of infested timber and destruction of the slabs containing the broods is often effective in preventing bark beetle outbreaks (Baker 1972). Chalgoza cone borer, *Diorycteria abietella* was controlled by mechanical collection and burning of infested cones bearing hibernating stages of the insect (Chaudhry 1964) in Baluchistan.

**Method and Material:** In December 1980 a detail study was made on demarkation of the affected areas, assessment of pupal population and percent natural mortality of pupae before snow fall. (Chaudhry and Rehman). Maps showing the centre of heavy defoliation and areas of mild attack were prepared. Sampling of pupal population was done in the affected areas with sample intensity of 0.5% and 0.1% in Murree and Azad Kashmir based on the total number of trees in the infested compartments. Number of trees in each affected compartment was taken from the compartment files. The number of kail trees taken for population purpose was fixed according to the sampling intensity for each compartment. Perusal of compartment maps indicated that in almost all the compartments Kacha roads or inspection paths run through the middle of the compartment. The total length of path was divided by the number of sample trees for observation intervals. Kacha road/inspection path running through the compartment was followed in each compartment for pupal population sampling. Pupal population sampling was started from one end of the path/road. Trees were taken alternately at definite intervals on uphill and downhill side at a distance of 200 metres from the path/road. Pupal population sampling was repeated after snow melt with the same sample intensity and method.

On the basis of sampling results, manual labourers were engaged for pupal collection under supervision of respective territorial staff of forest departments. The pupae were found everywhere in the soil and around the tree base during the pupal collection campaign. For assessing the surviving pupae sampling was also made on the area basis after the completion of pupal collection. In area basis sampling one sample plot of one square metre was taken in a line per two acres area. The sampling intensity was increased from 0.1 to 1% at both the places in case of tree base sampling for minimizing the experimental errors.

Wire gauze cages measuring 0.63 x 0.45 x 0.30 m containing the collected pupae were installed in the kail forest surrounding the heavily defoliated areas, so that all parasites emerging from pupae escape to work on the left over progeny of the pest. The wire gauze of cages was of 16 mesh per inch so that moths of the pest do not escape and die within the cage. Each cage contained 15 to 60 kg (12000-48000 pupae). The pupal collection operation was started from 25th March in Murree and 7th April in Azad Kashmir. Collected pupae were purchased daily by staff of the respective Forest Department at rate of Rs. 8 to 20 per kilogram according to local conditions and availability of pupal population.



Table 1

Compartment	Before snow fall				After snow melt			
	Number of trees sampled	Number of pupae collected	Average number of pupae per tree base	Range	Number of pupae collected	Average number of pupae per tree base	Range	
Patriata (Murree)	25	50	741	15	0 - 71	844	16	0 - 43
	27	40	513	13	0 - 51	580	14	0 - 35
	36	45	475	10	0 - 90	430	9	0 - 62
	37/II	125	2626	21	0 - 185	3450	27	1 - 205
Uri (A.K.)	2A	50	555	11	0 - 48	775	15	0 - 60
	2B	10	1175	117	21 - 327	1100	110	16 - 310
Kohala	3	40	1166	29	0 - 242	1203	30	1 - 220
	9	45	689	15	0 - 42	560	12	0 - 36
	15	10	985	98	21 - 228	870	87	15 - 236

**Results and Discussion: Assessment and Control.** In December 1980, the heavily and lightly defoliated areas were mapped and sampled together for pupal population at a sampling intensity of 0.5 and 0.1% based on total trees in infested compartment for Murree and Azad Kashmir respectively. For this purpose the roads and paths running through each forest compartment were used as control lines. Starting from one end of the road/path, alternate trees were taken 200 metres uphill and the same distance downhill of the road/path and pupae counted in a circle of 1 m radius around each sample tree. A sampling of the same intensity was also conducted after the snowmelt in March. The results are shown in Table I.

The data indicate that the pupal population was much higher in Azad Kashmir as compared to Murree, and that there was no significant mortality of pupae during the snowfall.

On the basis of sampling it was estimated that a total population of 2, 3 and 2.5 million pupae was present under the soil at Patriata (Murree), Loon Bagla and Danna (Azad Kashmir, respectively).

As a control measure the following quantities of pupae were collected from 27th March to 20th May, 1981 in Murree and 7th April to 29th April in Azad Kashmir.

Locality/Block	Compartment numbers.	Quantity of pupae collected kg.
Murree/Patraita	25	391
	27	51
	36	340
	37/II	1395
Loon Bagla/Uri (Azad Kashmir)	2A	197
	2B	1930
	3	1769
Danna/Kohala (Azad Kashmir)	9	554
	15	2417
Total		9044

In Murree a total of 2177 kg pupae were collected from the four infested compartments while in Azad Kashmir 3896 kg pupae were collected from Loon Bagla and 2971 kg from Danna.

After the completion of pupal collection, the area was again sampled for



the pupal population from 18th May to 10th June, 1981. As the pupae were found everywhere around the tree base as well as in the ground the sampling was done on the tree basis as well as on area basis. In the tree base samples 1% of the total trees in the infested compartment was taken. Total length of kacha road run through the middle of the compartments was measured and calculated according to the scale of map. The total length of path was divided by the number of sample trees for observations intervals.

The pupal population estimated is as follows:

Compartment		Number of sample trees taken.	Average pupal population per tree base	Range
Patriata	25	97	0.7	0 - 5
	27	81	2.7	0 - 21
	36	88	1.7	0 - 6
	37/II	253	1.0	0 - 22
Uri (A.K.)	2A	400	3.5	0 - 22
	2B	100	2.0	0 - 8
	3	414	1.2	0 - 5
Kohala	9	400	3.0	0 - 20
(A.K.)		420	3.8	0 - 45

The above data indicate that pupal population has been greatly reduced from 110 to 3.8 pupae per sample as a result of the mechanical control operations undertaken during April and May, 1981.

In area basis sampling the total area in acres of the infested compartment was taken from the record files of the respective Divisional Forest Officer. The kacha paths/roads and all the accessible locality were followed for sampling. A sample plot measuring 1 square metre was taken per 2 acre area. The sampled plots were dug out up to 20 cm. depth and the pupal collection was made. The observations recorded are as follows:

Locality	Compartment No.	Pupal population per square metre area		
		No. of samples	Average	Range
1	2	3	4	5
Murree/	25	87	0.5	0 - 3
Patriata.	27	54	1.8	0 - 11
Murree/	36	37	2.0	0 - 10
Patriata.	37/II	177	0.14	0 - 1
Loon Bagla/	2A	250	2.0	0 - 15
Uri (A.K.)	2B	45	4.0	0 - 26
	3	350	3.5	0 - 32
Danna/Kohala	9	150	1.6	0 - 13
(A.K.)	15	341	1.4	0 - 20

On area basis sampling the pupal population was found on an average 0.5 to 4.0 pupae per square metre area.

**Light Trapping:** After emergence of moths, light trapping was attempted by lighting petromaxes in different parts of forest from 28th May to 8th June, 1981 in Patriata (Murree) and from 3rd June to 8th June, 1981 in Azad Kashmir. Moths were not attracted to light. The data recorded on physical collection of moths are as follows:



Locality	Date of collection	Total moths	Male moths	Female moths
1	2	3	4	5
Patriata (Murree)	28-5-81	166	116	50
	29-5-81	314	210	104
	30-5-81	158	94	64
	31-5-81	206	128	78
	1-6-81	300	185	115
	2-6-81	370	218	152
	3-6-81	322	212	110
	4-6-81	610	360	250
	6-6-81	800	455	345
	7-6-81	378	200	178
	8-6-81	300	212	88
Loon Bagla (A.K.)	3-6-81	84	46	38
	4-6-81	303	184	119
	5-6-81	1321	683	638
	6-6-81	1690	888	802
	7-6-81	1838	938	900
	8-6-81	1042	542	500

A total of 10202 moths were collected in which the females were 4531 while male were 5671. The sex ratio has considerably been disturbed by physical operation of manual labourers. As only one male can fertilize one female so the rest of males will not get their mates and die without mating. This will also help in reduction in pest population in the coming active season.

*Natural enemies:* The following were recorded as the insect pests of the pupae: Chalcidae, Megaselia sp. and Ear wig. Lizards and dogs also fed on the larvae and pupae. In addition sparrows and black spotted starlings were also found feeding on the moths.

*Conclusion:* The pupal population before the operation was 10-117 per sample. It was reduced to 0.7 - 3.8 pupae per sample. It was reduced to 0.7 - 3.8 pupae per sample. This reduction in pupal population is more than 80% of the total hibernating pupae which will avoid future threat of any epidemic of blue pine. The population of moths emerging from the surviving pupae is not much to pose any danger of serious infestation. The collection of hibernating pupae 7000 kg (5-6 million) at Azad Kashmir and 2200 kg (1.7 million) in Murree by local labour followed by collection of moths will minimize the occurrence of kail defoliator outbreak in 1981 to a large extent. The parasites emerged from the

pupae caged in forest will help to parasitise and kill the surviving population of the pest.

**Acknowledgements:** The authors are highly grateful to Dr. G.M. Khattak, Ex-Director General, Pakistan Forest Institute, Peshawar for his constant encouragement and valuable guidance during the course of these studies.

The authors express their thanks to Dr. M. Ashraf, Chief Conservator of Forests Punjab, Khwaja Hamidullah, Chief Conservator of Forests Azad Kashmir for their co-operation and support.

Thanks are due to Mr. Ashraf Hafiz, Conservator of Forests Punjab, Mr. Amin Khan, Divisional Forest Officer Murree Forest Division, Mr. Usman, Conservator of Forests Azad Kashmir and Mr. Sardar Khan, Divisional Forest Officer Jehlum Valley Forest Division for their assistance and co-operation during the course of these studies.

Deep gratitudes are expressed to Messers Malik Ihsan, Sub-Divisional Forest Officer Murree, Hayat Khan, Sub-Divisional Forest Officer Azad Kashmir, Raja Siraj, Forester Murree, Sardar Abdur Rashid Khan, M. Ashfaq, Jehangir Khan, Forester Jehlum Forest Division Azad Kashmir for their hard work and dedication during the operations.

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