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## Migrations of the eastern population of the Monarch Butterfly in North America to the overwintering site in the Neo-Volcanic Plateau of Mexico

(Lep. Danaidae)

by

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Since our previous report (URQUHART & URQUHART, 1976) further data on the autumnal migration of the monarch butterfly, *Danaus p. plexippus* have been obtained (Table 1). By plotting average release-recapture lines taken from previous publications (see reference list) together with the more recent data contained in this paper three flight patterns are evident. Flight pattern D is based on the flights of migrants moving in a southerly direction ( $180^{\circ}$ – $200^{\circ}$ ) to the coast of the Gulf of Mexico. Upon reaching the coast they change direction and move  $260^{\circ}$ , due to an antipathy to fly over large bodies of water (URQUHART, 1960), although recent sight records indicate that some do so. Flight pattern C represents the resultant of patterns D and E. Thus, a migrant leaving point F would follow patterns D and E to be recaptured along pattern C at point G (fig. 1).

Flight pattern B represents a direct flight ( $160^{\circ}$ – $210^{\circ}$ ) directly to the overwintering site in Mexico (fig. 1).

By comparing patterns D and B it is apparant that the principal flight direction, whether influenced by the sun or some other factor or factors, is  $180^{\circ}$ – $210^{\circ}$ .

The migration routes to the overwintering site, together with areas of maximum population concentrations in the breeding area (fig. 2A) and migration along the coast of the Gulf of Mexico (fig. 2 B), are indicated by average release-recapture lines plotted on a „Physiographic Diagram of North America“ published by the Geographical Press of Columbia University, New York, based partly on the „Geological Map of North America“, scale 1:5.000.000 published in 1946

by the Geological Society of America.

Two overwintering areas involving three separate loci have been previously involved in publication (URQUHART, 1976). Since the time of this publication, field parties have examined many localities throughout the Neo-volcanic Plateau of Mexico resulting in the discovery of three additional areas. Hence, to date we have been able to locate five areas representing 13 loci of concentration (fig. 2).

At one locus concentration were located on over 1000 trees in a forest area of 8.3 hectares (fig. 2), while at another locus aggregations were on only eight trees. Thus, the extent of the locus and the number of trees involved varies considerably from one locus to another.

All loci were located at elevations of 3000–3500 meters.

Accessibility to the various loci varied from one in which a logging road passed through the colony to one which required the use of a guide and his horses to assist the field party, by means of ropes attached to the horses, to scale the precipitous slope of the mountain which was strewn with large, slippery boulders.

We are now attempting to study the return, or vernal, migration from the overwintering site to the breeding grounds by alar tagging in the various areas of the Neo-volcanic Plateau. Studies are also being carried out with respect to the migrations down the Florida Peninsula, which has been previously referred to as an „aberrant“ migration, together with the movement through the various islands of the Caribbean Sea.

(Explanation of terms used: „Site“ refers to the entire Neo-volcanic Plateau of Mexico where the monarchs overwinter; „area“ refers to one particular mountain where the monarchs occur; „locus (i)“ refers to locations of aggregations within a particular area.

The overwintering site was previously and wrongly referred to as the Sierra Madre Mountains).

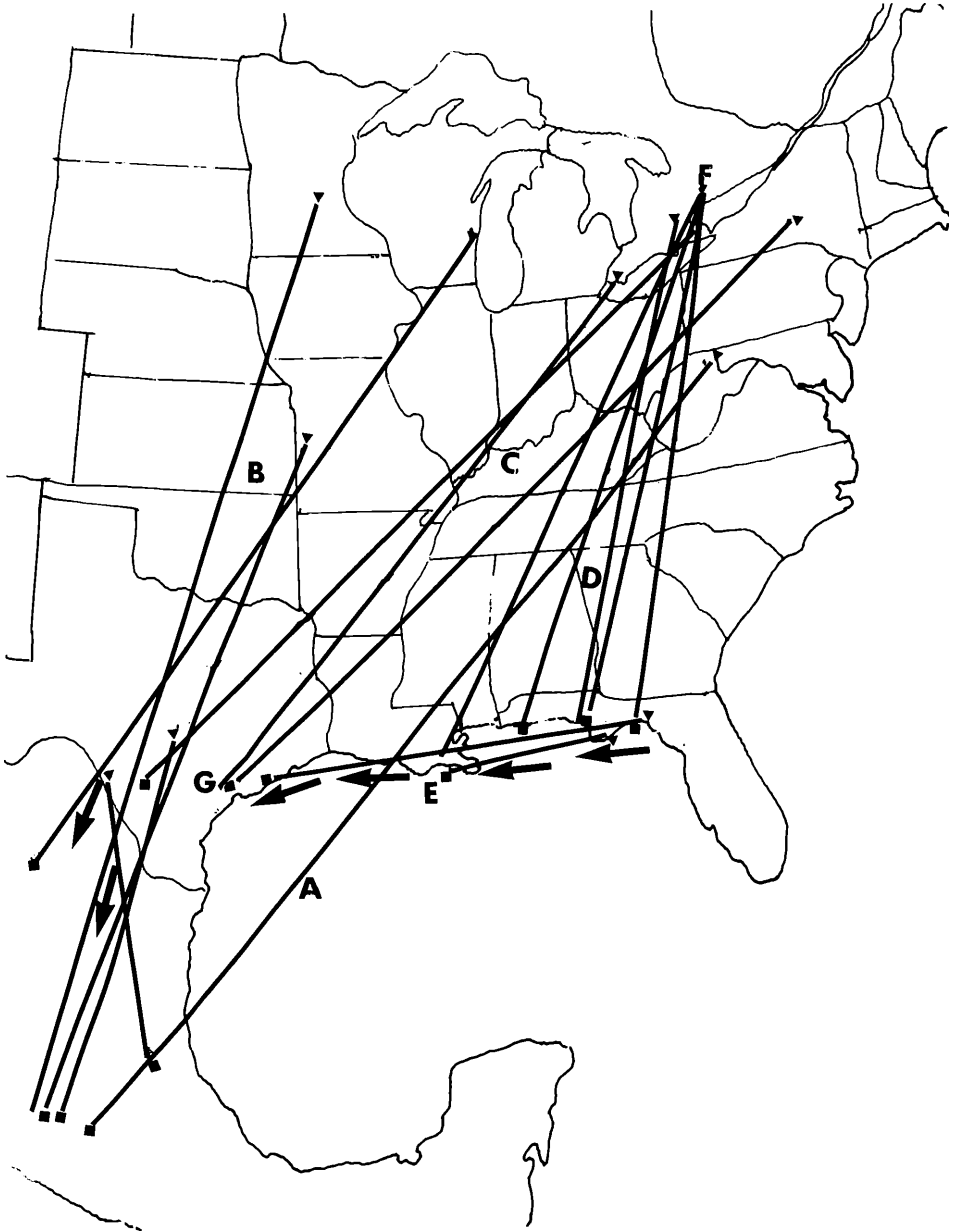
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The present paper deals with part of a larger program concerning the biology of the monarch butterfly (*Danaus p. plexippus* L.) with special reference to its migrations: It is sponsored by research grants from the National Research Council of Canada, by the National Geographic Society of the United States of America, and by the Insect Migration Association.

Table 1: Release-recapture of alar tagged migrant  
(Recent significant records)

Point of Release	Point of Recapture	Flight Direction	Distance (kms)
Brampton, Ontario	Panama City, Florida	202°	1590
Cobourg, Ontario	Cottdonale, Florida	206°	1650
St. Marks, Florida	Appalachicola, Florida	245°	97
Appalachicola, Florida	Mexico Beach, Florida	299°	47
St. Marks, Florida	Grand Isle, Louisiana	262°	690
Hinton, West Virginia	Whitney, Texas	253°	1650
Binghamton, New York	Edna, Texas	241°	2400
Point Pelee, Ontario	Victoria, Texas	228°	1975
Burlington, Ontario	Pearsall, Texas	234°	2370
Toronto, Ontario	San Augustine, Texas	228°	1860
Shell Point, Florida	Texas City, Texas	270°	1050
Hinton, West Virginia	Whitney, Texas	254°	1675
Long Point, Ontario	Oakwood, Texas	235°	1195
Cobourg, Ontario	Seadrift, Texas	230°	2380
Fredericksburg, Texas	Los Ranchitos, Michoacan, Mexico	192°	1200
Nevada, Missouri	Monera Alta, Michoacan, Mexico	199°	2090
Chaska, Minnesota	Barranca Honda, Michoacan, Mexico	194°	2808
Eagle Pass, Texas	Maney, Huichapan, Hidalgo, Mexico	172°	750
Manitowoc, Wisconsin	Cuatro Ciengas, Coahila, Mexico	218°	2300
Westover, West Virginia	Atacomulco, Mexico, Mexico	230°	1675
Lynchburg, Ohio	Malinaltenango, Mexico, Mexico	217°	3000
Oley, Pennsylvania	Valley of the Cedars, Michoacan, Mexico	230°	2950

Please note – the repetition of Mexico is because of the state of Mexico in the country of Mexico.



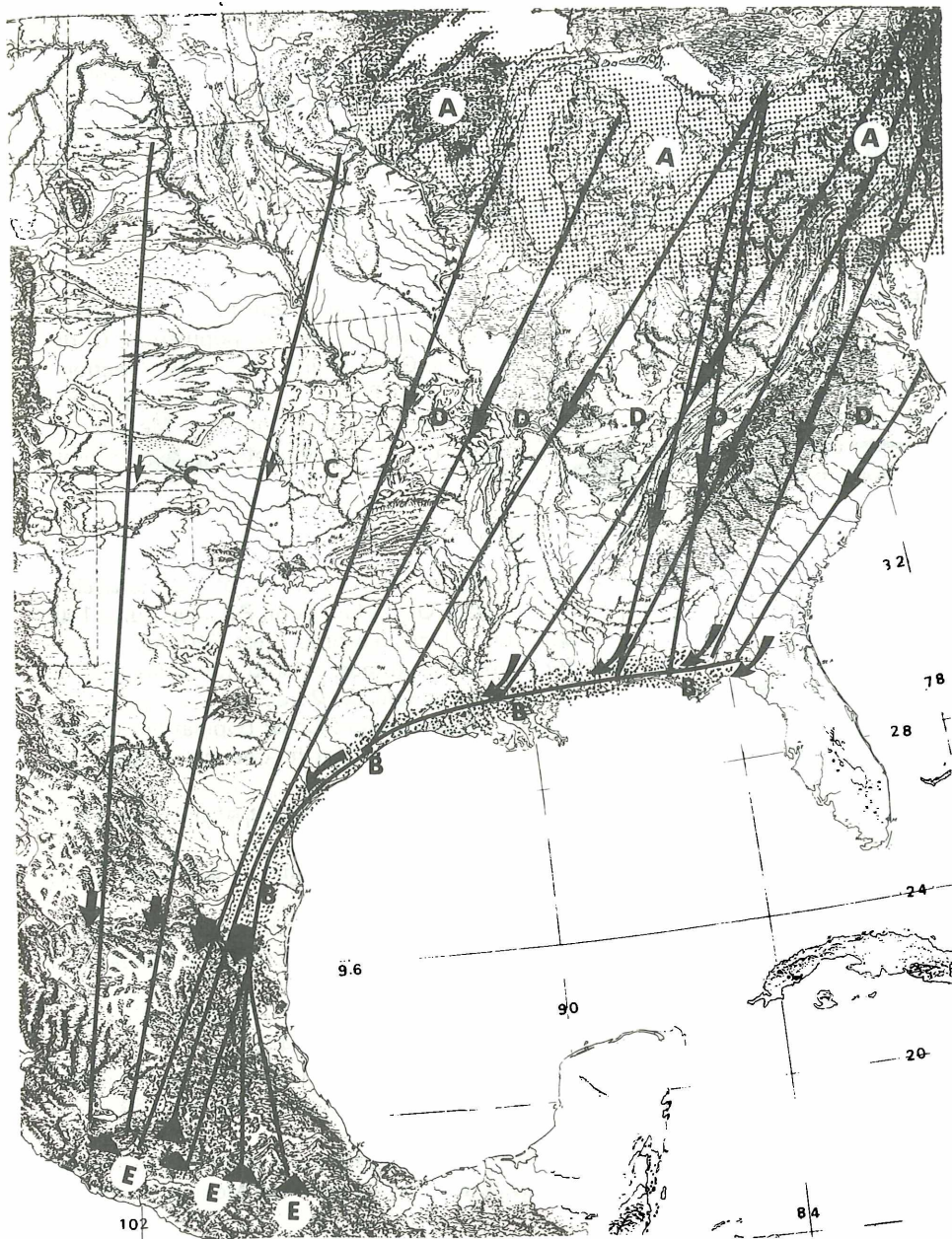


Fig. 1:

Flight patterns based on numerous release-recapture lines from previous publications together with data included in the present report. Pattern D, southward movement; pattern F, westward movement; pattern C, movement resulting from flight patterns D and E; pattern B, direct movement from the Great Plains to the overwintering site; A, movement combining patterns D, E and C.;

➔ direction of movement; ▼ release point; ■ recapture point.

Fig. 2:

Flight lines from breeding grounds to the overwintering site in Mexico. A, area of maximum population growth; B, area of maximum migrant population, C, direction of flight from breeding grounds in the Great Plains regions; D, direction of flight from breeding grounds east of the Great Plains; E, five areas (a, b, c, d, e) harbouring overwintering monarchs in the Neo-volcanic Plateau of Mexico;

➔ direction of flight; ➡ maximum migrant movement; ➡ minimum migrant movement.

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### Zusammenfassung

Wanderungen der östlichen Population des Monarch (*Danaus p. plexippus* L.) in N-Amerika zu den Überwinterungsplätzen des Neo-vulkanischen Plateaus von Mexiko. Aus zahlreichen früheren und jetzigen Rückmeldungen markierter Falter ergaben sich drei deutliche Flugmuster (Abb. 1 und 2). Vom Gebiet F gehen Flüge D in südlicher Richtung ( $180^{\circ}$ – $200^{\circ}$ ) zur Küste des Golfs von Mexiko und wenden sich, nachdem sie diesen erreicht haben, nach Westen ( $260^{\circ}$ ), weil fast alle das Überfliegen weiter Wasserflächen scheuen. Das Ergebnis der Flüge D + E ist praktisch dasselbe wie der Flugrichtung C, denn sie alle laufen im Gebiet G zusammen. Der Flug A und die Flüge B ( $160^{\circ}$ – $210^{\circ}$ ) leiten auf  $\pm$  geradem Weg zu den Überwinterungsplätzen in Mexiko. Der Vergleich der Wanderungen B und D mit einer hauptsächlichlichen Richtung von  $180^{\circ}$ – $210^{\circ}$  zeigt, daß die Flugrichtungen weder von der Sonne noch einem anderen Faktor beeinflußt werden. In den mexikanischen Winterquartieren, die alle in Höhen von 3000–3500 m liegen und nicht – wie früher angeführt – zu den Sierra Madre Mountains gehören, wurden seither 13 Stellen mit acht bis über 1000 Schlaf- oder Ruhebäumen (letztere in einem Waldgebiet von 8,3 ha) gefunden.

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