



## **Modeling of the modal structure of the rainy season in Israel and its application to ecological aspects of amphibian reproduction success**

Adi Etkin (1), Hadas Saaroni (2), Baruch Ziv (3), Shimon Fridkin (1), and Avital Gasith (1)

(1) Tel Aviv University, The Porter School of Environmental Studies, Tel Aviv, Israel (adietkin13@gmail.com), (2) Tel Aviv University, Geography and the Human Environment, Tel Aviv, Israel (saaroni@post.tau.ac.il), (3) The Open University of Israel, Dept. of Natural Science, Ra'anana, Israel

In mediterranean-climate regions rain falls during a limited period in winter. In Israel (mediterranean-climate), about 95% falls between October and April, 2/3 in mid-winter months. We analyzed daily rainfall information (Israel Meteorological Service) for the period 1951-2014, (126 stations, representing the mediterranean-climate region of Israel). A “daily rainfall” characteristic was calculated for each day by averaging rainfall over the entire set of stations. To identify the modal structure of the rainy season we applied various smoothing filters on the daily rainfall data of 10 selected seasons that represented different number of modes. The smoothing duration started from 7 days and was gradually extended until the modality of the rainy season was best represented. In addition, we performed a series of Gaussians for each season. Each Gaussian corresponds to one mode, characterized by its timing, amplitude and duration. The compatibility of the modeled season with the observed (smoothed) one was assessed by the correlation between them, the standard error and the variance, attempting to keep the number of Gaussians to minimum.

Up to five modes were usually found, not confined to the mid-winter months. Significant modes were found in October (2000) as well as April (1971). The correlation between the modeled and the observed rainfall was above 0.9.

Amphibians inhabiting winter pools in Israel are highly dependent on the pool's hydroperiod (time of filling to drying). Spawning season in Israel is mainly between mid-December to the end of March varying from north to south and by the timing of pool filling with rainwater. Reproduction success (completion of metamorphosis) depends on the timing of spawning and on the pools' hydroperiod. The latter is determined by the pattern and amount of rainfall. Interrupted or short hydroperiod result in reproduction failure. Selected rain-pools in the central coastal plain of Israel were inspected for the dates of filling and drying against the structure of the rainy season, the temperature and evaporation regimes (data from the nearest meteorological station - Bet Dagan). Two opposing seasonal pattern of pool hydro-dynamic were identified; in winter 2001/2002 the pools were filled in early December and dried in early April, whereas in 2002/2003 they were filled in late January and dried in early July. Filling of the pools was in accordance with the main modes of the rain. The substantial difference in the time of drying of the pools in the above seasons may be attributed to the timing and rain intensity of the last mode, the difference in rainfall, (~20% higher in 2003) and the difference in rate of evaporation. A prolonged heat wave, accompanied by low relative humidity (Sharav), at the end of February and the first half of March 2002 probably contributed to the early drying of the pools in 2002. Reproduction success of amphibians that require at least 12 weeks and often more to complete metamorphosis, is expected to be handicapped in years with a rainfall characteristics and resulting short hydroperiod similar to that observed in 2002 in the central coastal plain.