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Historical Overview of Locusts Attack in India: A Review Article

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ABSTRACT

Locusts are migratory pests. They are always present in the deserts between Mauritania and India with an invasion area of about 30 million sq. km. They fly downwind in search of lush green vegetation and conducive breeding conditions. When the locust infestations are widespread and heavy, that period of one or two years is called plague. In India, Scheduled Desert Area (SDA) provides favourable breeding conditions to Desert Locusts. The SDA extends over an area of 205,785.45 sq. km. in the states of Rajasthan, Gujarat and Haryana. In the year 2020, India is facing the worst Locust Attack since 1993. Locust control operations have been carried out in 1,86,787 hectares area from 11th April 2020 till 19th July 2020 in the states by Locust Circle Offices (LCOs).

Keywords:
Locusts; Scheduled Desert Area; India; Locust Circle Offices

1. Introduction

The locusts have a kilo years long history. The written record of locusts is 3,500 years old, engraved on an ox bone in Oracle Script (Jiaguwen, the earliest Chinese script), asking: "Will locusts appear in the field; will it not rain?" (Guo F, Chen Y, Lu B (1991). Locusts find their mentions in religious texts of all major religions. In the Persian Zoroastrian Vendidad, locust is declared as one of the *Xrafstra* (evil) creations of *Angra Mainya* (Destructive Spirit). The Bible (Old Testament) describes the attack of locusts.[1] The Book of Nahum (Chapter 3; Verse 15) states the fact that locusts increase their numbers rapidly[2], The Book of Deutronomy (Chapter 28; Verse 42) says that the swarms of locusts will take over all your trees and the crops of your land, you will sow much seed in the field but you will harvest little (Chapter 28; Verse 38). *In the ancient epic in Sanskrit, The Mahabharata, Karna warns the Pandavas that in the war "the Kauravas*

[1] The Exodus, Chapter 10, verses 14 and 15 of the Bible (Old Testament) "*Never before had there been such a plague of locusts, nor will there ever be again. They covered all the ground until it was black. They devoured all that was left after the hail – everything growing in the fields and the fruit on the trees.*"

[2] The Book of Nahum, Chapter 3; Verse 15, *"There the fire will consume you; the sword will cut you down- they will devour you like a swarm of locusts. Multiply like grasshoppers, multiply like locusts!"*

will pounce on them as the swarm of locusts"[3]. The Holy Quran also mentions locusts saying Allah punished Egypt with five different plagues.[4]

Locusts are migratory pests. They belong to the grasshopper family *Acrididae* (Uvarov, 1927). Locusts are short-horned grasshoppers but differ from grasshoppers because of their ability to change their physiology and behaviour (known as phase polyphenism) in general, and their morphology (colour and shape) in particular, in response to changes in population density, provided that the meteorological conditions are conducive (Lomer, Bateman, et.al, 2001). Adult locusts form swarms that contains millions or billions of individuals that behave as a coherent unit (known as gregarious phase) (Symmons and Cressman, 2001). The non-flying hopper (or nymphal) stage can form cohesive masses that are called hopper bands (Symmons, P. and K. Cressman, 2001). When the population of locusts diminishes, they behave as individuals (solitary phase) much like the grass hoppers (Symmons and Cressman, 2001). There are ten major locust species found all over the world- Desert Locust *(Schistocerca Gregaria),* Migratory Locusts *(Locusta migratoria),* Bombay Locust (*Nomadacris succincta*), Tree Locust (*Anacridium sp.),* Australian Plague Locust (*Chortoicetes terminifera*), Italian Locust (*Calliptus Italicus*), Moroccan Locust (*Dociostaurus morocannus*), Brown Locust (*Locustana pardalina*), Red Locust (*Nomadicris septemfaciata*), South American Locust (*Schistocerca paranensis*) (Ministry of Agriculture and Farmer's welfare, GOI). The most damaging to vegetation is the Desert Locust *(Schistocerca Gregaria)*. They are always present in the deserts between Mauritania and India with an invasion area of about 30 million sq. km which includes whole or parts of nearly 64 countries (FAO, Weather and Desert Locust 2016). This includes North West and East African countries, Arabian Peninsula, the Southern Republic of USSR, Iran, Afghanistan and the Indian sub-continent (locust-control-research/distribution Ministry of Agriculture and Farmer's welfare). The Desert Locusts are a menace to the bread and butter, earnings and food source of domestic populaces. A locust swarm of 1 sq. km size can consume the same amount of food in one day as 35, 000 individuals (FAO, Weather and Desert Locust 2016).

2. Biological Life cycle of Desert Locusts

Desert Locusts have three breeding periods summer, spring and winter and three distinct stages as given below-

i. Egg
ii. Hopper
iii. Adult

Egg

The Desert Locusts lay eggs in batches called pods. The conducive conditions for egg-laying are-

a) Moist sandy soil at a depth of about 10-15 cm,
b) The optimum temperature must be between 32- 35 degrees centigrade. At the optimum temperature the incubation period is 10 to 12 days.

At an interval of 7–10 days, Gregarious females lay 2-3 egg pods. Each pod has an average of 60-80 eggs while Solitarius females lay 3-4 times having 150-200 eggs in

[3] *The Mahabharata,* (कौरव्यवंशदावेऽस्मिन् क एष शलभायते, kauravyavaṃśadāve'smin ka eṣa śalabhāyate).

[4] The verse 133 of Chapter 7 says: *"We let loose upon them the flood, and the locusts, and the lice, and the frogs, and blood- all explicit signs- but they were too arrogant. They were a sinful people."*

average. The rate of maturing of eggs solely depends on temperature and moisture in the soil.

Hopper

After incubation period, wingless nymphs (hoppers) hatch out. Gregarious hopper develops in 5 instars (a phase between two periods of moulting in the development of an insect larva or other invertebrate animal) while solitarius hopper takes 5-6 instars. In each instar the appearance changes (Albrecht and Blackith, 1956).

- 1st Instar Newly hatched are white but turns black in 1-2 hours
- 2nd Instar Head is larger and pale colour pattern is clearly visible.
- 3rd Instar Two pairs of wings bud protrude on each side of thorax
- 4th Instar Colour is black and yellow.
- 5th Instar Colour is bright yellow with black pattern.

In general, each instar takes a week. The time taken from hatching fledging is reduced to 22 days when the average air temperature is about 37 degree centigrade.

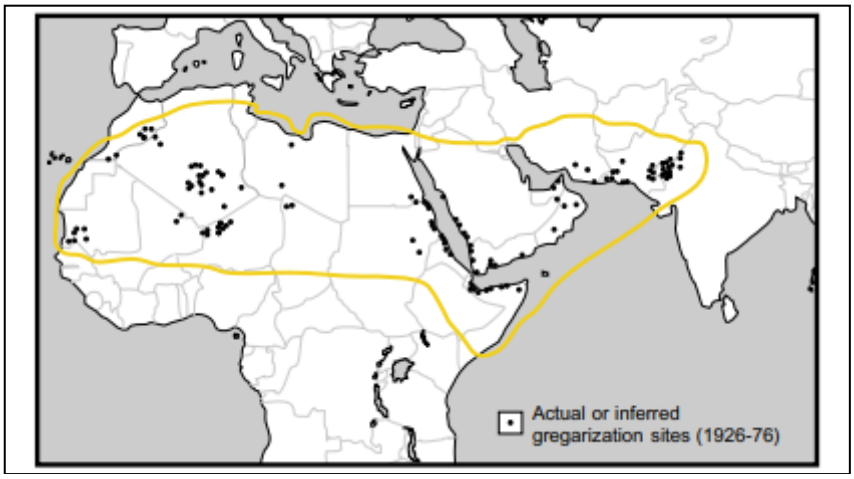
Adult

The 5th instar nymph (hopper) moults into adult. It is called a 'fledgling' and the process is known as 'fledging'. A fledgling has soft wings and only after a few days, the wings harden making it capable of flight. The hoppers with flying ability are called sexual 'immature adult'. They are pink in colour while the mature adults are bright yellow. The immature adults are the most detrimental as they can travel long-distances. Gregarious adults (swarms) fly during daylight while solitarius adults fly for only a few hours at night. They fly downwind in search of lush green vegetation and conducive breeding conditions.

3. Recessions, Upsurges, Plagues, and Declines of Desert Locusts in the World

Recession

The period when desert locusts do not harm crops and swarms are absent or rare is called recession. In the world, desert locusts are always present over an area of 30 million sq. km (Map 1). This area is dry or semi-arid where desert locusts are present in low densities, away from major agricultural zones.



(Map 1 Source: FAO, Weather and Desert Locust) Waloff, Z. 1981 in D. Pedgley, ed. Desert Locust Forecasting Manual)

Recessions	Upsurges	Plagues	Declines
-----	-----	1861-1867	
1868	-----	1869-1881	
1882-1888	-----	1889-1910	
1911	1912	1912-1919	1917-1919
1920-1925	1925-1926	1926-1934	1932-1934
1935-1939	1940-1941	1940-1948	1946-1948
1948	1949-1950	1949-1963	1961-1963
1964-1967	1967-1968	1968	1969
1969-1972	1972-1974	-----	-----
1975-1976	1977-1980	-----	-----
1981-1985	1985	1986-1988	1988-1989
1990-1992	1992-1994	-----	-----
1995	1996-1998	-----	-----
1999-2002	2003	2003-2005	2005
2006			

(Table 1 Source: Updated from Symmons and Cressman (2001); FAO Desert Locust Guidelines Ch.-1 P. 37)

Upsurge

The period between recession and plague is marked by outbreak and upsurge. The locust numbers rise through breeding, concentration, and gregarization over several months, which leads to the outbreak phase. Outbreak often happens at a local level and confined to certain habitats. If left uncontrolled, this may lead to formation of swarms. (Contingency Plan for Desert Locust Invasions, Outbreaks and Upsurges updated June 2019 ministry of agriculture and farmer welfare)

The upsurge is the outcome of successful breeding over generations, initially starting with a small population. As the number of locusts goes on increasing a large swarm is formed. In swarms, locusts behave as a single unit. Since 1970 till 2003, five upsurges have been recorded and only two of them have led to plague (as shown in table 1).

Plague

When the locust infestations are widespread and heavy, that period of one or two years is called plague. When the control operations fail and conducive breeding conditions persist, a plague can occur. In the 1900s, six major plagues of desert locusts have been reported (as shown in table 1). One of these plagues lasted for thirteen years.

Decline

Plagues decline due to two major factors- human efforts and natural factor. The plague declines due to rainfall failure in the areas where successful breeding takes place. Another cause is that the swarms migrate to areas wherefrom the adults or their progeny cannot return. The pest control operations conducted by various organisations help in curbing locust plague.

4. Locust Attacks in India's Agricultural History

Earlier, the locust attack used to befall in phases known as plague cycles. It is followed by recession. During the last two centuries, India faced a number of locust plagues, upsurges and incursions.

The table below presents locust plagues recorded during following years.

1812-1821	1900-1907
1843-1844	1912-1920
1863-1867	1926-1930
1869-1873	1940-1946
1876-1881	1949-1955
1889-1891	1959-1962

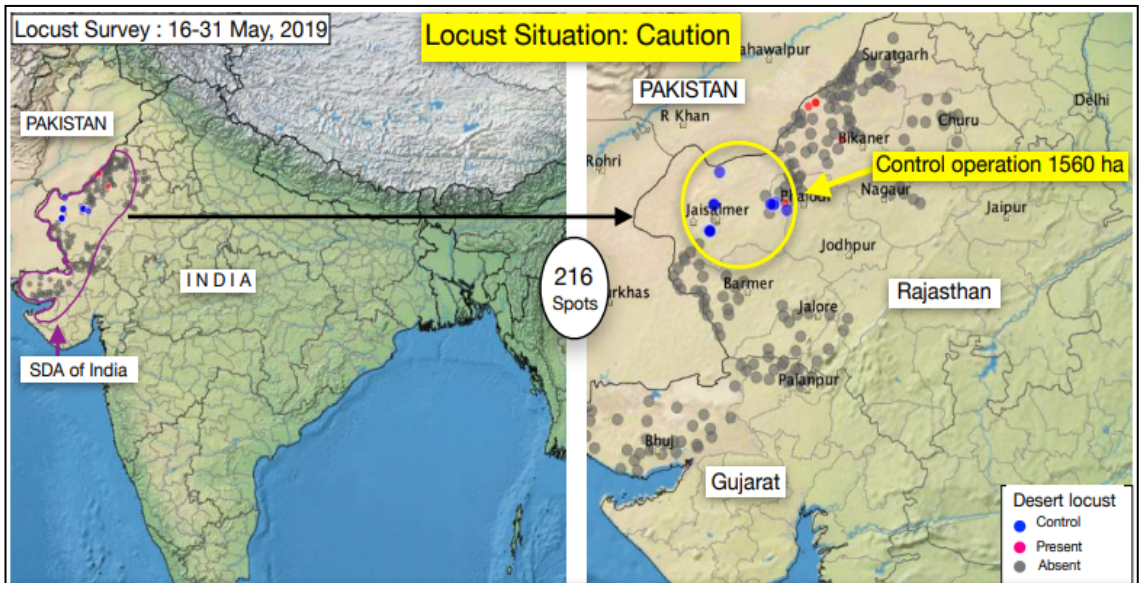
(Source: Locust Control and Research Ministry of Agriculture and Farmer Welfare, Government of India) Locust Plagues Recorded

The table below presents number of upsurges in distinct years from 1964 to 1997.

Year	**Number of Swarm Incursions**
1964	004
1968	167
1970	002
1973	006
1975	019
1976	002
1978	020
1983	026
1986	003
1989	015
1993	172
1997	004

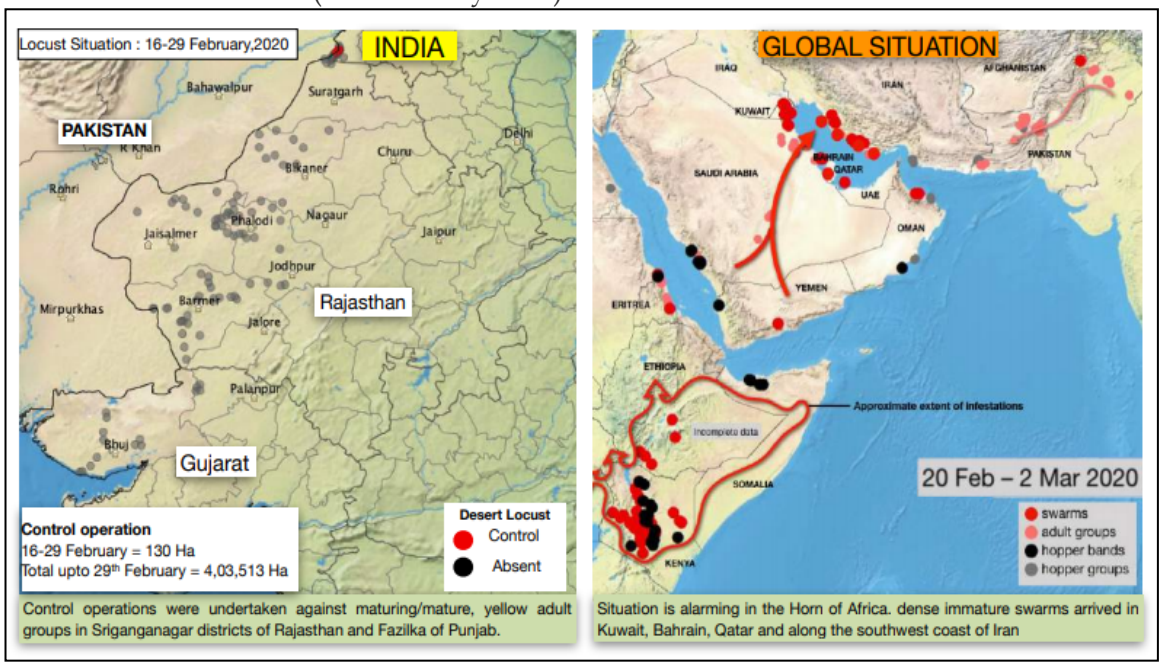
(Source: Locust Control and Research Ministry of Agriculture and Farmer Welfare, Government of India) Number of Upsurges

In the following years-1998, 2002, 2005, 2007, and 2010, localized locust breeding at small scales has been observed. The situation remained calm since 2010 till 2013. At some locations in Gujarat and Rajasthan solitary phase of Desert locust has been observed in the later years. During 2019-20, India witnessed a massive locust attack which was successfully controlled (PIB 27th may 2020). It started from 21st May, 2019.



(Map 2 Source: Locust Bulletin 16th –31st May 2019) Department of Agriculture, Cooperation and Farmer's Welfare, Government of India

It ended by 17th February 2020 and a total of 403,513 Hectare area was treated and locusts were controlled (PIB 13th May 2020).



(Map 3 Source: Locust Bulletin 16th –29th February 2020, Department of Agriculture, Cooperation and Farmer's Welfare, GOI)

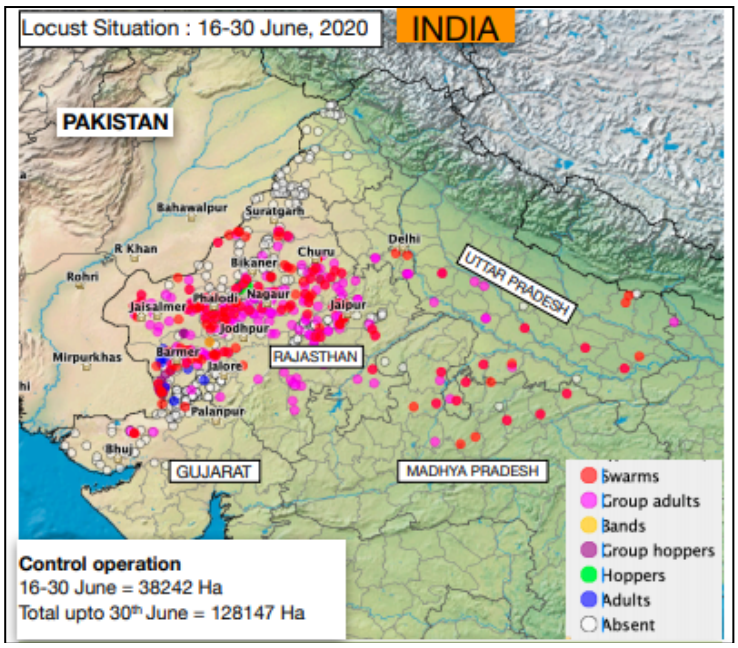
In India, Scheduled Desert Area (SDA) provides favourable breeding conditions to Desert Locusts. The SDA is 205,785.45 sq. km. in area in the states of Rajasthan (179,250.65 sq. Km), Gujarat (23,077.58 sq. Km), and Haryana (3,457.20 sq. Km). A detailed table is given below.

States	Districts	Number of Villages	Area in sq. Km
Rajasthan	Alwar	318	1380.30
	Barmer	1636	27,755.64
	Bikaner	673	22,611.13
	Churu	940	16,806.12
	Jaisalmer	562	43,583.94
	Jalore	612	12,208.56
	Jhunjhunu	692	5,879.82
	Jodhpur	624	17,660.10
	Nagaur	878	11,132.70
	Sikar	1506	7,765.80
	Sriganganagar	2308	12,466.56
Gujarat	Amreli	42	711.17
	Banaskantha	1086	9,843.09
	Bhuj	655	7,013.47
	Halar Jamnagar	221	2,374.50
Haryana	Mahendragarh	378	3,457.20

(Source: Locust Control and Research Ministry of Agriculture and Farmer Welfare, Government of India) Scheduled Desert Area in India

Locust Attack in India 2020

The survey, conducted from June 16-30, 2020, shows the spread of desert locusts to Delhi, Uttar Pradesh, Madhya Pradesh, and north western parts of Bihar (as shown in Map 4).



(Map 4 Source: Locust Bulletin 16th – 30th June 2020, Department of Agriculture, Cooperation and Farmer's Welfare, Government of India)

A total of 782 spots were surveyed during the period and control operations were undertaken on 327 spots covering an area of 38,242 Hectare. The movement of locust swarms were reported. Locust breeding was observed at Barmer near the border. But, this year 2020, India is facing the worst Locust Attack since 1993. Normally, the locust swarms enter the desert area through Pakistan for summer breeding in the month of June or July with the arrival of monsoon. But this year, the incursions of locusts and pink swarms have been reported much earlier since 11th April 2020 because Pakistan failed to contain previous year outbreak (PIB 27th May 2020).

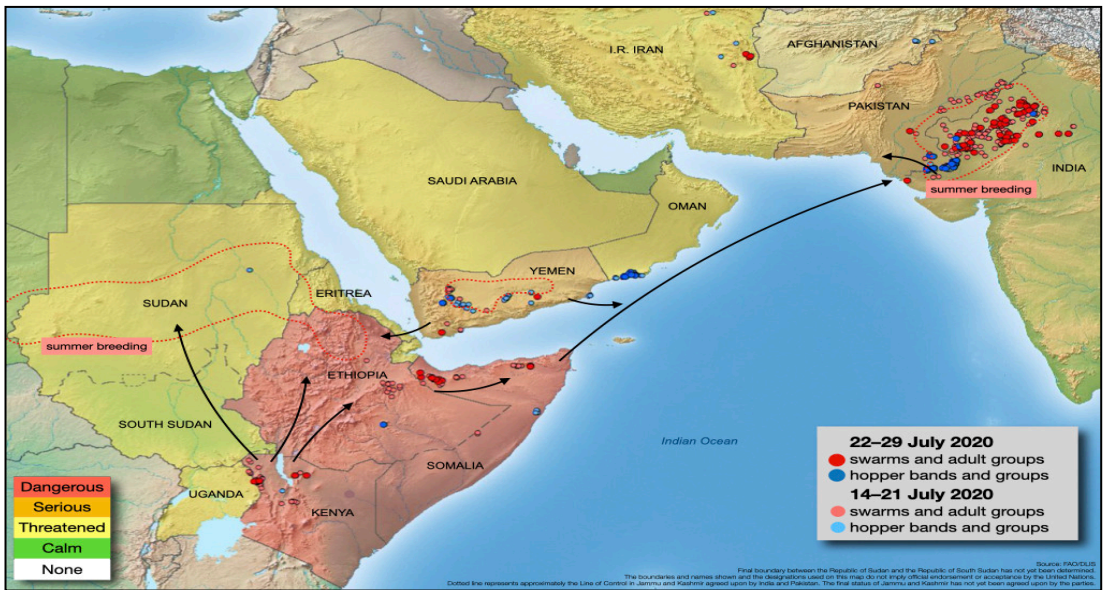
The government has placed an order of certain machines from United Kingdom (UK) to strengthen the anti-locust operations (PIB 5th May 2020). The Locust control operations have been carried out in 1,86,787 Hectare area in the states of Rajasthan, Gujarat, Punjab, Uttar Pradesh, and Haryana from 11th April 2020 till 19th July 2020 by Locust Circle Offices (LCOs) (PIB 20th July 2020).

The Madhya Pradesh government has deployed total 83 tractors and 47 fire brigade vehicles, while the Rajasthan government has deployed 2142 tractors and 46 fire brigade vehicles. The Punjab government is using 50 tractors and 6 fire brigade vehicles. On the other hand, Uttar Pradesh has deployed 4 tractors and 16 fire brigade vehicles, and Gujarat deployed 38 tractors for locust control (PIB 22nd June 2020). On 4th July 2020, a Bell Helicopter took its first sortie in areas of Jaisalmer (Rajasthan) and accomplished its mission of chemical spraying in targeted areas (PIB 5th July 2020).

As of 20th July 2020, 79 control groups are deployed in States of Gujarat, Rajasthan, Uttar Pradesh and Madhya Pradesh and additional 200 Central Government employees are assigned for anti-locust operations. In addition to that, 5 units with 15

UAVs (Unmanned Aerial Vehicles) are stationed at Jaisalmer, Barmer, Nagaur, Bikaner, and Phalodi in Rajasthan for successful control of locusts on tall trees and in beyond reach regions through spritzing of pesticides.

According to the Food and Agriculture Organization's Locust Status Update of 13th July 2020, there is a very high chances of second wave of locust infestation because more swarms are probably going to be formed in north-eastern Somalia and their movement to the summer breeding grounds on the India-Pakistan border is inevitable, as shown in Map 5.



(Map 5 Source: FAO Locust Update 29th July 2020, Food and Agricultural Organisation)

Till 20th July 2020, no major crop losses have been reported in the States of Uttar Pradesh, Gujarat, Madhya Pradesh, Chhattisgarh, Maharashtra, Haryana and Bihar. However, some minor crop damages have been reported in few districts of Rajasthan (PIB 20th July 2020).

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