The rarity of a species: *Stirellus catalinus* (Hemiptera: Cicadellidae) biases in distribution by sampling effort

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Introduction

Insects represent the majority of known species in the world; however, a large part of this group remains undocumented. Recently, the importance of insects for ecosystems has begun to highlighted due to the apparent decrease in their abundance and diversity. Unlike other groups such as birds and mammals, data on distributions and population trends in insects are scarce, therefore, the conservation status is unknown. Natural History Collections (NHCs) maintain a large amount of data and occurrences available for many species, in addition, solid and reliable sources of information on biodiversity, which has recently begun a former digitization.

Unfortunately, digital records of specimens represent a small fraction, correct use of this information to evaluate changes in abundance and distribution over time is still limited. The emergence of platforms such as BugGuide.net and iNaturalist.org have allowed obtaining quicky Digital Occurrence (DO) records for certain species. The objective of this project was to identify biases presented by the known historical distribution of a species through NHCs and DO records.

Methodology

Data from occurrence records from NHCs were compared with those from platforms such as the Global Biodiversity Information Facility (GBIF:org), Integrated Digitalized Biocollections (iDigBio.org), CONABIO (datos.gob), iNaturalist (iNaturalist.org) and entomological collections databases. Only records determined at the species level were included.

Sampling was also carried out in Mexico using a sweep net and light trap. Adult leafhoppers were captured and preserved in 95% ethanol, abdomens of males were dissected and rinsed with 10% KOH, rinsed with water and preserved in glycerin for study.

Species-level identifications were verified by examining NHCs specimens or by assessing reliability based on the “identifier” in digital records, with identifications made only by recognized taxonomist. Records with outlier geographic coordinates were removed, and records without geographic coordinates were georeferenced based on the specimen label locality.

For distribution analysis, occurrence points in Mexico were mapped for both digital repositories and historical collections. Cartographic analysis was performed in QGIS 2.16.3 with the WGS84 geodetic system.

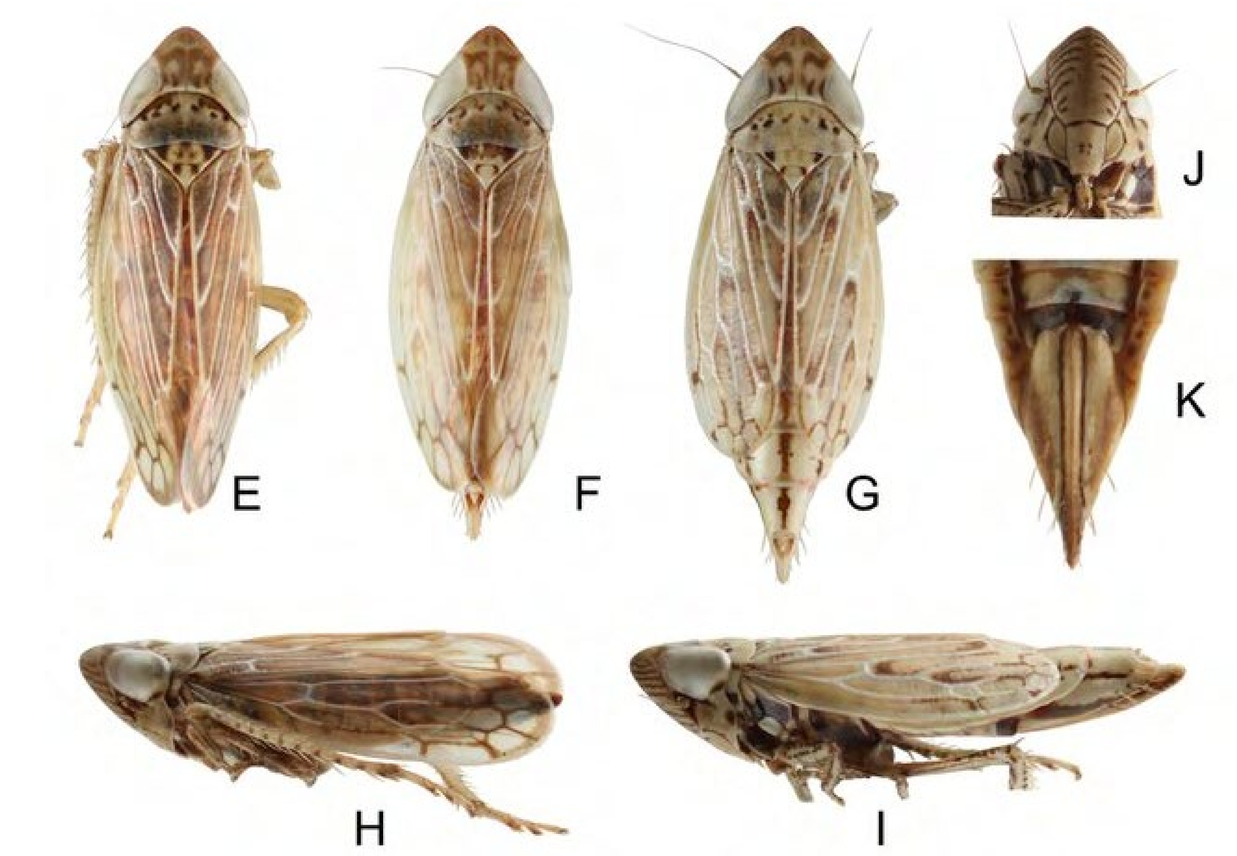

Fig 1. *Stirellus catalinus.* Taken from Duan et al 2019.

Discussion

Records show that this species, *S. catalinus*, is widely distributed in the Nearctic and Neotropical zones of Mexico. This case illustrates a bias in distributions, as it is uncommon in its type locality due to the fact that this is at the northern end of its distribution range. A similar case could occur with other insect species, e.g., *Kinonia elongata*, recorded only from its type locality (USA) but recently found in Chihuahua and Durango in Mexico (Duan et al 2019).

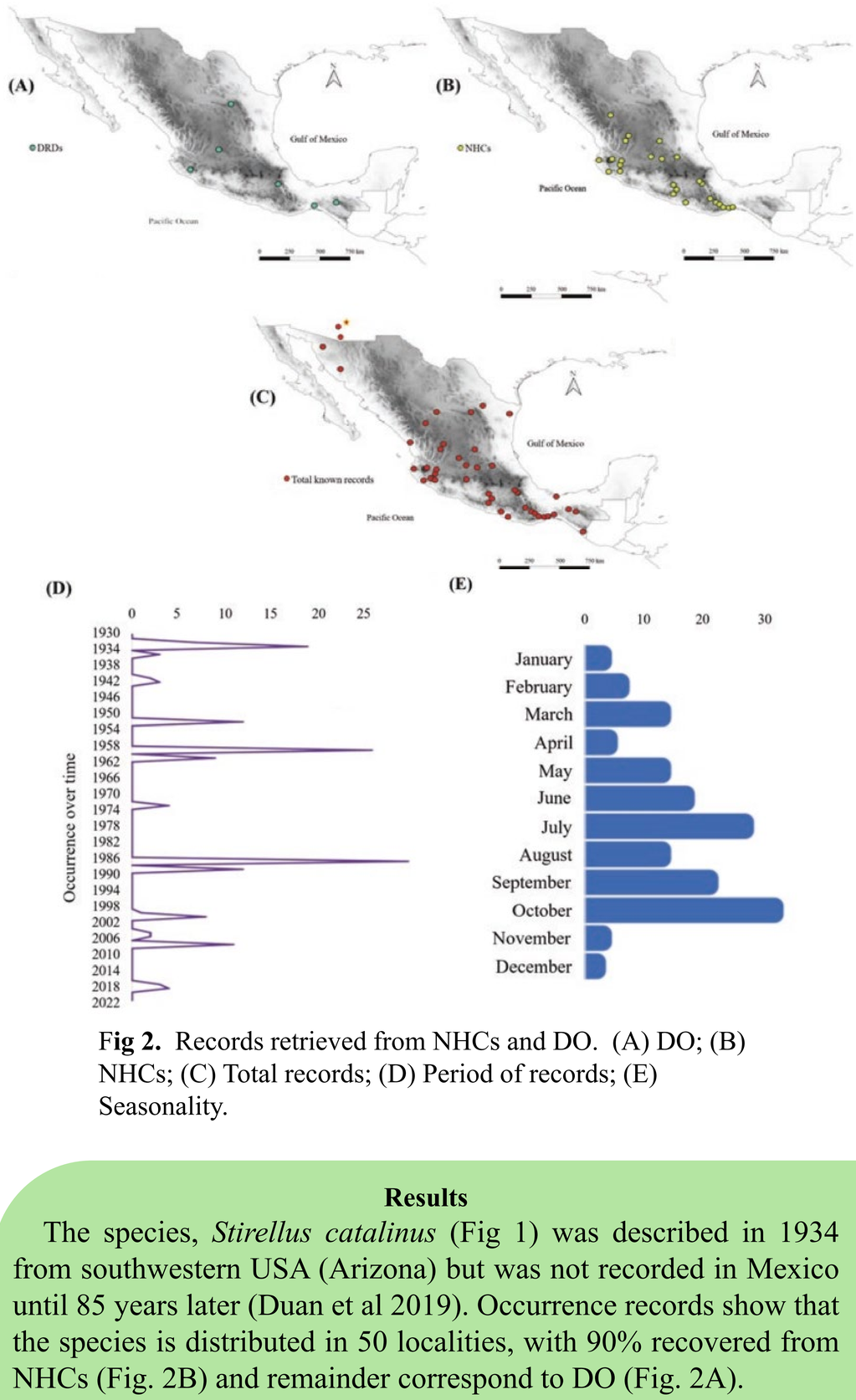

Fig 2. Records retrieved from NHCs and DO. (A) DO; (B) NHCs; (C) Total records; (D) Period of records; (E) Seasonality.

Results

The species, *Stirellus catalinus* (Fig 1) was described in 1934 from southwestern USA (Arizona) but was not recorded in Mexico until 85 years later (Duan et al 2019). Occurrence records show that the species is distributed in 50 localities, with 90% recovered from NHCs (Fig. 2B) and remainder correspond to DO (Fig. 2A).

35% of collection records were collected during the 21st century, with 65% in the mid-1980s. Records also could represent efficient seasonality and peaks of abundance (Fig. 2E). Occurrence records covered multiple interception events from the 1930s to the present (Fig. 2D).

The distribution constructed from the NHCs and DO shows that center of distribution for this species is further south from where it was described, so the type locality is an extreme of current distribution, which was distributional biased (Fig. 2C).

References

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