PRELIMINARY DATA ON CLIMATE CHANGE EFFECTS ON THE PHENOLOGY AND REPRODUCTIVE PARAMETERS OF TWO AQUATIC SPECIES NESTING IN THE ALPINE ENVIRONMENT: THE LITTLE GREBE *Tachybaptus ruficollis* AND THE EURASIAN COOT *Fulica atra* IN THE AURONZO DOLOMITES (EASTERN ALPS, VENETO, NORTH-EASTERN ITALY)

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Riassunto – Dati preliminari sugli effetti del cambiamento climatico su fenologia e parametri riproduttivi di due specie acquatiche nidificanti in ambiente alpino: il Tuffetto *Tachybaptus ruficollis* e la Folaga *Fulica atra* nelle Dolomiti di Auronzo (Veneto). Nel 2023 è stata verificata, per la prima volta, la seconda riproduzione di Tuffetto e Folaga presso il Lago di Misurina e il Lago Antorno. Sono stati registrati schiuse fino in settembre e giovani nutriti dai genitori fino alla metà di ottobre (per la Folaga in un caso fino a fine ottobre). I valori dei parametri riproduttivi erano superiori nella prima riproduzione rispetto alla seconda. Si evidenzia il ruolo del riscaldamento globale ed il parallelismo con gli insetti.

Bird species breeding in alpine environments must cope with strong seasonal climate changes and a reduced season suitable for reproductive activities, which leads to a lower number of breeding attempts per single suitable season compared to species nesting at lower altitudes (cf. e.g. Martin & Wiebe, 2004).

Climate change has various effects on animal species such as modification of ranges or phenology (see e.g. Charmantier & Gienapp, 2014; Dunn & Møller, 2014; Cohen *et al.*, 2018). One of the consequences occurring in the Alps in recent decades is the occupation of previously unused zones with expansion of the breeding ranges of bird species towards higher altitudes. In this context, breedings of the Little Grebe *Tachybaptus ruficollis* and Eurasian Coot *Fulica atra* were found at Lake Misurina (46°34'56"N 12°15'18"E, 1750 m a.s.l.) and Lake Antorno (46°35'41"N 12°15'54"E, 1870 m a.s.l.) in the Auronzo Dolomites (Eastern Alps, Veneto, North-eastern Italy) (Rassati, 2020).

The Little Grebe and Eurasian Coot usually have one or two broods per year (Cramp & Simmons, 1977, 1980). In the lakes of the Eastern Alps, it was believed in the recent past that, even though the possibility of a second egg laying could not be excluded, the characteristics (*sensu lato*) of the sites determined a single annual breeding of the two species (Rassati, 2013, 2020).

Regular monitoring over the years allowed the detection in 2023 of breedings of the Little Grebe and Eurasian Coot in the two above-mentioned lakes (Fig. 1), with hatchings until September and young fed by the parents until mid-October (for the Eurasian Coot, in one case until the end of October). Moreover, for both species, the second annual breeding was recorded for the first time.

Figure 1. Young individuals of the Little Grebe and Eurasian Coot. Lake Antorno. (Photo G. Rassati).
Figura 1. Giovani di Tuffetto e di Folaga. Lago Antorno. (Foto G. Rassati).

The fledging rate (no. fledged young/no. hatched pulli) and breeding success (no. fledged young/pair that produced pulli) (Tab. 1) were clearly higher in the first breeding than in the second one, even if the small number of cases does not allow definition of the true ratios with reasonable certainty. In addition, the second broods had a lower number of pulli per pair: Little Grebe 3.0 vs 3.8, Eurasian Coot 3.3 vs 3.7. Considering both the first and second breeding (Tab. 1), the values of the reproductive parameters differ variably from what was previously found (Rassati, 2020, unpub. data). However, the double breedings increased the total number of fledged young of the two species at the local scale.

The climate trend observed in Veneto from the 1950s onward generally confirms what is occurring at a European scale, i.e. a significant increase in temperatures: in particular, the mean annual temperature shows a sharply increasing trend (+1.3 °C in the period 1993-2017) (ARPAV, 2017). Summer 2023 was hot and at the end of August there was an intense heat wave especially in the mountains where heat records for the end of summer were broken and autumn 2023 saw a prolonged mildness never recorded in previous years, with the warmest September in 45 years (ARPA Veneto). Hence climate change and the consequent warming appear to be fundamental in allowing a second successful breeding in Alpine sites, confirming the extension (towards autumn

months) of the duration of the breeding period also in these environments.

Table 1. Reproductive parameters for the first (1) and second (2) breeding. 1-2: cumulative data (Breedings 1 and 2). BS: breeding success (mean ± SD). No. young: minimum and maximum number of fledged young per pair. / **Tabella 1.** Parametri riproduttivi inerenti la prima (1) e la seconda (2) riproduzione. 1-2: dati cumulati (Riproduzioni 1 e 2). BS: successo riproduttivo (media ± DS). No. young: numero minimo e massimo di giovani involati per coppia.

Little Grebe				
Breeding	No. pairs	Fledging rate	BS	No. young
1	6	78.3%	3.00 ± 0.63	2 - 4
2	2	50%	1.50 ± 0.71	1 - 2
1-2	8	72.4%	2.63 ± 0.92	1 - 4
Eurasian Coot				
Breeding	No. pairs	Fledging rate	BS	No. young
1	10	83.8%	3.10 ± 0.74	2 - 4
2	3	50%	1.67 ± 0.58	1 - 2
1-2	13	76.6%	2.77 ± 0.93	1 - 4

The second breedings of the Little Grebe and Eurasian Coot are also indicative of the parallelism that occurs with other animal classes as a consequence of global warming, e.g. with insects and the relative number of generations they complete in a year (Corbet *et al.*, 2006; Jönsson *et al.*, 2009; Altermatt, 2010), as well as the possibility of moving up valleys and slopes (Kocsis & Hufnagel, 2011; Öhrn, 2012). In this regard, on 29 August 2022 during surveys aimed at verifying the breeding of the species under study, the song of *Cicada orni* was heard in the wood of Norway Spruce *Picea abies*, Swiss Pine *Pinus cembra* and European Larch *Larix decidua* near Lake Misurina at 1780 m a.s.l.

In conclusion, the results highlight the changes caused by global warming with modification of the phenology of animal species and the "mixing" underway in Alpine animal communities with Mediterranean elements coming into contact with species with a Eurosiberian boreoalpine distribution (cf. e.g. Rassati, 2016) also of different faunal groups: contemporaneously with the song of *Cicada orni*, a Spotted Nutcracker *Nucifraga caryocatactes* was emitting its call a short distance away.

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