Migration and host plant use of the southern monarch, *Danaus erippus*

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Field research:

1. Bolivia:

(a) Tropical lowlands near Santa Cruz and Buena Vista east to Santiago de Chiquitos.

(b) Andean highlands from Sucre south to Potosí and Tarija

2. Argentina:

(a) Eastern cordillera of the Andes from Tucumán north to Salta and Jujuy.

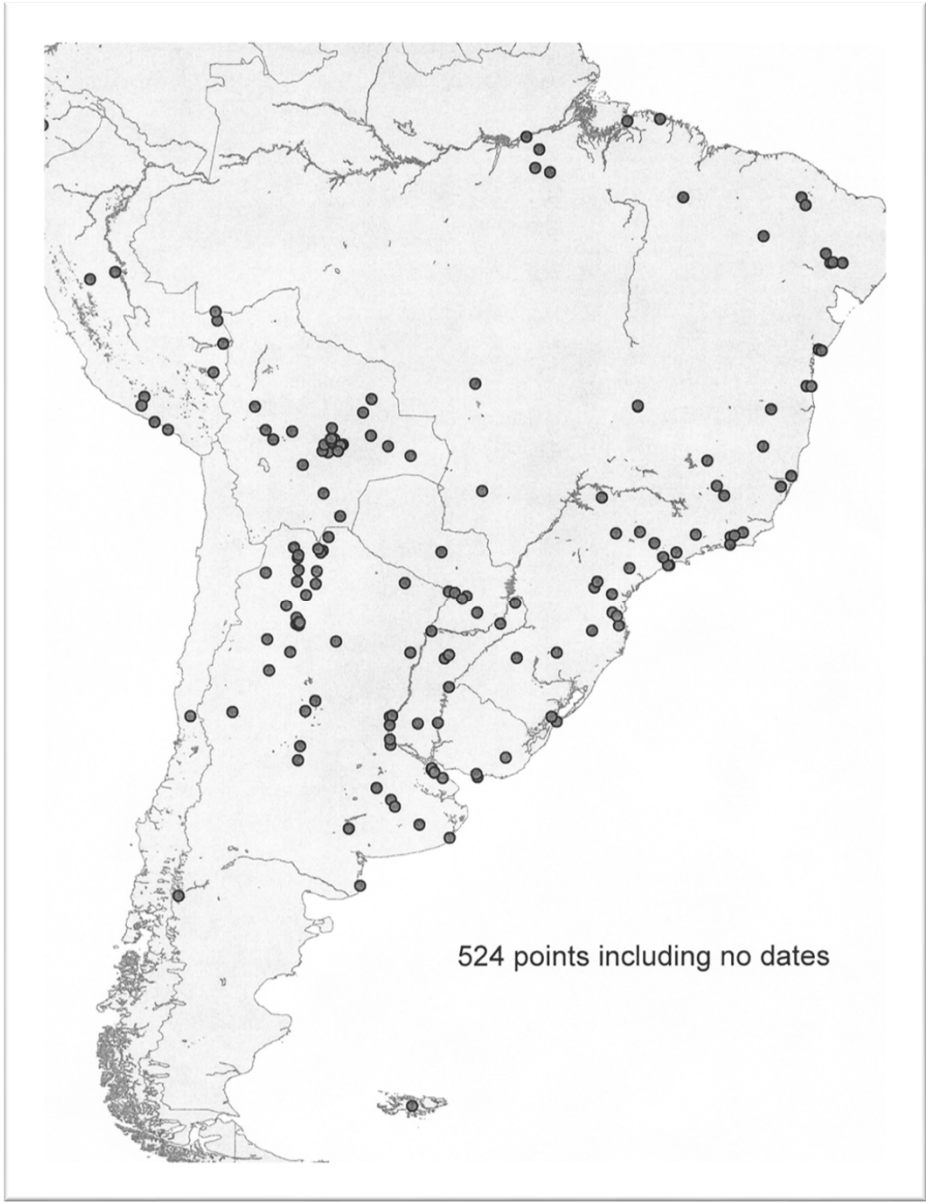
(b) Eastern Andean valleys along the edge of Yungas ecosystem

Data from museum collections:

1) Dr G. Lamas, Universidad Mayor de San Marcos, Lima
2) BMNH, London
3) McGuire Center for Lepidoptera and Biodiversity, Gainesville, FL.

Danaus plexippus nigrippus and *Danaus erippus*

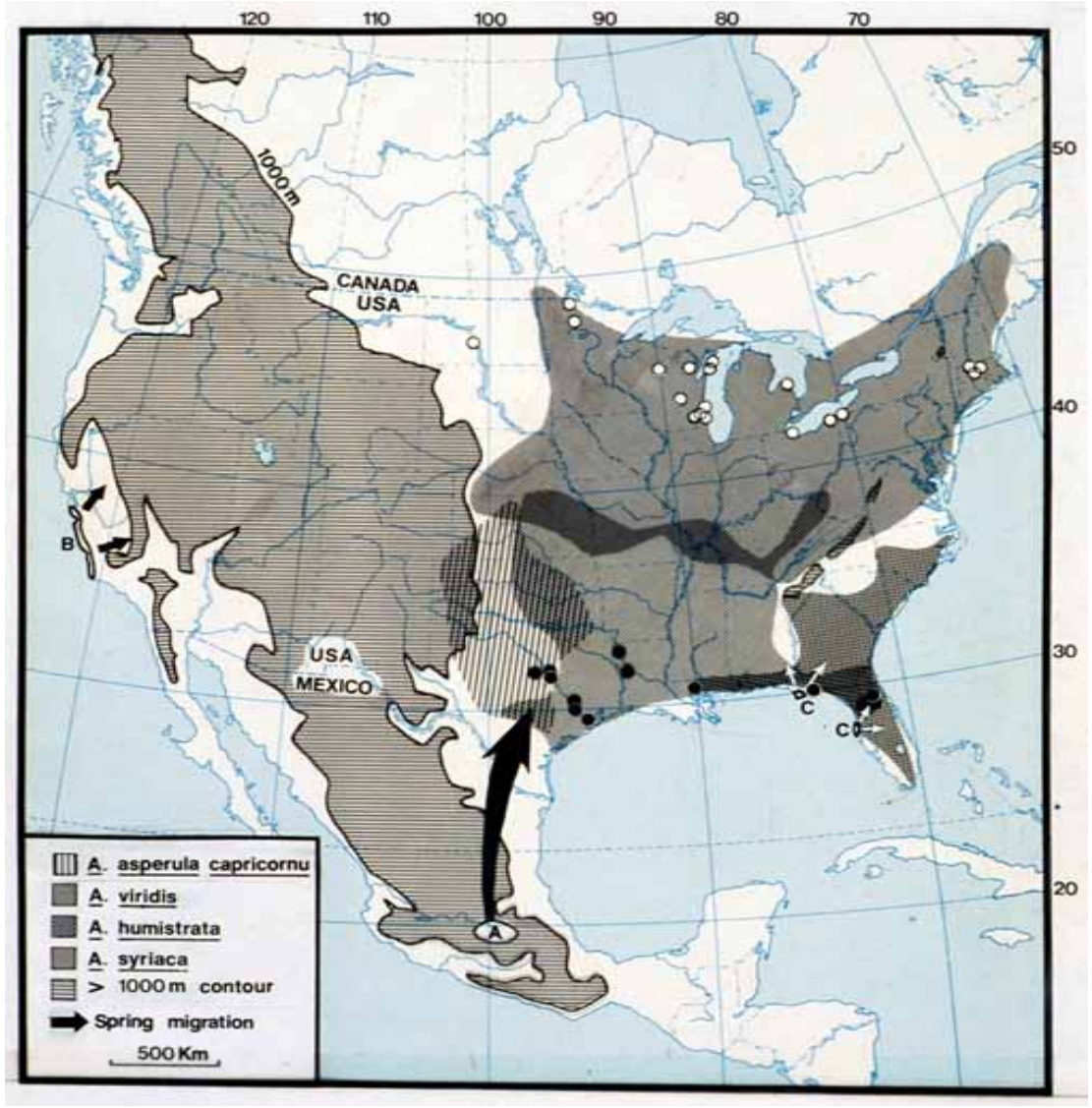
Distribution of *Danaus erippus* from museum records



Published information

- Sequence of 6 papers from K.J. Hayward in Argentina:
  - Records include spring, summer and autumn seasons
  - *D. erippus* only appears in the records in April and May (autumn).
  - Approx. 30 days of observations:
    - *D. erippus* was observed moving south in all of them except for two observations on 13 April 1928 and 30 April 1970 when seen flying north.
  - Hayward (1970) says northward flight was unusual & *D. erippus* is always seen flying south in the autumn parallel to the Andes:
    - Hayward, K.J. 1928. The Entomologist 61: 210-212.
    - Hayward, K.J. 1962. The Entomologist 95: 8-12.
    - Hayward, K.J. 1963. The Entomologist 96: 258-264.
    - Hayward, K.J. 1964. The Entomologist 97: 272-273.
    - Hayward, K.J. 1967. The Entomologist 100: 29-34.
    - Hayward, K.J. 1972. The Entomologist 105: 206-208.
  - At odds with speculations of Williams (1958), Johnson (1969) and Ackery and Vane-Wright (1984)(southern mirror of northern monarch)

Migration: Continental-scale resource use



Still no generally agreed ecological definition of migration.

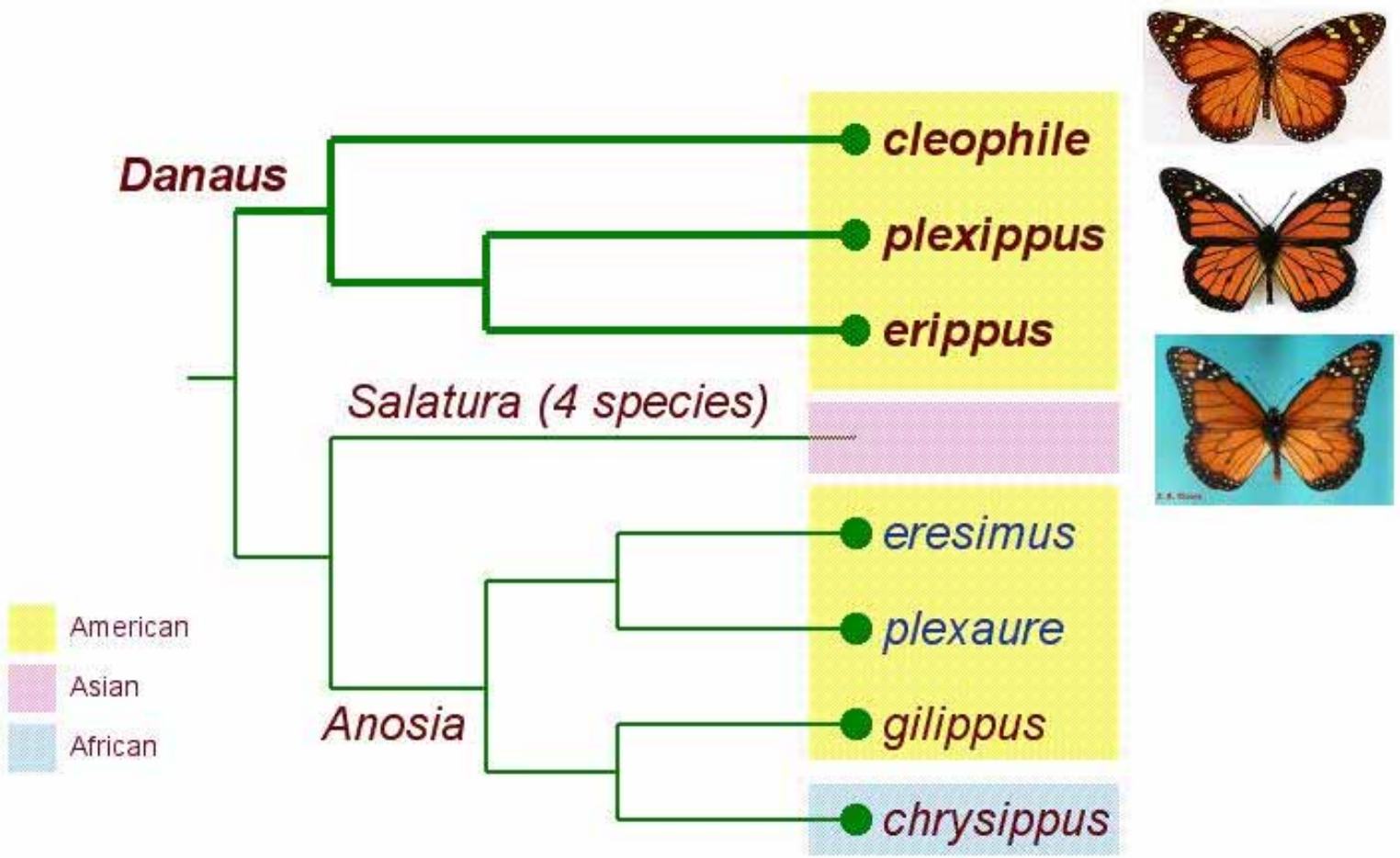
We define migration as:

"predictable, directional movement between spatially separated resources"

Includes "partial migration"

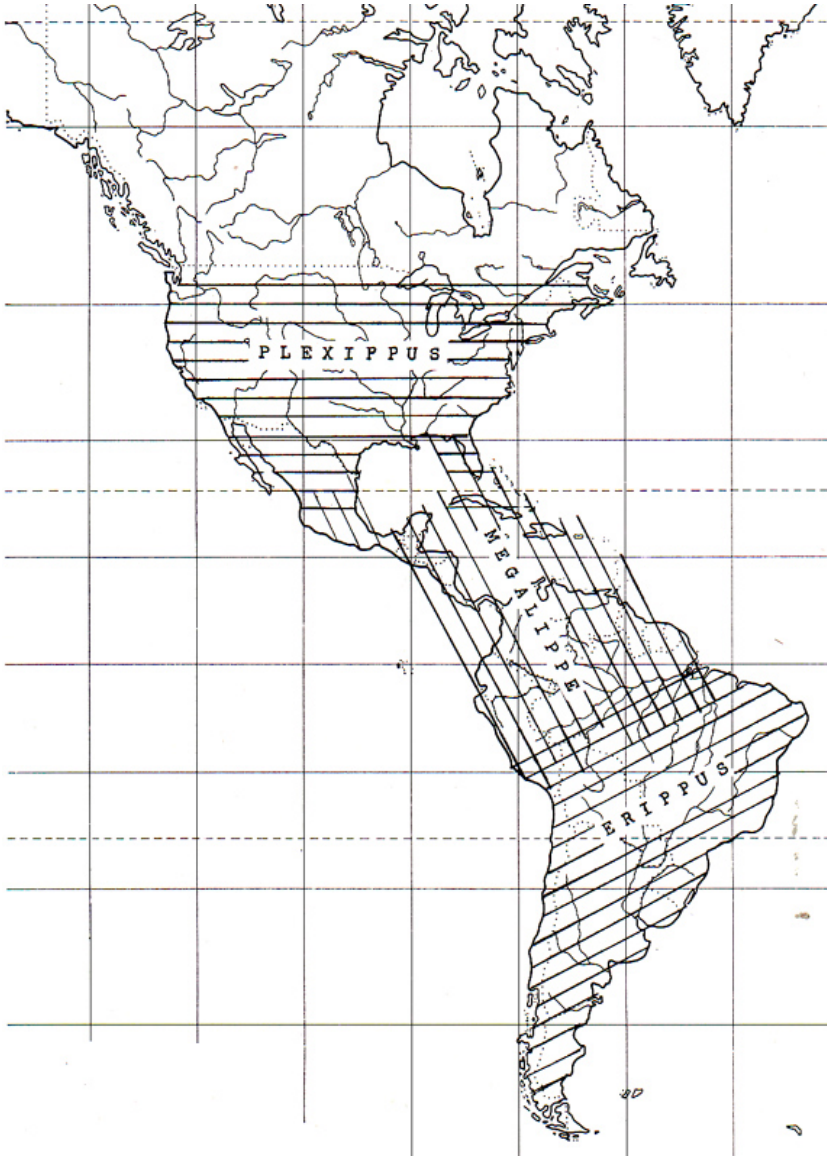
Malcolm, Cockrell, & Brower, 1993

Monarch phylogeny



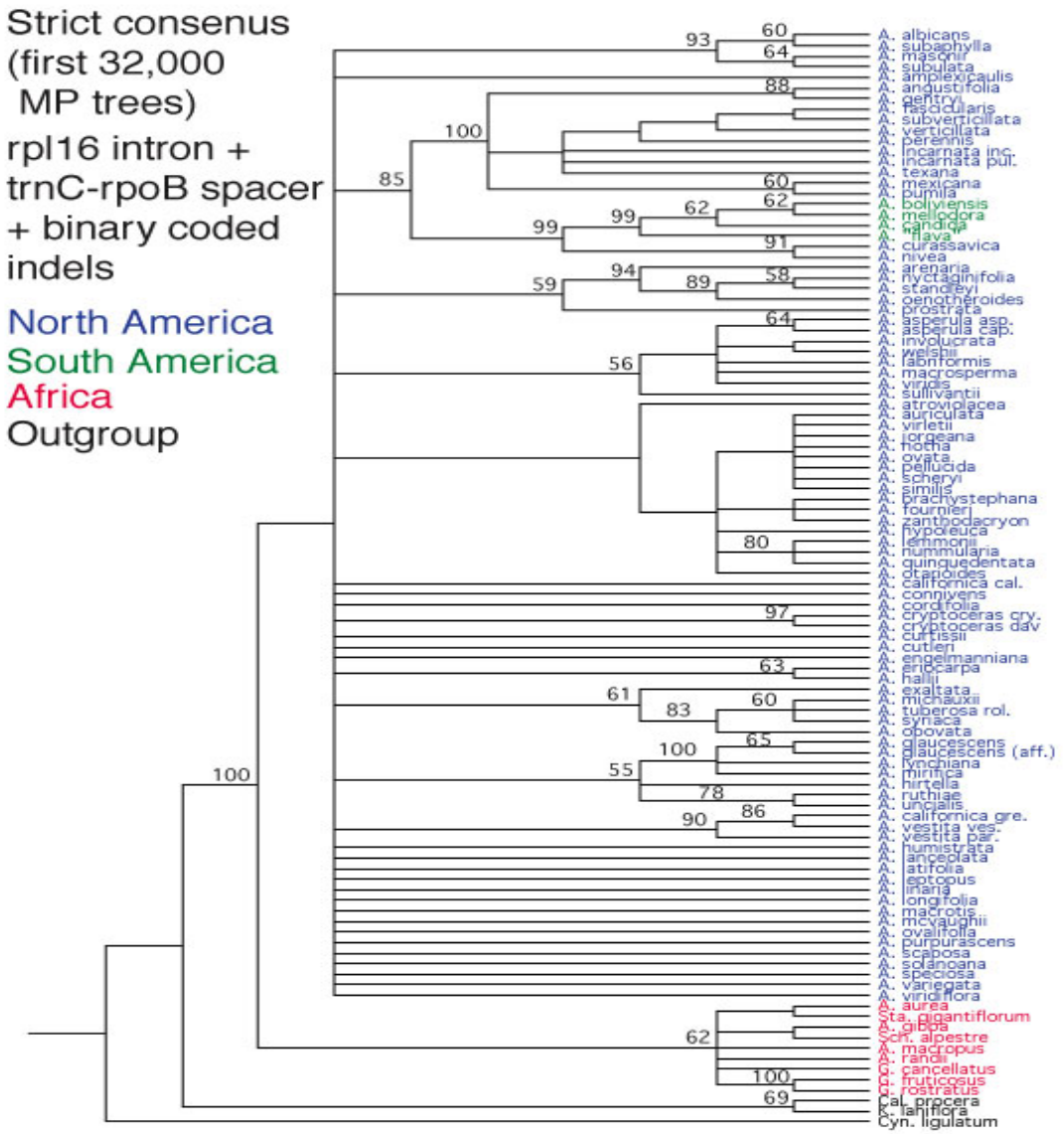
Distribution of monarchs, *Danaus plexippus plexippus, D.p.megalippe (+ nigrippus)* and *D. erippus* in the Americas.

- after Urquhart (1960)



Milkweed Diversity

- ≈230 *Asclepias* spp. worldwide
- ≈ 125 spp N. America:
  - (Woodson, Fishbein).
- Only 12 spp in South America:
  - (Bollwinkel)
- Confusing biogeography:
  - Kew/Missouri



Mark Fishbein

Asclepias curassavica

Mairana and Huaytu near Amboro National Park, Bolivia

Asclepias curassavica near Lules south of Tucumán, Argentina

Asclepias boliviensis

Rio Chaquimayu, N of Sucre, Bolivia

Asclepias boliviensis north of Sucre, Bolivia

Asclepias barjoniifolia

South of Millares, north of Potosí,
at approx. 4000m altitude, Bolivia

Asclepias barjoniifolia near Tarabuco, Bolivia

5th instar monarch on *A. barjoniifolia*

Asclepias pilgeriana

…near Villa Serrano, Bolivia, October 2009

Asclepias mellodora

…at Warnes, N of Santa Cruz, Bolivia, Oct 2009

Danaus erippus nectaring at *Eupatorium arnottianum*, April, NW Tucumán, Argentina

Episcada philoclea, Ithomiine migrants

Mechanitis lysimnia migrant

Cyanopepla hurama, Ctenuchiine moth migrant

Basking monarch by Rio Grande, NW Tucumán, Argentina

Basking female by Rio Grande

Ben below *Enterolobium* roost tree

Monarchs basking below roost tree in morning

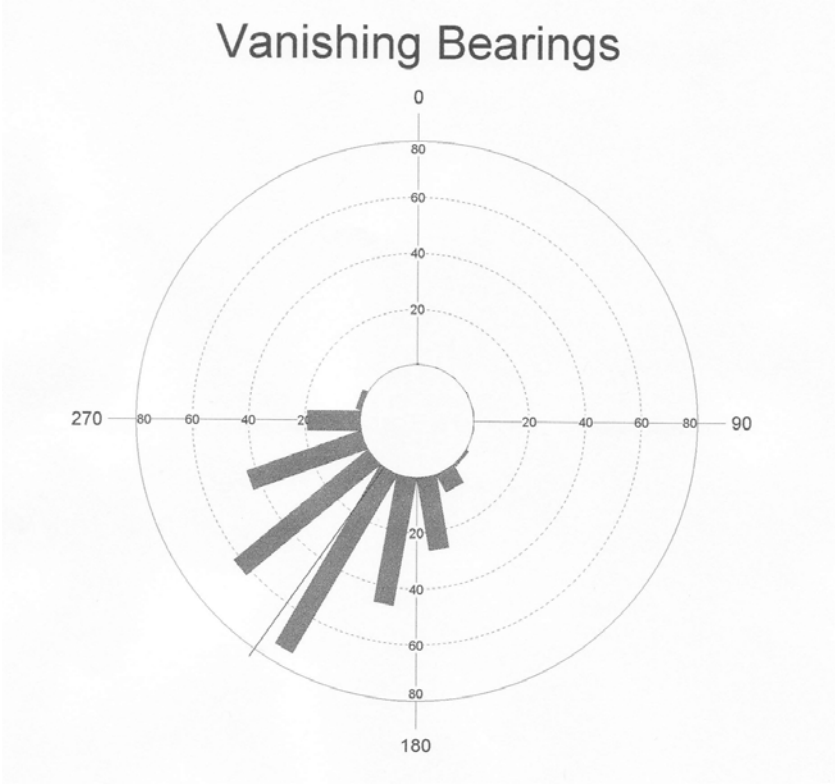
Monarch nectaring at *Eupatorium*

Orientation

Hayward, K.J. 1962. Migration of butterflies and a moth in Argentina, spring and summer 1960-61. *The Entomologist* 95: 8-12.

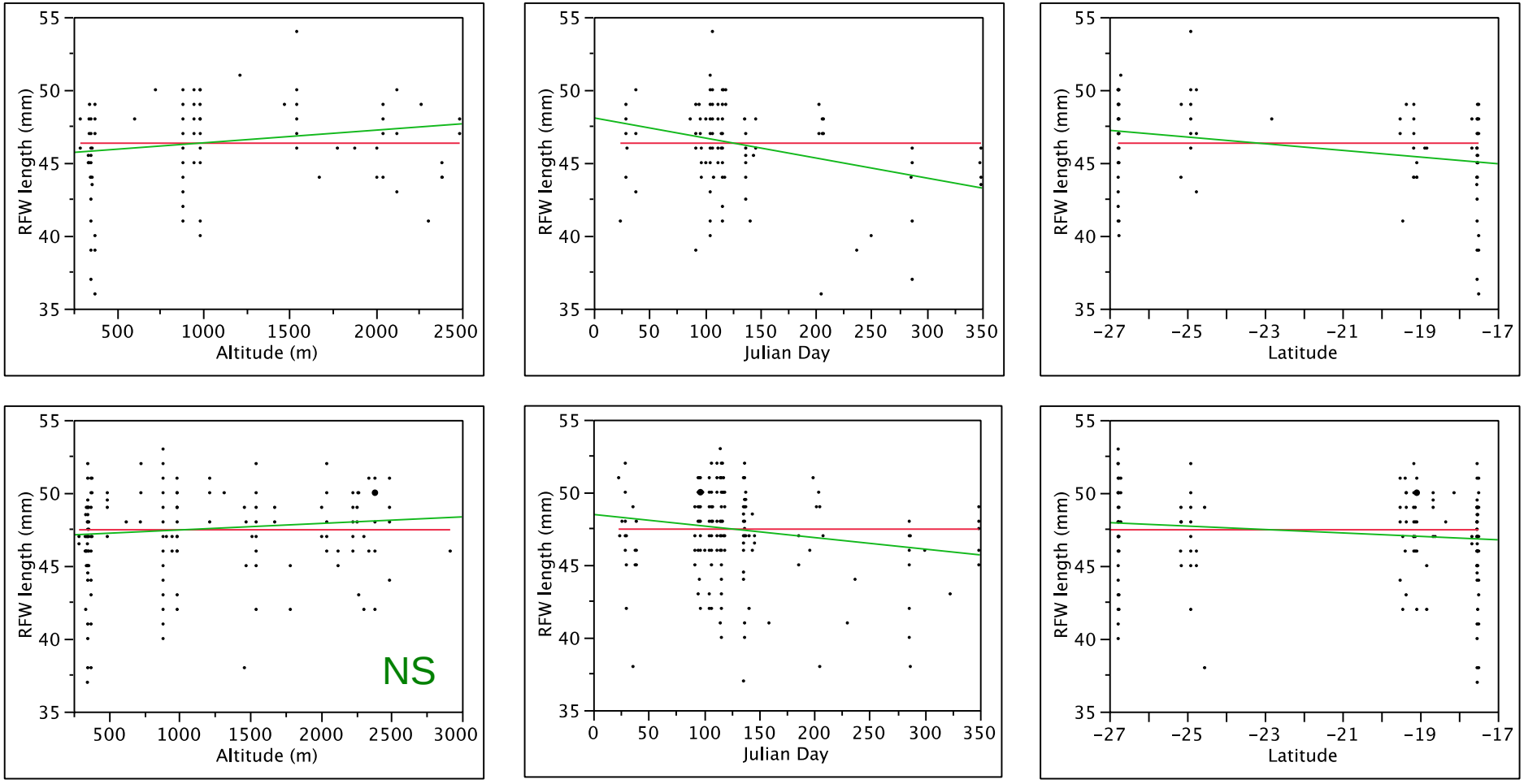
Dr Haedo Rossi contributed what Hayward thinks are the first records of mass migration of *D. erippus* in the Argentine:

"On 12th April, soon after noon, a steady compact stream of Diogas [Danaus] *erippus began to flow along the lower slopes of the mountains* [Rossi's house is just within the forest edge at the foot of the mountains west of Tucumán]*, flying towards the south at a height of between ground level and fifteen feet and continuing to do so till after 4 p.m., the width of the flight being about a mile. …"*



Our observations, April 2010:
Mean vector = 215.2° ±30.1° SD
N = 280 butterflies

Wing length

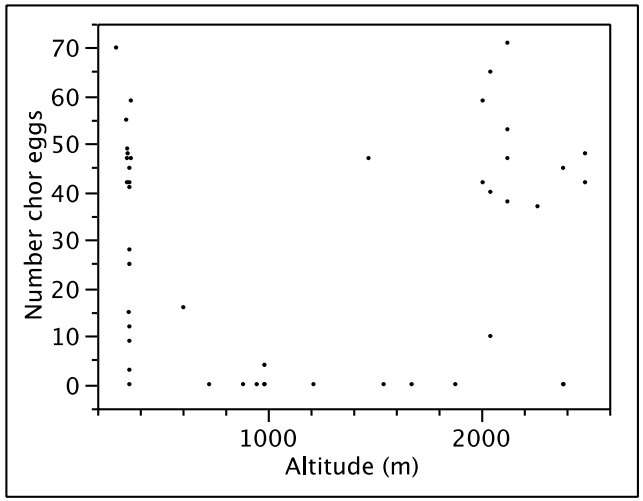


Female (top) = 46.34±0.24 SEM

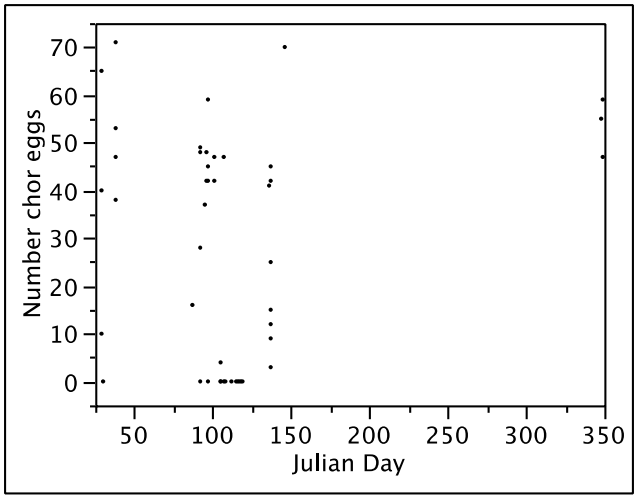
Male (bottom) = 47.46±0.17 SEM

Chorionated egg content

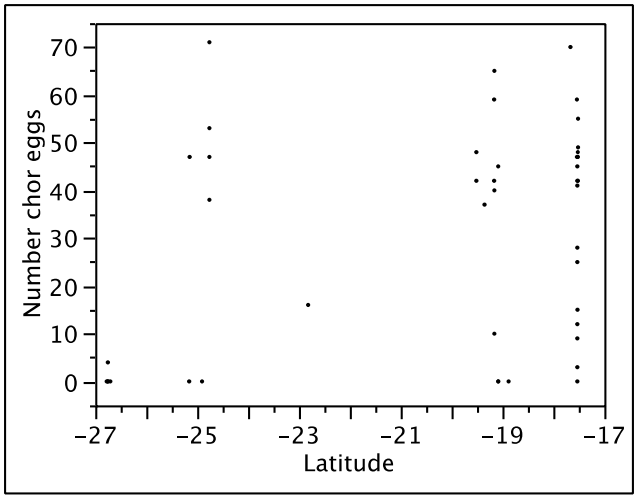
Altitude (m)



Julian Day



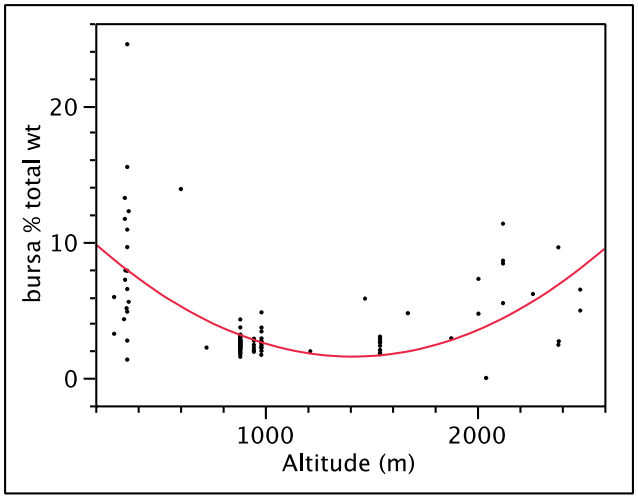
Latitude ° S



No obvious relationships – perhaps more eggs at low & high altitudes & at lower latitudes

Bursa copulatrix % of female weight

Altitude (m)



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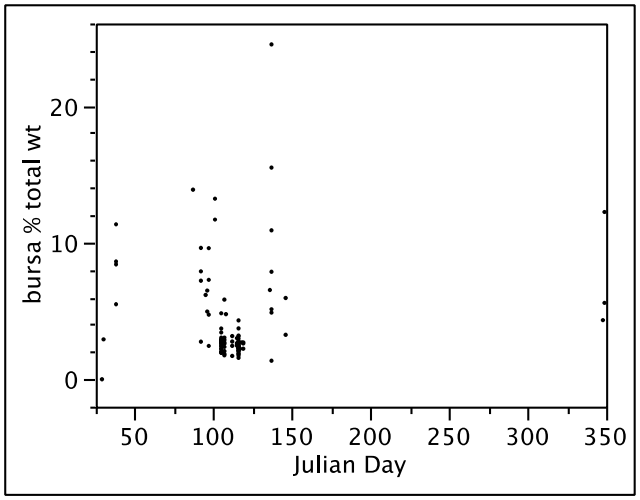
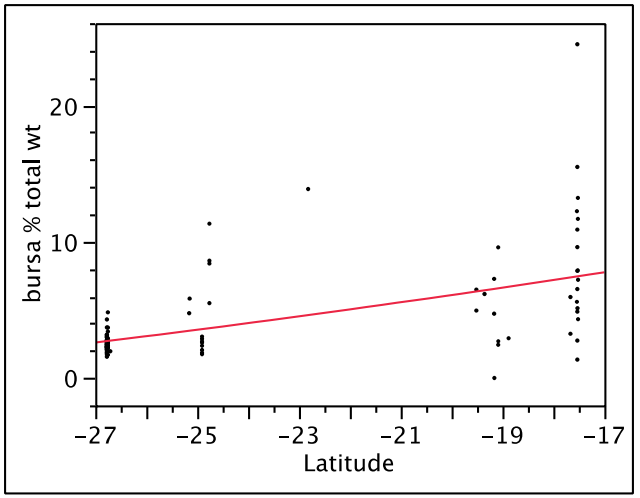
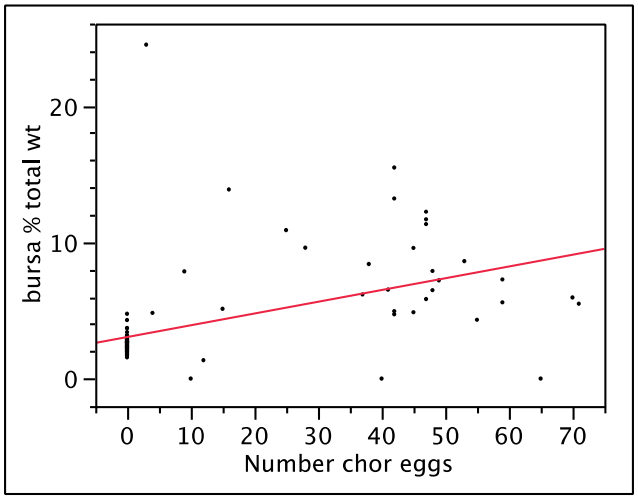


Latitude ° S



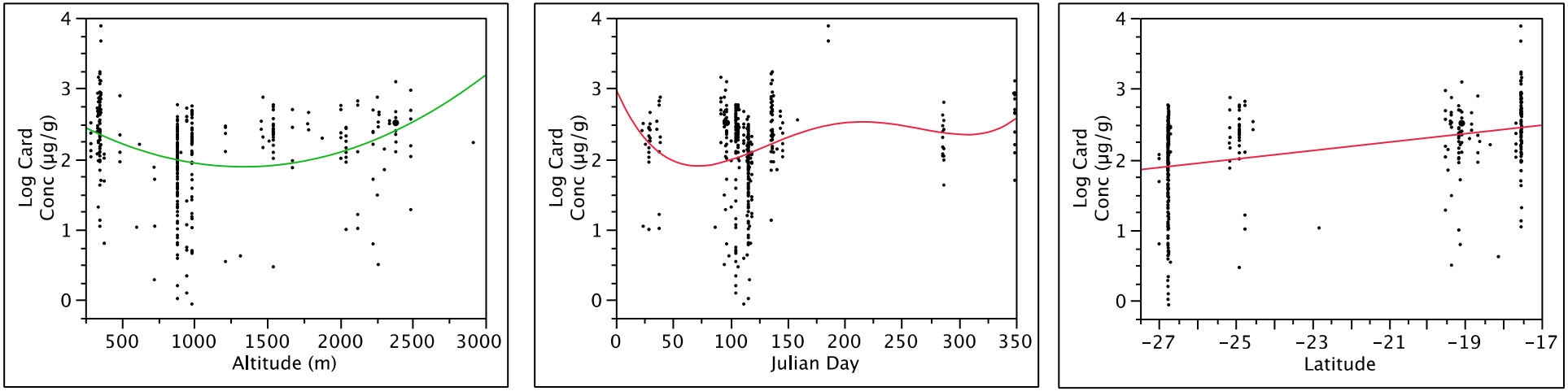


Significant polynomials for altitude & latitude, increased male contribution at low & high altitude and lower latitudes.

Bursa % also increases with number of chorionated eggs.

Cardenolide concentrations sequestered from larval host plants

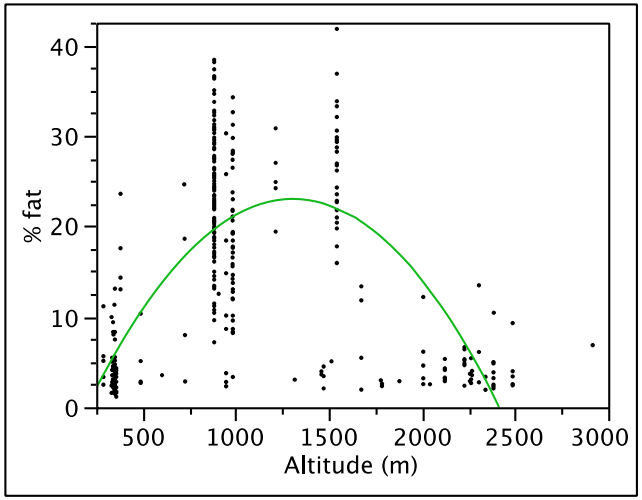
Altitude (m) Julian Day Latitude ° S



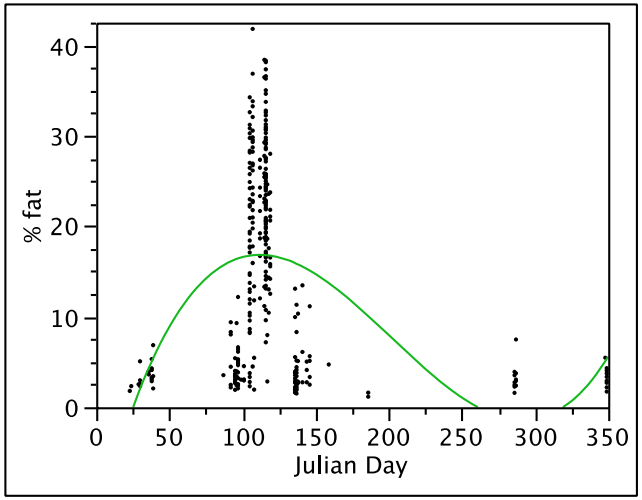
Significant polynomials for altitude, Julian day & latitude, lower cardenolide at intermediate altitude, autumn (April 90-120) & higher latitudes

Fat content of adults

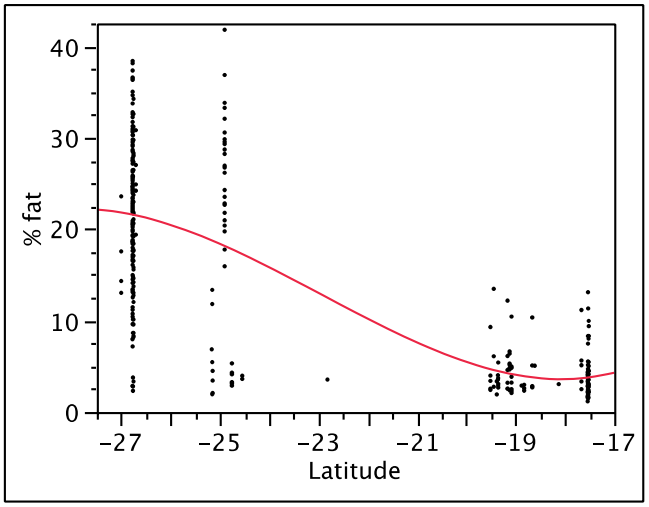
Altitude (m)



Julian Day



Latitude ° S



Significant polynomials for altitude, Julian day & latitude,
Higher fat at intermediate altitude,
autumn (April 90-120) & higher latitudes

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