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Breeding distribution of the Dipper *Cinclus cinclus* in the Reno valley (Appennino Emiliano, Northern Italy)

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Abstract - This work was carried out with the aim of collecting information with regard to the breeding of Dippers (*Cinclus cinclus*) in the upper part of the Reno valley (Appennino Emiliano, Northern Italy) and to correlate the nesting pair distribution with ecological parameters of the watercourses, with particular reference to water quality, assessed by I.B.E. method. The results have shown that the species is widely spread along the surveyed streams, most likely because of climatic conditions, producing a positive effect on the flow of the rivers, and the generally good conditions of the stream banks and beds. Water quality measures performed through I.B.E. procedures on seven sampling stations have not revealed correlations between the presence of the Dipper and the evaluated variables. Accordingly, it is considered that limiting factors for this species could be related to criteria not taken into account in this research.

Introduction

Particularly during the breeding season, the Dipper (*Cinclus cinclus*) feeds almost exclusively on larvae and nymphs of insects living in the stream macrobenthonic biocoenosis, preferring in particular stoneflies (*Plecoptera*), mayflies (*Ephemeroptera*) and caddis (*Trichoptera*) (Ormerod 1985, Ormerod *et al.* 1985a, Cramp 1988, Tyler and Ormerod 1994).
Correspondingly, benthonic communities are widely used in environmental quality assessment of the watercourses. In Italy the evaluation of stream quality is conducted using the I.B.E. (Indice Biotico Esteso) method (Ghetti 1997), as set up in the United Kingdom (Woodiwiss 1978), and applied in our Country during the last ten years or more (Ghetti 1986).
This work was focused in order to obtain information about breeding Dipper in the upper part of the Reno valley and to evaluate possible correlations between distribution of nesting pairs and some ecological parameters of the watercourses, with particular reference to water quality assessed by the I.B.E. method.

Study area and methods

This study was carried out in the upper part of the Reno valley and its tributaries, upstream of the town of Bologna (Appennino Emiliano, Northern Italy) (Fig. 1), in an area where there was no available information on this species, although nesting Dippers were monitored in neighbouring areas (Ceccarelli 1987, Ravasini *et al.* 1988, Farina and Tellini Florenzano 1997). This valley seems to match the ecological needs of the Dipper because of climatic conditions, characterised by heavy rainfalls during most of the year and by a short dry period in summer (Fabozzi *et al.*, 1994): in these conditions also the smallest watercourses are permanent, showing a relatively constant flow at least during the Dipper nesting season. In addition, the rugged morphology and the presence of broadleaved trees overhanging the streams create good conditions for breeding Dippers (Tyler and Ormerod 1994).
The ornithological research was carried out from March 9th to June 8th 1995, with 24 days of field work, and was developed in two different phases:

1) at the beginning of the nesting period a survey was conducted to assess the distribution of the Dipper on the watercourses of the whole study area; the presence of the species was checked by direct observations and dropping and nest findings in 14 random stream stretches, each of them 500-1.000 m long (Fig. 1);

2) additionally, a more detailed study was carried out on the sample area of the Limentra di Treppio watershed (250 - 600 m a.s.l.). This watershed was chosen as sample area on the basis of the results of the survey as described in 1), since here the Dipper was found upstream and not in the ending part of the water-

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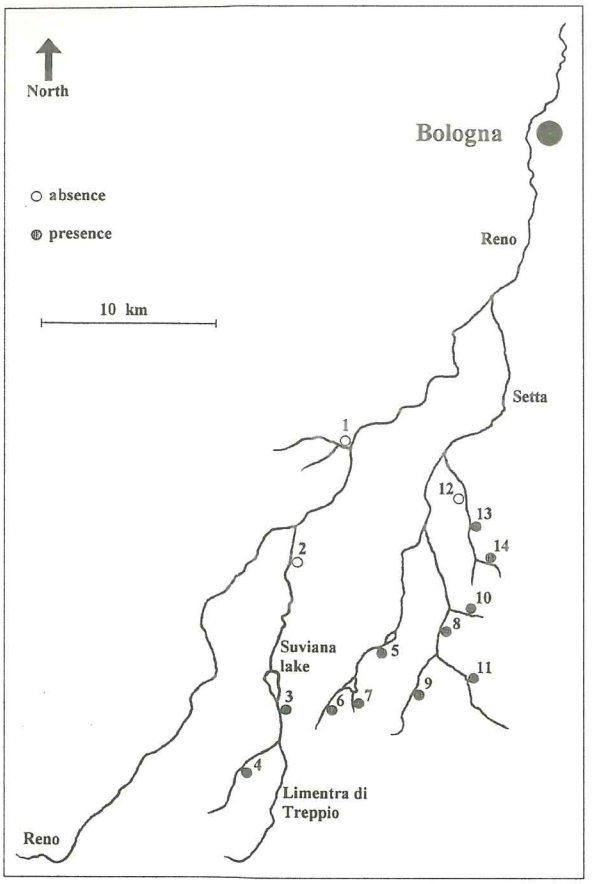

Fig. 1. Checked stretches in the upper part of the Reno valley during the first phase of the survey aiming to verify the distribution of the Dipper. The numbers of the stretches correspond to those of Tab. 1.

course. When possible, the length of breeding territories was assessed by the research of the occupied nests and by the doubling back method (Sarà *et al.* 1994). During the work approximately 19.000 m of watercourses were surveyed (Fig. 2).

The Limentra di Treppio watershed is schematically divided into two parts. The division between these two parts is marked by the artificial lake of Suviana, used for the production of electric power. The upper part shows a low density of human settlements and is characterised by a geological substratum of marly arenaceous flysch (Amadesi 1968); the morphology is rugged and the forest coverage is wide, with abandoned coppiced woods dominated by *Quercus cerris* and *Q. pubescens*, *Castanea sativa* and *Fagus sylvatica* (only at the highest altitude). Downstream the geomorphology changes suddenly due to the presence of extended clayey rocks; the landscape becomes soft, the soil in large part is tilled and the woods appear only in scattered patches, especially upon sloping areas. The dam creating the Suviana lake induces a considerable modification of the natural downstream flow, producing high flow periods alternated with slow flow periods, both of them generally lasting only a few hours.

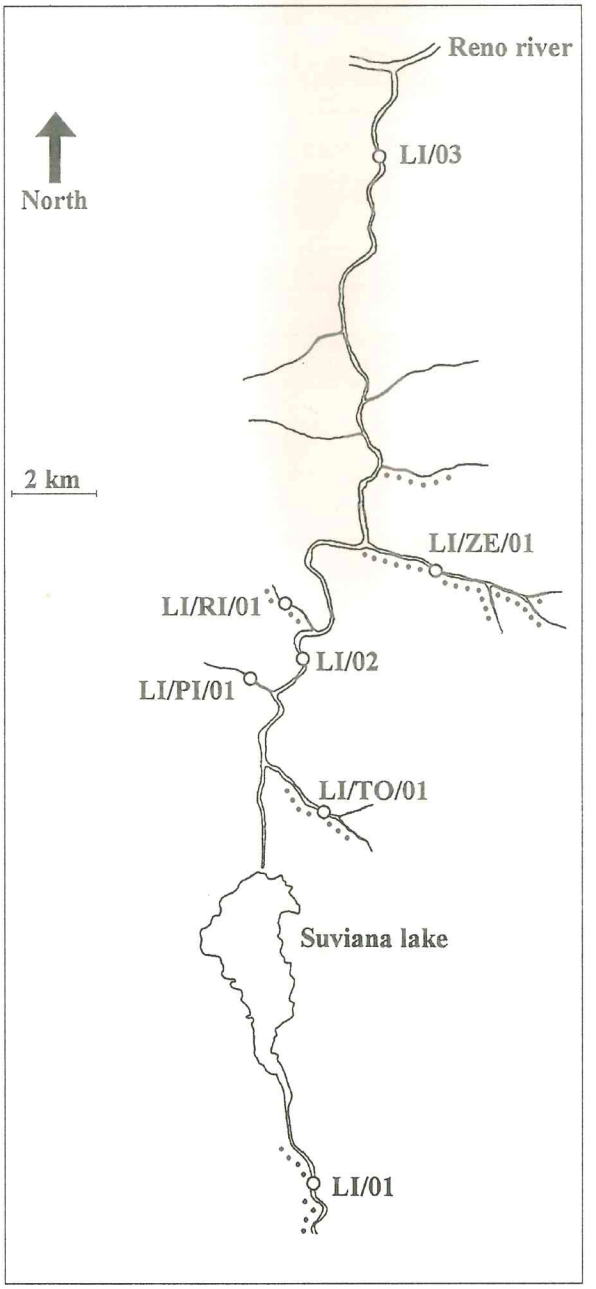

Fig. 2. Dipper distribution in the sample watershed of the Limentra di Treppio stream based on the observations carried out during the second phase of the survey. The full dots (•) beside the watercourses show the stretches where signs of Dipper presence were recorded. The empty circles (o) indicate the water quality sampling stations; the letters correspond to those of Tab. 2 and Tab. 3.

In order to assess possible parameters able to affect the distribution of nesting pairs in the Limentra di Treppio watershed, water quality was evaluated in seven different stations (Fig. 2), following the standard procedures of I.B.E. method (Ghetti 1986, 1997).
In accordance with the I.B.E. routine procedure, pH and conductivity were measured during the macrobenthonic collecting operations. The data were gathered during the first half of July 1995.
The measured parameters (independent variables) and presence/absence data of Dipper (dependent variable) were correlated by stepwise multiple regression analysis by means of SPSS software package (SPSS Inc. 1997).

Results

The species is widely spread along the checked watercourses of the upper part of the Reno valley (Fig. 1). Dipper presence was established in 11 of the 14 surveyed stretches (Tab. 1).
In the Limentra di Treppio sample area evidence was found of a considerable presence of the Dipper upstream the lake: of 4540 m of surveyed stretches, 3800 resulted occupied. Downstream of the dam signs of presence were not found in the main watercourse, but were along four of the eight surveyed tributaries (Fig. 2), for a total of 5410 occupied meters *vs.* 14490 checked. The proportion of the checked areas where a presence was found was significantly higher upstream as opposed downstream (test of equality of two proportions = 2975.5; p=0.0001).
In the Limentra di Treppio watershed, downstream of the dam at least five territories in four distinct tributaries were discovered and two occupied nests were observed. Applying the doubling-back method, the length of two contiguous territories was evaluated in about 1000 and 1200 m respectively. The field survey showed how in this area the Dipper occupies small watercourses with low flow, some just one meter wide. However, the evidence of territories along streams narrower than 2 m did not allow comparison as to the breeding density in different river stretches according to the observation of Tyler and Ormerod (1994).
The water quality assessment (Tab. 2) has shown decreasing I.B.E. values along the main stream of the Limentra di Treppio, on account of the modification of the natural flow because of the dam and, additionally, due to the progressive increase of human settlements in the lower part of the watershed, affecting the water quality.
The surveyed tributaries are characterised by good water conditions (quality class I or II), except for Riagna stream where an 8/7 I.B.E. value was found (LI/RI/01 - quality class II/III).
The values of the chemical and physical parameters are shown in Tab. 3. The stepwise regression (Tab. 4) did not allow for identification of factors influencing significantly the Dipper distribution.

Discussion

The collected data confirm that the study area is characterised by suitable habitat conditions for breeding Dippers even on smallest watercourses. In contrast to

Tab. 1. Presence of the Dipper in the surveyed stretches in the upper part of the Reno valley (A: absence; X: signs of presence; T: territorial behaviour; IS: adults with faecal sac or food; Ni: occupied nest; Ju: recently fledged juveniles).

n.	Watercourse	Place	Altitude (m)	Presence
1	Vergatello	Africa	225	A
2	Limentra	Ponte di Verzuno-Riola	250	A
3	Limentra	Fabbriche	500	IS
4	Limentrella	Treppio	540	T
5	Brasimone	Molino delle Mogne-Lago S.Maria	550	Ni
6	Brasimone	Lavaccioni	900	Ni
7	Torto	Brasimone - San Giuseppe	870	Ju
8	Setta	Badia	430	X
9	Setta	Rio Secco-Molinuccio	690	X
10	Voglio	Pian del Voglio	500	X
11	Gambellato	Baragazza	500	X
12	Sambro	Valle	390	A
13	Sambro	S. Benedetto V.S.-Molino Tarello	550	X
14	Sambruzzo	Qualto	640	X

Tab. 2. Results of the I.B.E. analysis at the seven sampling stations in the Limentra di Treppio watershed (*see also Fig. 2*).

TAXA	LI/01	LI/02	LI/03	LI/ZE/01	LI/TO/01	LI/PI/01	LI/RI/01
Plecoptera							
Leuctridae							
Leuctra	L	U	U	L	L	I	
Nemouridae							
Nemoura		*					
Protonemoura		*		L	I		
Perlidae							
Dinocras	L						
Perla	L						
Ephemeroptera							
Baëtidae							
Baëtis	L	L	U	U	U	L	L
Caenidae							
Caenis				I	I		
Ephemerellidae							
Ephemerella	L	U	L	*	I		
Ephemeridae							
Ephemera	*			*	*		
Heptagenidae							
Ecdyonurus	I	I	*	*	U	*	
Electrogena				*	I		
Eleorus	I						
Leptophlebiidae							
Habroleptoides					I		
Habrophlebia	I	I		*	I	L	L
Paraleptophlebia		*					
Trichoptera							
Hydropsychidae	L	L	*	I	I		
Hydroptilidae				*			
Limnephilidae	L	I		*	U		U
Philopotamidae	I	I		I	I		I
Polycentropodidae	I	I	*	I	I	I	I
Rhyacophilidae	L	I	*	L	L	L	I
Coleoptera							
Dryopidae						I	
Dytiscidae				*		I	L
Elmidae	L	L	I	L	L	I	I
Gyrinidae				I			
Helodidae					I		
Hydraenidae	L	I	I	L	L	L	L
Hydrophilidae						I	
Odonata							
Gomphidae							
Onychogomphus				I			
Diptera							
Ceratopogonidae	*	I	*	*	I	L	L
Chironomidae	*	I		I	*	*	*
Dixidae						I	
Limoniidae	I	U	I	I	L		

Segue: Tab. 2

Continua: Tab. 2

TAXA	LI/01	LI/02	LI/03	LI/ZE/01	LI/TO/01	LI/PI/01	LI/RI/01
⊕ *Psychodidae*				*	*		
Simuliidae	I	*	*	I	*		
⊕ *Stratiomyidae*				*	*	*	
Tabanidae	I						
Tipulidae				I			
Heteroptera							
Nepidae						I	
Notonectidae						I	
⊕ *Veliidae*							*
Gastropoda							
Ancylidae		I					
Hirudinea							
Erpobdellidae							
Dina	I						
Erpobdella		I			I	I	I
Oligocheta							
Lumbricidae	I					I	
Other							
⊕ *Idracarini*	*	*	*	*	*	*	*
TAXA (totale number)	20	17	6	16	20	16	11
I.B.E.	10/11	9	7	10/9	10/11	9/8	8/7
QUALITY CLASS	I	II	III	I/II	I	II	II/III

Legenda:
U - dominant *taxon* in the sampled community
L - *taxon* actually present and abundant
I - *taxon* actually present
* - *taxon* related to drift or not considered in the index computing
⊕ - *taxon* not included in the index computing

Tab. 3. Altitude of the macrobenthos collecting stations and pH and conductivity values; measurements were effected only one time during the macrobenthos collecting operations (*see also Fig. 2*).

STATIONS	LI/01	LI/02	LI/03	LI/ZE/01	LI/TO/01	LI/PI/01	LI/RI/01
Altitude (m a.s.l.)	490	360	255	375	405	410	395
pH	8,4	8,5	8,3	8,3	8,0	8,2	8,1
Conductivity (*m*S/cm)	251	262	292	525	443	621	665

Tab. 4. Results of the correlation, effected by means of stepwise multiple regression analysis, between Dipper presence (dependent variable) and physical-chemical and biological parameters (independent variables) - (n. s. = not significant).

Parameter	Partial Correlation	F to Enter	
Altitude	- .566	2.356	n. s.
pH	. 437	1.177	n. s.
Conductivity	- .245	.319	n. s.
Taxa	- .397	.936	n. s.
I.B.E.	- .551	2.182	n. s.
Water Quality Class	.633	3.344	n. s.

the observations of other Authors, it does not seem possible to demonstrate any correlation between Dipper presence and nesting site availability (Del Guasta and Marcuzzi 1993), or stream water level reduction in summer (Bernoni 1987), or indeed bank and bed modifications induced by man in order to canalise the watercourses (Lo Valvo *et al.* 1994).

In the wide range survey no significant differences were observed with regard to the geomorphological and vegetational aspects between the tree stream stretches where the species was absent and the others, where evidence of Dippers have been found. In those stretches, the absence of the Dipper could be due to particular water conditions.

On the Limentra di Treppio stream, pH values seem to be optimal for the species and therefore can not be considered a limiting factor, in contrast to observations in ecosystems characterised by water acidity (Ormerod *et al.* 1985b, 1991, Ormerod and Tyler 1987, Peris *et al.* 1991, Vickery 1991, 1992, Vickery and Ormerod 1991, Tyler and Ormerod 1992).

On the main stream of Limentra, the presence of the Dipper seems to be related to high levels of water quality and to the consequent biodiversity observed in the macrobenthonic community, typical of the watercourse upstream the Suviana lake. Downstream of the dam, a progressive water quality decrease becomes evident along the river, with the gradual disappearance of *Trichoptera* and the evident numerical reduction of *Plecoptera* and *Ephemeroptera*. In this stretch, the Dipper occurs only occasionally and no nesting pairs have been found. This pattern appears similar to that recorded in different environmental conditions (Sarà *et al.* 1994).

The Dipper-I.B.E. relationship is not so clear in the tributaries; in fact, in the LI/RI/01 station the Dipper has been found, in spite of a II/III quality class. This can be explained by relevant abundance of *Limnephilidae* (*Trichoptera*), which represents an important food resource during the breeding season (Tyler and Ormerod 1992).

In conclusion, limiting factors for the Dipper could probably be also related to other parameters non considered in this research, the effects of which could make unclear any possible correlation between water quality assessed by I.B.E. method and Dipper breeding distribution.

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Riassunto - Il presente lavoro è stato intrapreso con la finalità di acquisire dati sulla presenza del Merlo acquaiolo (*Cinclus cinclus*) in periodo riproduttivo nella parte montana della valle del Reno (Appennino Emiliano, nord Italia) e di correlare la distribuzione delle coppie nidificanti con parametri utilizzati per valutare le condizioni ecologiche dei corsi d'acqua ed in particolare con la qualità delle acque definita con il metodo I.B.E. I risultati ottenuti hanno mostrato che questa specie è ampiamente diffusa lungo i torrenti oggetto dell'indagine, probabilmente a causa del clima, che influenza positivamente le portate dei fiumi e dei loro affluenti, e delle condizioni generalmente buone delle rive e dei letti dei corsi d'acqua presenti nell'area. I campionamenti effettuati attraverso le procedure del metodo I.B.E. su sette sezioni non hanno consentito di evidenziare correlazioni significative tra la presenza del Merlo acquaiolo e le diverse variabili considerate. Pertanto, i fattori limitanti per la specie potrebbero essere legati anche ad altri parametri non valutati nel corso del presente studio.

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