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ARTIFICIAL SITES AND AMPHIBIANS: A PRELIMINARY BIBLIOGRAPHIC ANALYSIS

SUMMARY

Many amphibian species reproduce or are active in artificial habitats such as ponds, troughs, and caves. In this study, we analysed the temporal patterns relating amphibians and artificial sites, emerging from the scientific literature examined from Scopus database over the period 1981-2020. The proportion of papers relating to amphibians and artificial sites remained constant during 1981-2000, but increased from 2005, suggesting a recent growing scientific interest over this topic.

Key words. Amphibian decline, change-point analysis, constructed ponds, trend.

RIASSUNTO

Siti artificiali e anfibi: un'analisi preliminare della bibliografia. Lo studio analizza il trend delle pubblicazioni accessibili su Scopus e riguardanti siti artificiali e anfibi, nel periodo 1981-2020. L'incremento delle pubblicazioni a partire dal 2005 mostra un recente interesse su questo argomento.

Parole chiave. Anfibi, declino, change-point analysis, siti artificiali, andamento.

Introduction

Amphibians breed, forage and are active in different kinds of man-made artificial habitats. In particular, species with a biphasic reproductive cycle often breed in artificial water reservoirs, that were constructed for watering livestock, crop irrigation, water discharge or human consumption (Temple &

Cox, 2009; Romano *et al.*, 2012; Hartel *et al.*, 2014). However, this ecological adaptation has been recognised as relevant for the ecology and conservation of amphibian populations only in recent times (e.g., Arntzen & Teunis, 1993; Caballero-Diaz *et al.*, 2020 and references therein). In this preliminary study, this growing interest concerning amphibian artificial sites was assessed by evaluating the trend of the annual number of scientific papers published on this topic over 40 years, from 1981 to 2020.

Materials and Methods

In March 2021, Scopus database was searched for the annual numbers of papers published in the period 1981-2020, with the word "amphibians" in title, abstract or keywords. Moreover, for each year, the number of amphibian articles with the words "artificial pond", or "man-made", or "constructed", or "tank", or "trough" in title, abstract or keywords was also retrieved. Only papers effectively dealing with artificial amphibians breeding or activity sites were selected. The total scientific output increased exponentially in the last 100 years (Larsen & von Ins, 2010), and to evaluate the presence of proportional trends, we divided the total annual amphibian publications by the annual number of articles dealing with artificial sites. Temporal patterns were analysed by means of Mann-Kendall non-parametric test (Gilbert, 1987) and the presence of change-points was modelled by means of a Bayesian algorithm that uses Markov chain Monte Carlo iterations (Gallagher *et al.*, 2011). All statistics were obtained with PAST 4.05 software.

Results and Discussion

During the 40-year study period, 35,975 articles with the word "amphibians" in title, abstract or keywords were retrieved. Within these, 210 papers dealing with artificial sites were selected. There was a clear overall temporal increase in both time series over the entire period (Mann-Kendall trend test, $P < 0.0001$, in both cases; Fig. 1). However, the percentage of publications dealing with artificial sites remained constant during the 1981-1990 and 1991-2000 decades (Mann-Kendall trend test, $P > 0.40$, in both cases), while an increasing trend was observed starting in 2001-2010 (Mann-Kendall trend test, $P = 0.014$, Fig. 1). There were two change points in the total amphibian publication series, the first in 2005 and the second in 2010 (Fig. 1). Also the artificial papers series showed two change points in 2005 and in 2007, when a plateau in the series could be observed.

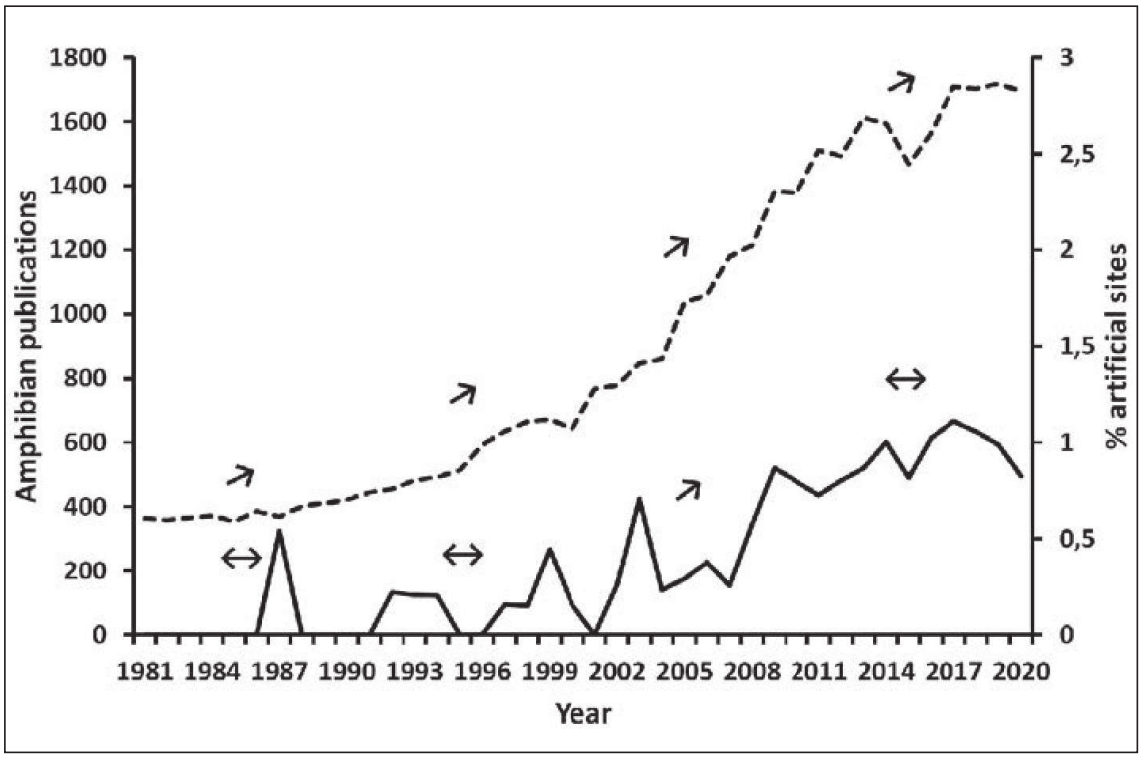

Fig. 1 — Trend in amphibian (stippled line) and in the % of artificial site papers (filled line). One-sided arrows indicate increasing trend; two-sided arrows indicate no trend.

Our preliminary analysis showed that a constant increase in amphibian publication was observed over the last 40 years, as observed in all scientific disciplines over the same period (LARSEN & VON INS, 2010). A more interesting finding is that there was a higher rate of scientific publications concerning amphibians and artificial sites, in the decade 2001-2010 and in particular starting in 2005. These preliminary findings suggest that there was a recent interest in the ecology of amphibians breeding, feeding or active in artificial habitats. The implications of this specific interest should be investigated to better understand conservation issues of amphibian populations that reproduce in small and isolated standing water habitats. Amphibians are experiencing a global decline, since about 1990 (BLAUSTEIN & WAKE, 1990). Many different factors have been suggested as responsible for these widespread declines such as habitat modification, water pollution, climate change, diseases and introduction of invasive alien species (STUART *et al.*, 2004). In regions with temperate and dry climate, the loss of standing water habitats, due to reduction in rainfall or abandonment of traditional farming, are possible causes of decline (e.g. TEMPLE & COX, 2009; CANESSA *et al.*, 2013). In these situations, maintaining artificial water reservoirs used in traditional farming, could be a successful conservation strategy, being favourable to both

local agricultural communities and endangered amphibian populations (TEMPLE & COX, 2009).

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