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INDIRECT SPECIES CONSERVATION ON THE EXAMPLE OF THE CO-OCCURRENCE OF DIPPER (*CINCLUS CINCLUS*), BROWN TROUT (*SALMO TRUTTA M. FARIO*), NOBLE CRAYFISH (*ASTACUS ASTACUS*) AND CADDIES FLIES (*TRICHOPTERA*)

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Summary. Bioindicators can give us valuable information about habitat conditions of other organisms' sites. Moreover, public interest in particular species can help in the protection of other, less popular taxa. Dipper, brown trout and noble crayfish are species which people are interested in and which are widely believed to be associated with clean waters. Caddies flies larvae are less popular, but they are valuable habitat quality indicators. In this study the concept of indirect conservation is analysed on the example of the species mentioned.

Key words: bioindicators, BMWPL-PL, caddies flies, flagship species, surrogate species, umbrella species

INTRODUCTION

What are surrogate species? This expression might be used in a situation when we use one organism in order to protect another [Andelman and Fagan 2000]. In this study the expression 'indirect species conservation' is used. We can distinguish different kinds of this method of conservation: 1) indicator species – when one taxon gives us information about the situation of another one or of the environment, for example biodiversity indicators, pollution indicators (for more information see Noss [1990], Caro and O'Doherty [1999]); 2) keystone species – these are organisms whose impact is disproportionately large relative

to their abundance [Power *et al.* 1996]; 3) umbrella species – protection of these species assures the existence of other organisms which live in the same area and are dependent on similar environmental conditions (for more information see Noss [1990], New [1997], Caro and O'Doherty [1999]); 4) ambassadorial species – these are species which are popular, charismatic, that people like and are interested in, that can be useful in getting public opinion and funds [Radke 2002]; 5) flagship species – protection of this species serves whole ecosystems, they can have attributes of both ambassadorial and umbrella species (for more information see Noss [1990], Caro and O'Doherty [1999], Caro *et al.* [2004], Sergio *et al.* [2006].

In this work the concept of surrogate species is discussed on the example of caddies flies *Trichoptera* larvae and three species: dipper *Cinclus cinclus* (L.), brown trout *Salmo trutta m. fario* L. and noble crayfish *Astacus astacus* L. Figure 1 shows selected relationships between these species and attributes which give possibilities of considering the use of indirect methods of conservation in relation to these species. Not all relations occur in every correlation of caddies flies and chosen species. The concept was based on literature studies.

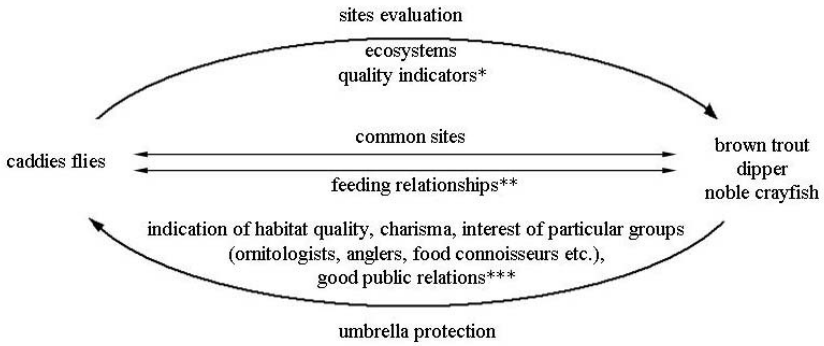

Fig. 1. Relations between caddies flies and brown trout/dipper/noble crayfish and attributes which give possibilities of considering the use of indirect methods of conservation in relation to those species
*[Czachorowski and Pietrzak 2003]
**[Cios 1992, Taylor and O'Halloran 2001, Strużyński 2007]
***[Rudnicki 1985, Eklöv *et al.* 1999, Soracea *et al.* 2002, Chylarecki *et al.* 2006, Sikora *et al.* 2007, Strużyński 2007]

The aim of this study was to check if the possibilities of using chosen organisms as surrogate species can be based on ecological reasons, or if it can work just as a psychological concept.

The following analyses were conducted: 1) checking the possibilities of using caddies flies larvae for evaluation of lowland sites of brow trout and noble crayfish and lowland wintering area of dipper; 2) comparison of indicator properties, in the case of water quality, of three chosen species and caddies flies larvae; 3) indication of the similarity of dipper, brown trout and noble crayfish sites in case of caddies flies assemblage.

MATERIALS AND METHODS

The studies were conducted from 29 April 2007 to 12 April 2008 at nine sites in central and north-east Poland. These sites are listed below – name of a river, name of the closest town: 1) Krutynia, Krutyński Piecek, 2) Marózka, Waplewo, 3) Drwęca, Drwęck, 4) Pasłęka, Łęguty, 5) Gać, above Konewka, 6) Krypianka, Garbatka Letnisko, 7) Jeziorka, Kolonia Jurki, 8) Gzówka, Jedlnia Letnisko, 9) Krasna, between Błotnica and Modrzewina. Not on every sites all of the studied species occurred. Sites of dipper: 1, 2, 4, 9 (probably), brown trout: 2, 3, 4, 7, 9, noble crayfish: 5, 6, 8 (historical site), 9.

Information on the occurrence of the species mentioned above is based on reliable literature or personal sources. On each site the inventory of cadies flies larvae was conducted twice (between April and June and between August and October). Larvae were classified to family level.

RESULTS

1114 caddies flies larvae from 11 families were caught. In total different numbers of families were detected on each species site: 6 for dipper, 8 for brown trout and 9 for noble crayfish. For each site several ecological indices were counted (Tab. 1).

Table 1. Number of families and ecological indices values

Site number	Number of families	Margalef's index	Simpson's diversity index	Shannon--Wiener diversity index	Pielou index	BMWP--PL*	ASPT**
1	6	0.94	0.56	1.47	0.57	42	7.00
2	4	0.54	0.43	1.11	0.56	28	7.00
3	5	0.82	0.72	2.01	0.86	35	7.00
4	2	0.20	0.24	0.58	0.58	12	6.00
5	5	0.91	0.70	1.99	0.86	38	7.60
6	6	1.21	0.64	1.72	0.67	34	6.80
7	4	0.66	0.33	0.95	0.48	25	6.25
8	4	0.83	0.68	1.71	0.85	28	7.00
9	4	0.64	0.11	0.39	0.20	28	7.00
Mean value	4.44	0.75	0.49	1.33	0.62	30.00	6.85

*[Kownacki and Soszka 2004], **[Hawkes 1997].

Grey colour indicates values higher than mean value

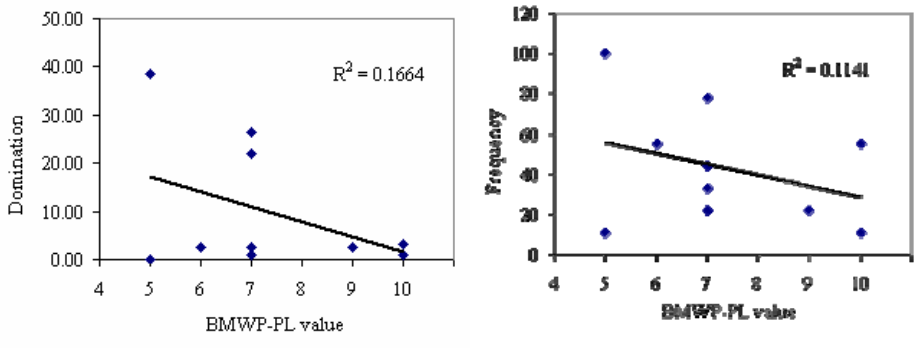

Fig. 2. Domination and frequency of caddies flies families with specific BMWP-PL value

Table 2. Sites similarity calculated using Jaccard's index

Site number	1	2	3	4	5	6	7	8	9
1	x	x	x	x	x	x	x	x	x
2	66.67	x	x	x	x	x	x	x	x
3	37.50	12.50	x	x	x	x	x	x	x
4	33.33	50.00	16.67	x	x	x	x	x	x
5	57.14	50.00	25.00	16.67	x	x	x	x	x
6	33.33	25.00	37.50	14.29	37.50	x	x	x	x
7	66.67	60.00	28.57	50.00	50.00	25.00	x	x	x
8	25.00	14.29	80.00	20.00	28.57	42.86	33.33	x	x
9	66.67	60.00	28.57	20.00	80.00	42.86	60.00	33.33	x

In order to compare indicator properties of the three chosen species and caddies flies larvae, domination (counted together for all sites) and frequency of caddies flies families with specific BMWP-PL value was calculated. These analyses were supposed to show if on the sites of the chosen species, caddies flies with higher scores are more numerous and more frequent. The results are presented in Figure 2. Moreover, the similarity of the sites was calculated using Jaccard's index. The results are shown in Table 2. Mann Whitney U-test was used in order to detect if the presence of the same flagship species determined similarity between sites. Relationship between Jaccard's index and the presence or absence of common flagship species was tested but no significance was found ($p = 0{,}208$).

DISCUSSION AND CONCLUSIONS

The assemblage of caddies flies families differs between the studied sites. Calculation of selected indices shows that in the case of chosen flagship species most of the values that were higher than average (three diversity indices were

analysed together) divided by number of sites were found for noble crayfish = 3.25 (dipper = 1.5, brown trout = 1.4). Neither domination nor greater frequency of caddies flies larvae with higher BMWP-PL scores were noted on the studied sites. However, if the presence of families with 9 and 10 points would be considered as a water quality indicator it is again noble crayfish that gets the best result. On all sites of this species larvae from this group occurred (for dipper on 3 out of 4, and for brown trout for 3 out of 5). The presence of the same flagship species did not determine similarity of caddies flies larvae assemblage between sites. It suggests that on studied sites chosen species did not reveal preferences for analysed feature. Summarising, this study show that caddies flies larvae can be used for classification of the sites of chosen species. However, using each of these animals as flagship species for caddies flies, even if they can be considered charismatic, in this case will not serve as protection for any special assemblage of this organisms.

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POŚREDNIA OCHRONA GATUNKÓW NA PRZYKŁADZIE WSPÓŁWYSTĘPOWANIA PLUSZCZA (*CINCLUS CINCLUS*), PSTRĄGA POTOKOWEGO (*SALMO TRUTTA M. FARIO*), RAKA SZLACHETNEGO (*ASTACUS ASTACUS*) I CHRUŚCIKÓW (*TRICHOPETRA*)

Streszczenie. Bioindykatory mogą dostarczać cennych informacji o warunkach siedliskowych stanowisk innych organizmów. Również zainteresowanie społeczne, którym darzone są określone gatunki może pomóc w ochronie innych, mniej popularnych taksonów. Pluszcz, pstrąg potokowy i rak szlachetny to gatunki cieszące się zainteresowaniem i powszechnie kojarzone z czystymi wodami. Larwy chruścików są znacznie mniej popularne, jednakże są cenionym wskaźnikiem jakości środowiska. W tej pracy pośrednia ochrona rozważana jest na przykładzie wspomnianych gatunków.

Słowa kluczowe: bioindykatory, BMWP-PL, chruściki, gatunki sztandarowe, pośrednia ochrona gatunków, gatunki parasolowe