ORIGINAL PAPERS

POPULATION TRENDS OF SOME MIGRANTS AT THE SOUTHERN BALTIC COAST - AUTUMN CATCHING RESULTS 1961-1990

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ABSTRACT

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The paper gives basic migration monitoring data from three bird stations working 1961-1990 at the Polish Baltic coast. They were situated near sea shore in narrow stripes of forest between sea and open areas unsuitable for forest birds. This caused concentration of these migrants into narrow stream of diurnal migration and forced night migrants moving during day-time to pass catching area alwas along the same line. This caused that continuous adaptation of catching sites to changing local conditions did not change catching probability too much. The numbers of individuals caught were recalculated to the standard period with one net in use as they were a little bit differentiated. General methodological discussion of migration monitoring was published elsewhere (Busse 1980, 1990). The graphs presented in the paper give „raw data„, being comparable between stations as they are yearly per-cent values in relation to 1961-70 average catching at the station. The "smoothed data" are the 5-year moving averages of the raw data. Coefficients of regression R and fluctuations CF are given as indices of trend and yearly fluctuations around smoothed curve respectively.

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INTRODUCTION

The Operation Baltic bird migration study program was established in 1961 at the southern Baltic coast of Poland. Although at the beginning the program was not intended as a bird number monitoring program the methods fixed from the first years of work allow to use collected data for monitoring purposes. Since the beginning the monitoring data were published in few papers covering different time-span of the work. The first, basic papers were published in 1973 (Busse 1973 a, b) - presenting catching results for period 1961-1970 and 1974 - (Abraszewska-Kowalczyk 1974) - results of visual observations in the same period. Next were papers by Busse (1984) - some catching results 1961-1980 - and Busse, Cofta (1986) - some autumn and spring catching results 1961-1980. Exceeding 30 year period of Operation Baltic work prompted presentation of the extensive data paper, which is intendend to be a source of basic monitoring data from the area. Some more detailed analyses were recently presented in few papers (Busse and Marova 1993; Busse 1994 a, 1994 b).

MATERIAL AND METHODS

The data were collected at three localities situated on the southern Baltic coast of Poland (Fig. 1). The ringing stations of the Operation Baltic are organized as temporary camps located at the sea coast in places suitable for mist-netting, which is the main method of bird catching. The data included in the paper were collected at Mierzeja Wiślana (54°21N, 19°19E), Hel (54°46N, 18°28E) and Bukowo/Bukowo-Kopań (54°21N, 16°17E/54°28N, 16°25E) during autumns 1961-1990. All these stations situated in generally the same landscape conditions - narrow strip of forest between sea beach and other open area unsuitable for forest birds - water body as lagoon (Mierzeja Wiślana), bay (Hel), on lake (Bukowo) or open meadows being prolongation of an open lake space (Kopań). At Mierzeja Wiślana width of the forest is a few hundred meters, but migration is concentrated at a strip of around 100 southernmost meters bordering with reedbeds of the Vistula lagoon. At Hel, Bukowo and Bukowo-Kopań width of forest stripes is less than 100 meters. These conditions allow birds to move along the forest during daytime and concentrate in narrow stream of migration. Daytime dispersion of night migrants is limited to two direction movements along the forest strip. In peak days of passage there are observed pronounced diurnal movements of night migrants in the main direction of migration. Catching areas were situated mainly in young pine plantations but usually contained small areas of older pine forest as well as patches or groups of broadleaf trees and bushes. Detailed sketches of station areas in the years 1961-1967 were published elsewhere (Busse and Kania 1970). The locations were changed later but general ecological conditions were the same during all the time of work.

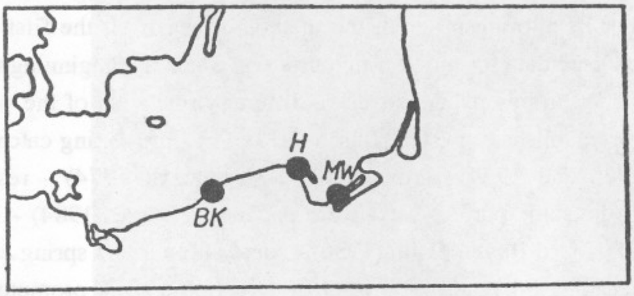


Fig. 1. A map of the Polish stations of Operation Baltic.
BK – Bukowo/Bukowo-Kopań, H – Hel, MW – Mierzeja Wiślana

Because of growth of young trees at the catching areas, locations of nets were continuously adapted to the changing conditions according to observations made during work. During the period when the main catching area was stable adjustment of net locations was rather slight, and proportions of nets located in different types of habitats remained unchanged. Every few years, when it was expected that in a short time general catching conditions will fail, the catching area was moved to a new place. As pine plantations in the study areas were planted in different years, it was possible to find location where general ecological pattern was the same and the area was in a proper growth stage.

Changes of catching areas were at Mierzeja Wiślana in years 1965 and 1983, at Hel - 1962, 1968 and 1977. At Bukowo the change was in 1971 and then 1983 Bukowo-Kopań station was established at the neighbouring coastal lake Kopań, where was a similar strip of forest. At the Kopań station in 1988 the catching area was shifted a few hundred meters. The equivalence of new catching areas was checked by parallel catching in new and old places: Mierzeja Wiślana 1965-1970 and 1981-1982, Bukowo-Bukowo Kopań 1981-1982. Slight changes of the area were not monitored. Periods of work and catching devices used are listed in the Table 1. General method of work was continuous mist-net catching with a stable number of nets used. The nets were erected at the beginning of a season and removed at the end. The nets were in operation day and night and they were not closed in any circumstances. Despite of this regime there were slight changes in net number because some of them were damaged by animals or stolen and not instantly replaced or repaired. The nets were standard 7-7,5 m long, 2 m high, four shelves and 16 mm mesh and only in few first years the standard of nets was not fixed and there were three shelves and 18 mm mesh. Since 1962 the nets were double tethered against wind-shift. In some years at Mierzeja Wiślana a heligoland trap was in use (Table 1).

Period of work of the stations was nearly stable during all time-span of studies except only the first few years. Period of work was shorter at Hel than at Mierzeja Wiślana and Bukowo. Preparation of raw data (numbers of individuals caught) into monitoring indices contained few recalculations intended to reach as high camparability as posssible. All recalculations were done for every bird species separately.

1. Number of individuals caught in a season was recalculated for standard period (August 17th-October 25th). When period of work was shorter than the standard one, number of individuals was corrected for the lacking period basing on cumulative curves for the species; they were constructed from data collected in the years when all standard period was covered (for details see Busse 1973a). In the years when period of work

was longer than the standard one, individuals caught outside the standard period were cut off from the total. This recalculation can cause errors (higher variation) in estimation of bird number of very early or very late migrants. The errors can be expected mainly at Hel, while at other stations in a few early years only.

Table 1

Period of work and catching devices at Operation Baltic brid stations 1961-1990. Helg. – heligoland trap.

	Mierzeja Wiślana			Hel		Bukowo	
	Period	Nets	Helg.	Period	Nets	Period	Nets
1961	15.09–14.10	6		15.09–14.10	10	15.09–14.10	6
1962	22.08–30.09	15		1.09–30.09	50	11.09–10.10	19
1963	17.08–30.10	45	+	1.09–15.10	27	6.09–15.10	40
1964	17.08–25.10	80	+	6.09–15.10	35	6.09–15.10	42
1965	17.08–25.10	47		6.09–15.10	40	7.09–15.10	30
1966	17.08–25.10	50		6.09–15.10	38	6.09–15.10	53
1967	17.08–25.10	56		6.09–15.10	43	17.08–25.10	50
1968	17.08–25.10	57	+	6.09–15.10	55	17.08–25.10	52
1969	17.08–25.10	60	+	6.09–15.10	48	17.08–25.10	49
1970	17.08–14.11	55	+	6.09–30.09	52	6.09–10.10	48
1971	17.08–14.11	75	+	6.09–15.10	47	17.08–22.10	44
1972	14.08–17.11	44	+	3.09–17.10	48	14.08–27.10	39
1973	14.08–16.11	57		3.09–17.10	45	14.08–27.10	50
1974	14.08–1.11	44		3.09–17.10	47	14.08–27.10	42
1975	14.08–1.11	49	+	15.09–17.10	40	14.08–27.10	47
1976	14.08–1.11	40		3.09–17.10	30	14.08–1.11	25
1977	16.08–1.11	53	+	13.09–17.10	50	16.08–1.11	50
1978	14.08–1.11	60	+	3.09–17.10	50	14.08–1.11	45
1979	14.08–1.11	50		3.09–17.10	47	16.08–1.11	47
1980	14.08–1.11	40		3.09–17.10	40	14.08–1.11	40
1981	14.08–1.11	89		3.09–17.10	45	14.08–1.11	45
1982	14.08–1.11	83		–	–	14.08–1.11	50
1983	14.08–1.11	68		3.09–17.10	54	14.08–1.11	53
1984	14.08–1.11	41		3.09–17.10	39	14.08–1.11	38
1985	14.08–1.11	45		3.09–17.10	50	14.08–1.11	44
1986	14.08–1.11	45		3.09–17.10	49	14.08–1.11	43
1987	14.08–1.11	50		–	–	14.08–1.11	55
1988	14.08–1.11	55		–	–	14.08–1.11	55
1989	14.08–1.11	55		–	–	14.08–1.11	45
1990	14.08–1.11	50		–	–	14.08–1.11	45

2. Number of birds standardized for a period of work was then recalculated into per-net values to eliminate influence of different net number used in different years. Except two first years, when number of nets was much lower than later and few years when number of nets was clearly higher (eg. Mierzeja Wiślana 1971 and 1981-82) number of nets was not too differentiated - fluctuating at 40-50 pieces per station. In the local conditions allowing birds to pass through the catching area, number of nets probably does not influence much catching efficiency per net. Birds caught into heligoland trap used in some years at Mierzeja Wiślana were noted separately for calculation of equivalency coefficient which was found at an average level of ten nets. This can cause, however, an overestimation of numbers of few species (e.g. Coal Tit and Long-tailed Tit) which were caught in this device more efficiently than others.

3. The "raw data" were then expressed in per cent values in relation to the average level for 1961-1970 (Busse 1973a). Because catching efficiency at new catching areas could be different, the results were compared by parallel catching at both places simultaneously. In few cases the basic 1961-1970 average values had tobe corrected (Mierzeja Wiślana and Bukowo-Kopań 1983 on) for every species separately.

Relating monitoring indices to a standard time period gives possibility to compare number indices between stations and combine them into pooled values. Pooling per cent values eliminate danger of suppressing trends at stations where the bird species was generally less numerous.

Apart from the above mentioned "raw data" presenting per cent number monitoring indices for every year at graphs (Fig. 2-25) there are shown smoothed curves. Smoothing was done by five years running average calculated by the formula:

$$S_y = \left(r_{y-2} + 2r_{y-1} + 3r_{y+1} + 2r_{y+1} + r_{y+2}\right)/9$$

where Sy - smoothed index value, r_y - raw data values for year y and years neighbouring the year y.

Trends are characterized by values of two coefficients - R - regression coefficient with statistical significance and CF - coefficient of fluctuations around smoothed average (Busse 1990):

$$CF = 1/M \cdot \left(\sum \left(X_{oy} - X_y\right)^2 /N \right) \cdot 100\% ,$$

where: M - mean value of population size index for all studied years, X_y - thevralue of population size index for year "y", X_{oy} - local value of moving average for the year "y", and N - number of years in the sample.

It must be stressed here that regression coefficient is not adequate enough to describe population number dynamics. It was pointed earlier by Busse (1990), in the paper where general problems of evaluation monitoring data collected by means of bird catching at migration were extensively discussed. Detailed problems can be discussed later, when more papers evaluating species number dynamics at bigger areas (as Busse 1994b, Busse and Marova 1993) will be available. Some special methodological limitations must be discussed after detailed analysis of separate species or groups of species (e.g. Cofta 1985). At the moment it could be in principle belived that the method is good to study the long-term number dynamics of migrating populations of birds - e.g. Busse (1994 b) has shown that despite of catching method and locality of the station number of Great Grey Shrike (*Lanius excubitor*) dropped drastically in a short time in the whole Baltic - eastern North Sea area except northernmost stations only (nine bird stations included in the analysis).

RESULTS

As this paper is intended to be mainly a source of basic and rough information the data are presented in a standard, comprehensive form of graphs with short comments only. The first, main set of graphs (Fig. 2-25) gives data on number fluctuations in subsequent years at every station as well as smoothed curves for these data. At every graph there are given R and CF coefficient values as well as number of individuals caught per station (N). In some cases number of individuals caught is low, but the data are presented, because there is number of examples that the catches are reasonably grouped and they can fit to the patterns observed at other stations. The second set of graphs (Fig. 26-33) contains data pooled for all three stations. There can be found less fluctuating number indices (lower values of CF coefficient) better describing population number trends at bigger area breeding range of the species. The general pattern of population dynamics trends in different ecological groups of birds is discussed in a separate paper (Busse 1994a).

Sparrowhawk (*Accipiter nisus*) - Fig. 2 and 26. High numbers occured at Hel and Bukowo in 1970, in 1990 at Bukowo-Kopań only - as numbers at these stations are generally low these values can be not meaningful.

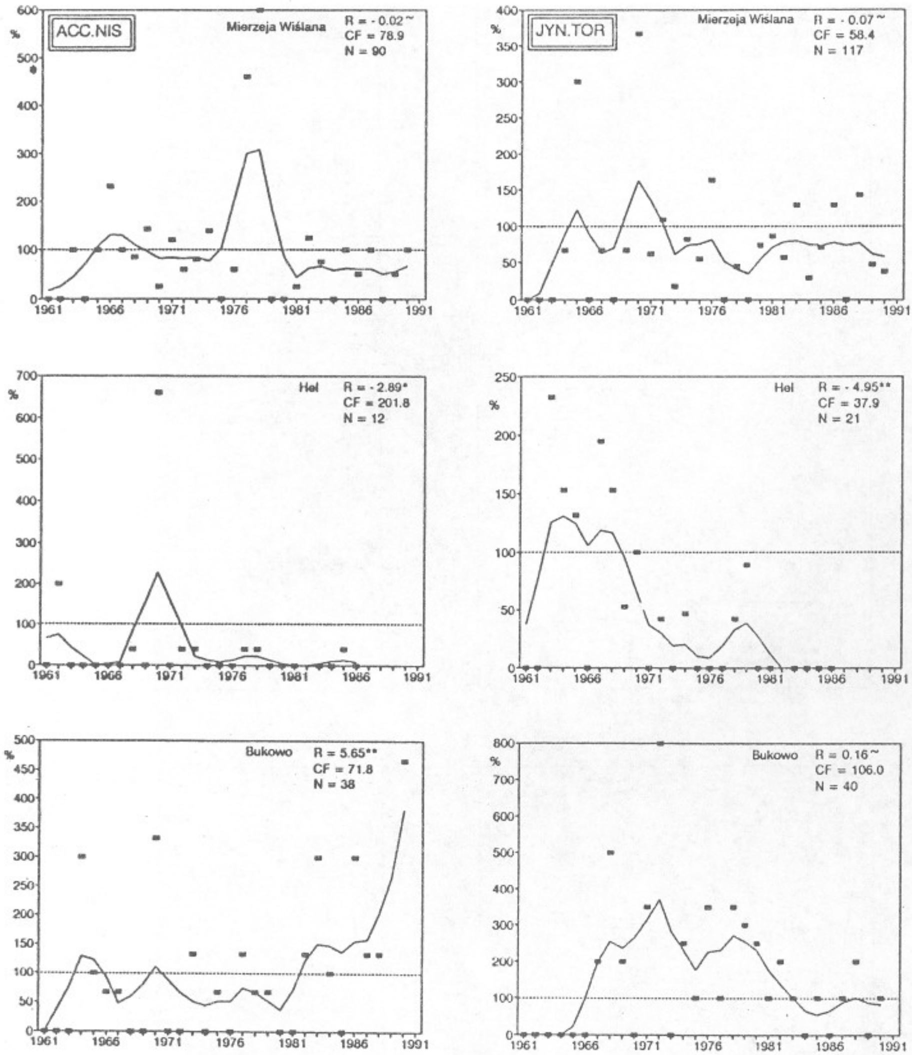


Fig. 2. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. ACC.NIS – *Accipiter nisus*, JYN.TOR – *Jynx torquilla*

R – regression coefficient with statistical significance (~ –$p > 0.05$, * – $0.01 < p < 0.05$, ** – $p < 0.01$), *CF* – coefficient of fluctuations, *N* – number of individualis caught.

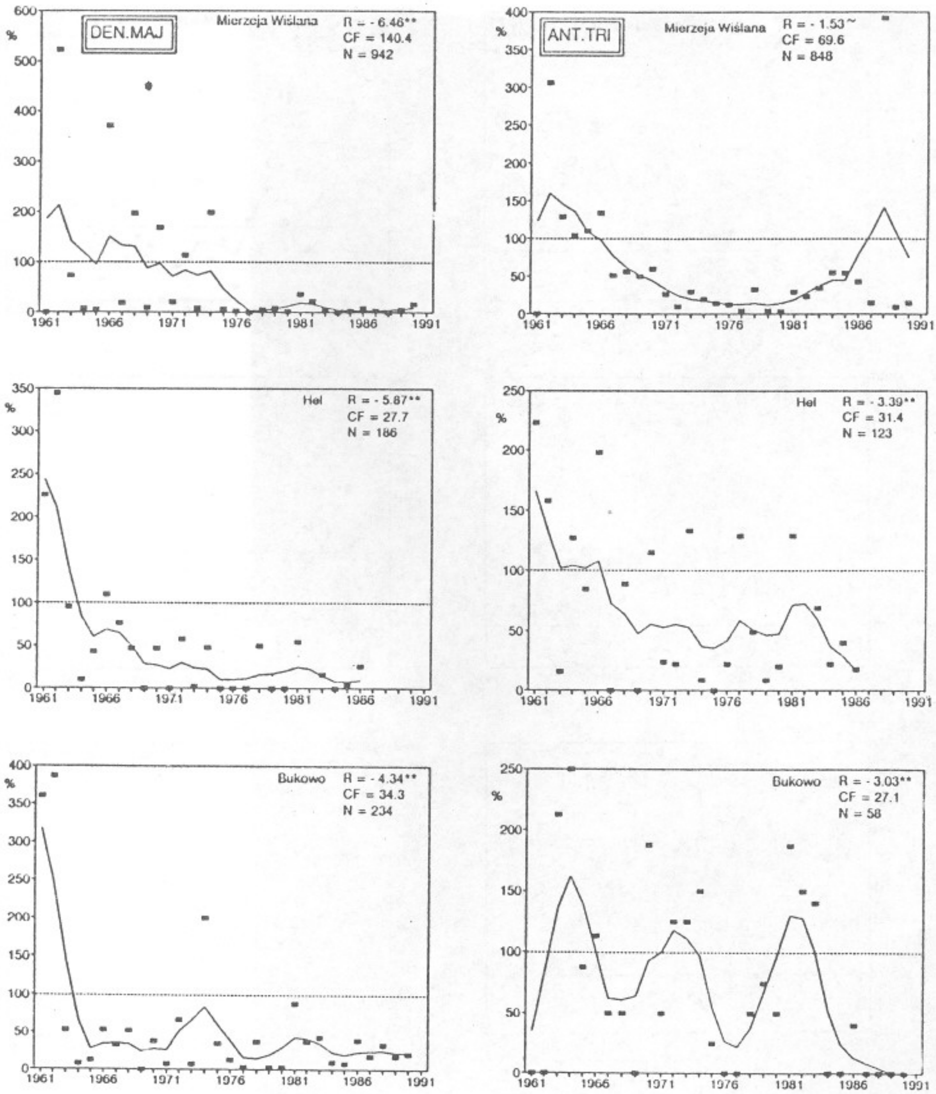


Fig. 3. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. DEN.MAJ – *Dendrocopos major*, ANT.TRI – *Anthus trivialis*. Other explanations as at Fig. 2.

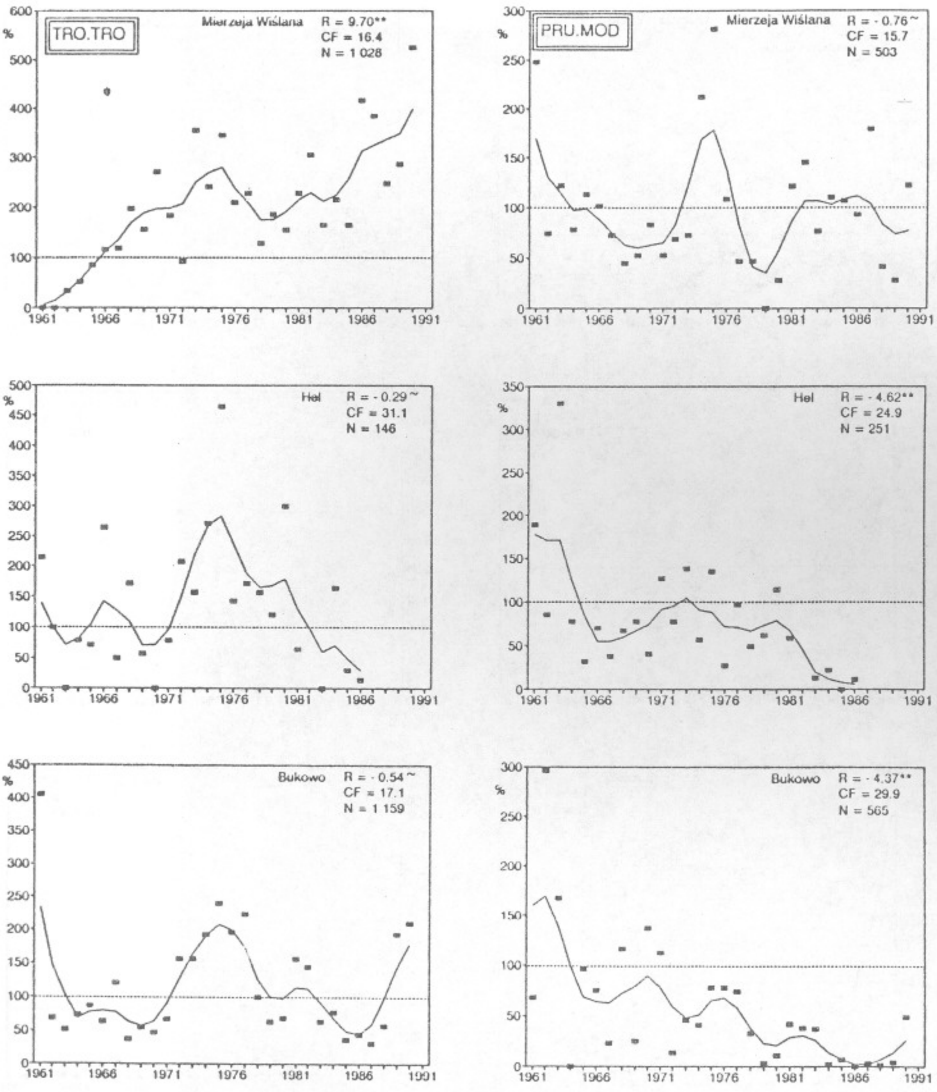


Fig. 4. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. TRO.TRO – *Troglodytes troglodytes*, PRU.MOD – *Prunella modularis*. Other explanations as at Fig. 2.

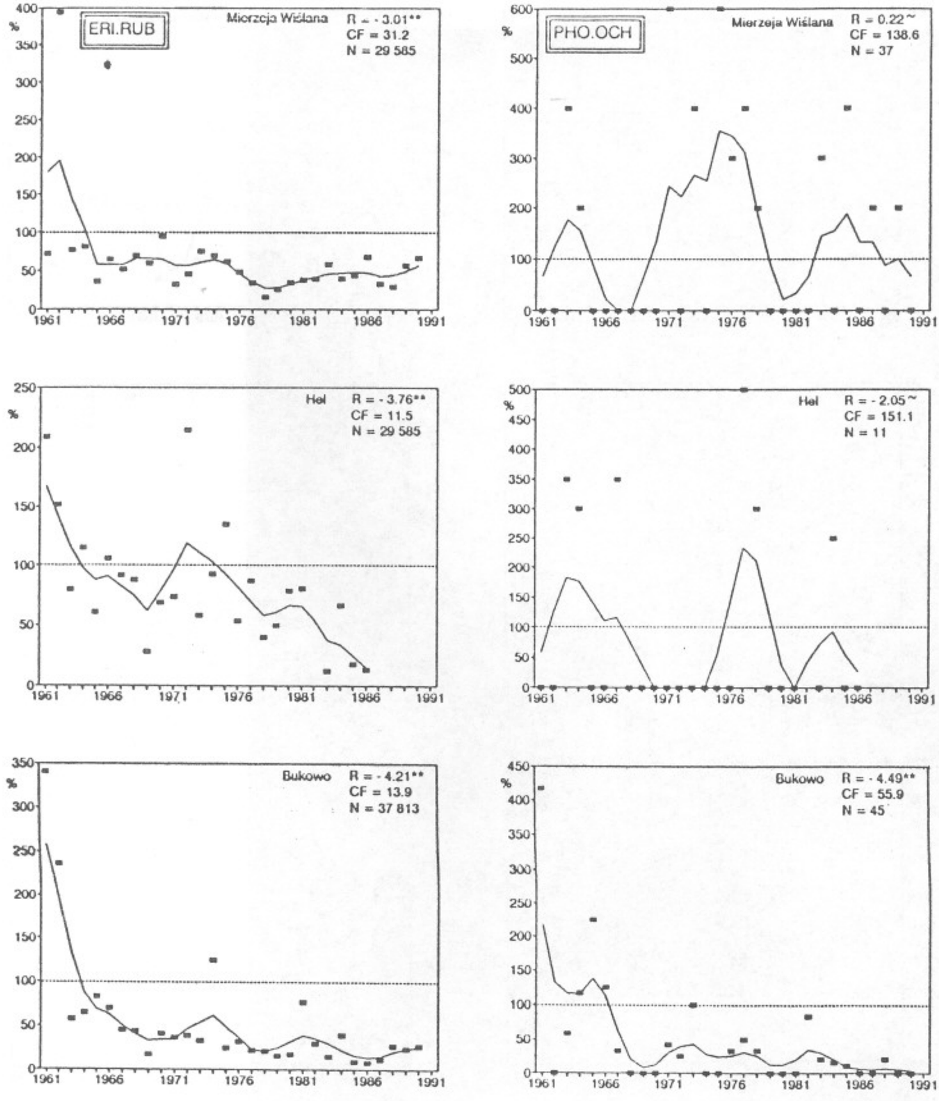


Fig. 5. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. ERI.RUB – *Erithacus rubecula*, PHO.OCH – *Phoenicurus ochruros*. Other explanations as at Fig. 2.

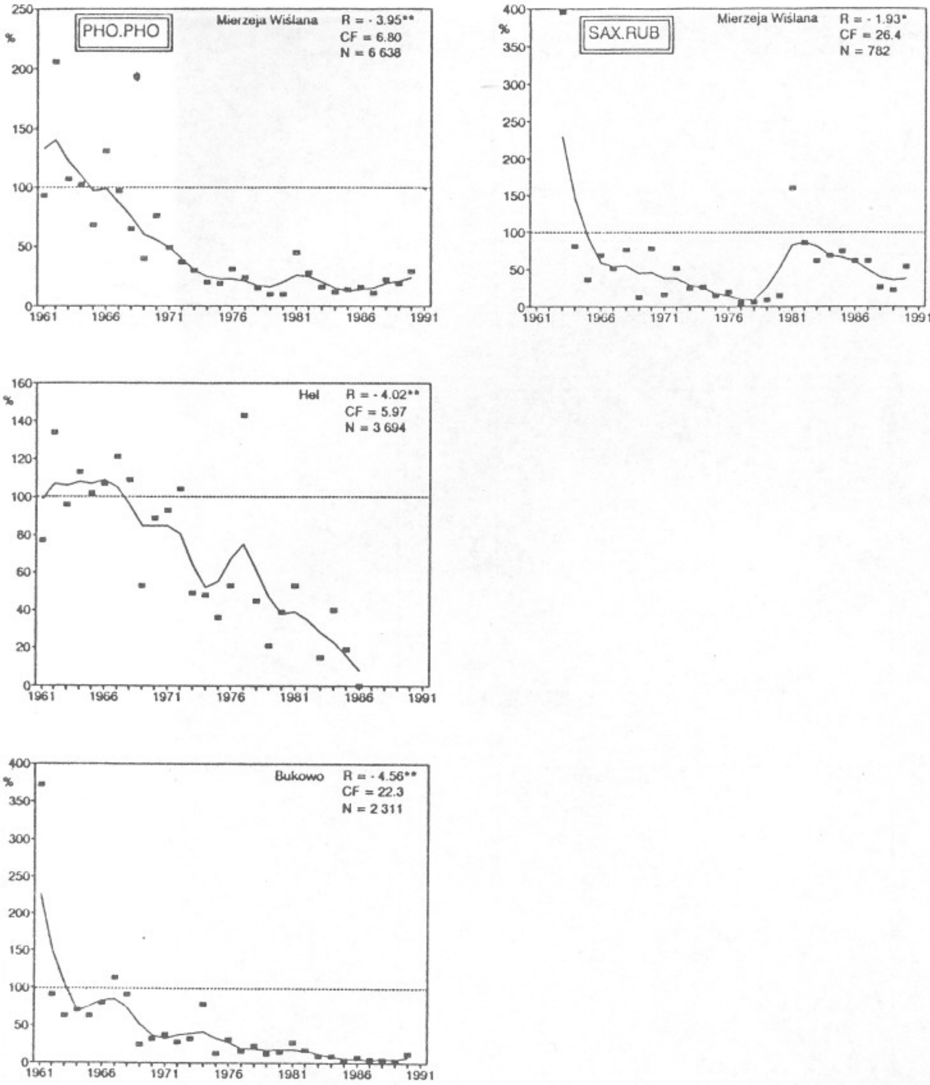


Fig. 6. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. PHO.PHO – *Phoenicurus phoenicurus*, SAX.RUB – *Saxicola rubetra*. Other explanations as at Fig. 2.

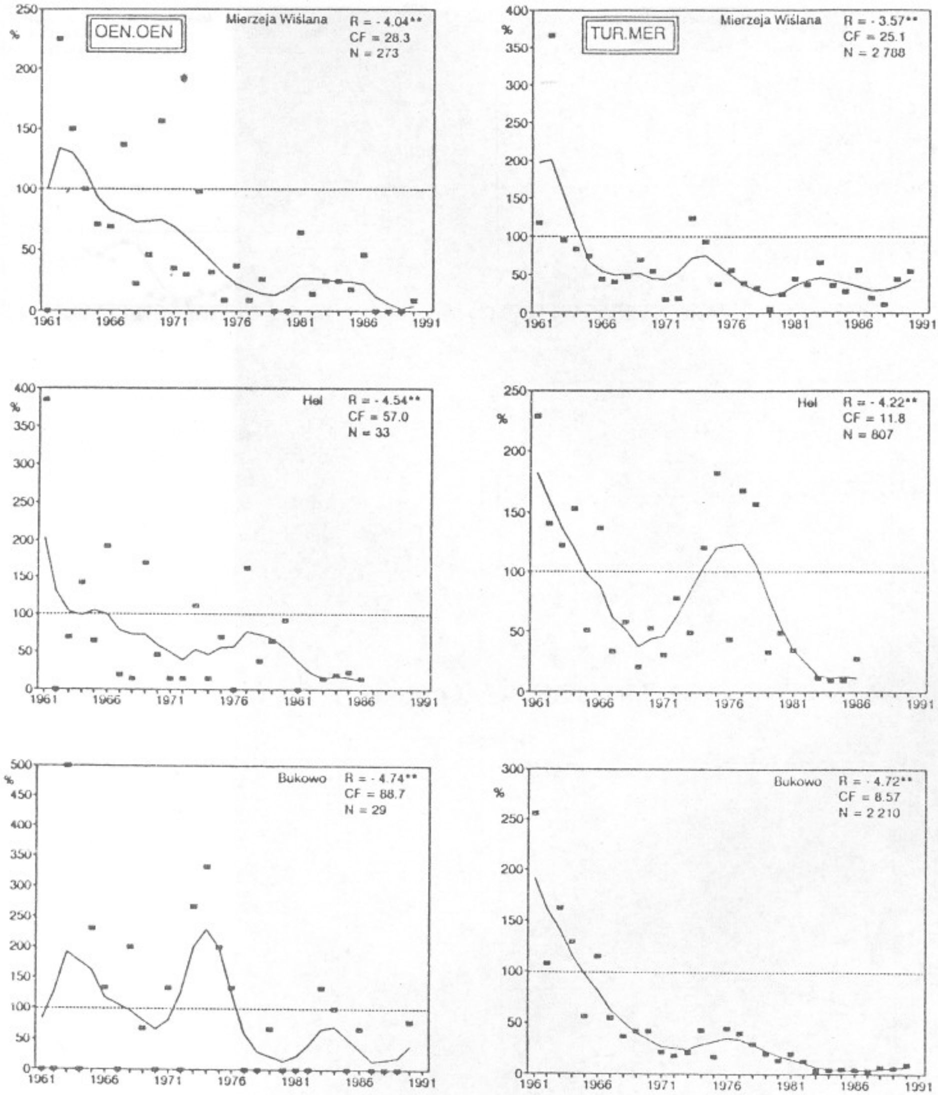


Fig. 7. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. OEN.OEN – *Oenanthe oenanthe*, TUR.MER – *Turdus merula*. Other explanations as at Fig. 2.

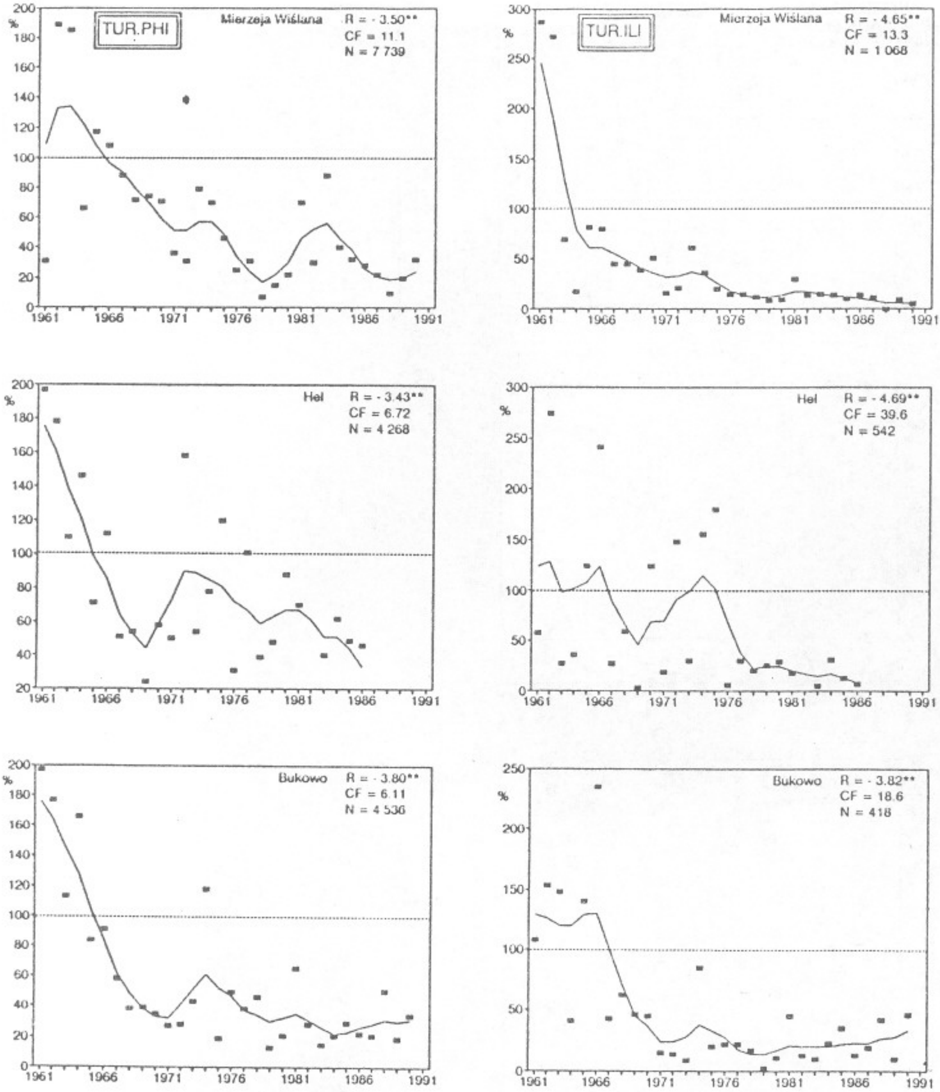


Fig. 8. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. TUR.PHI –*Turdus philomelos*, TUR.ILI – *Turdus iliacus*. Other explanations as at Fig. 2.

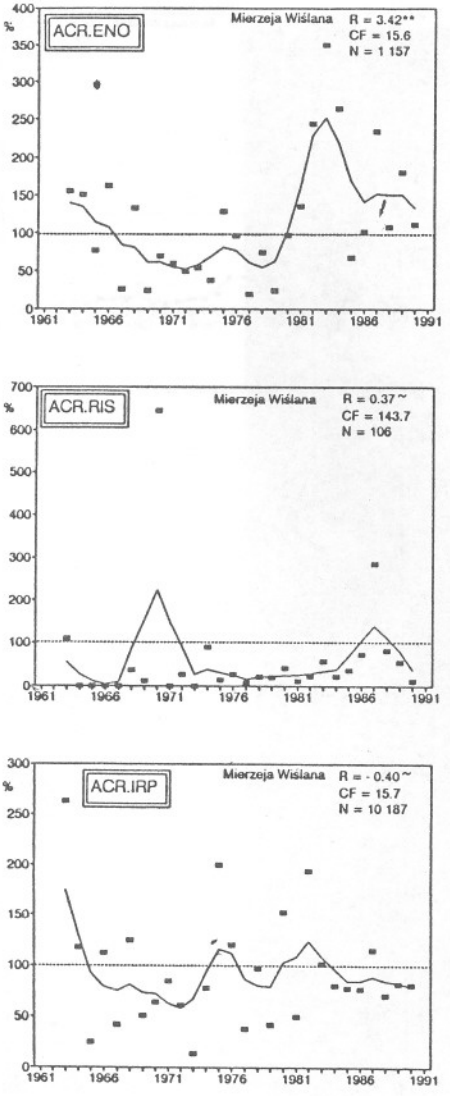


Fig. 9. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. ACR.ENO – *Acrocephalus schoenobaenus*, ACR.ARU – *Acrocephalus arundinaceus*, ACR.RIS – *Acrocephalus palustris*, ACR.IRP – *Acrocephalus scirpaceus*. Other explanations as at Fig. 2.

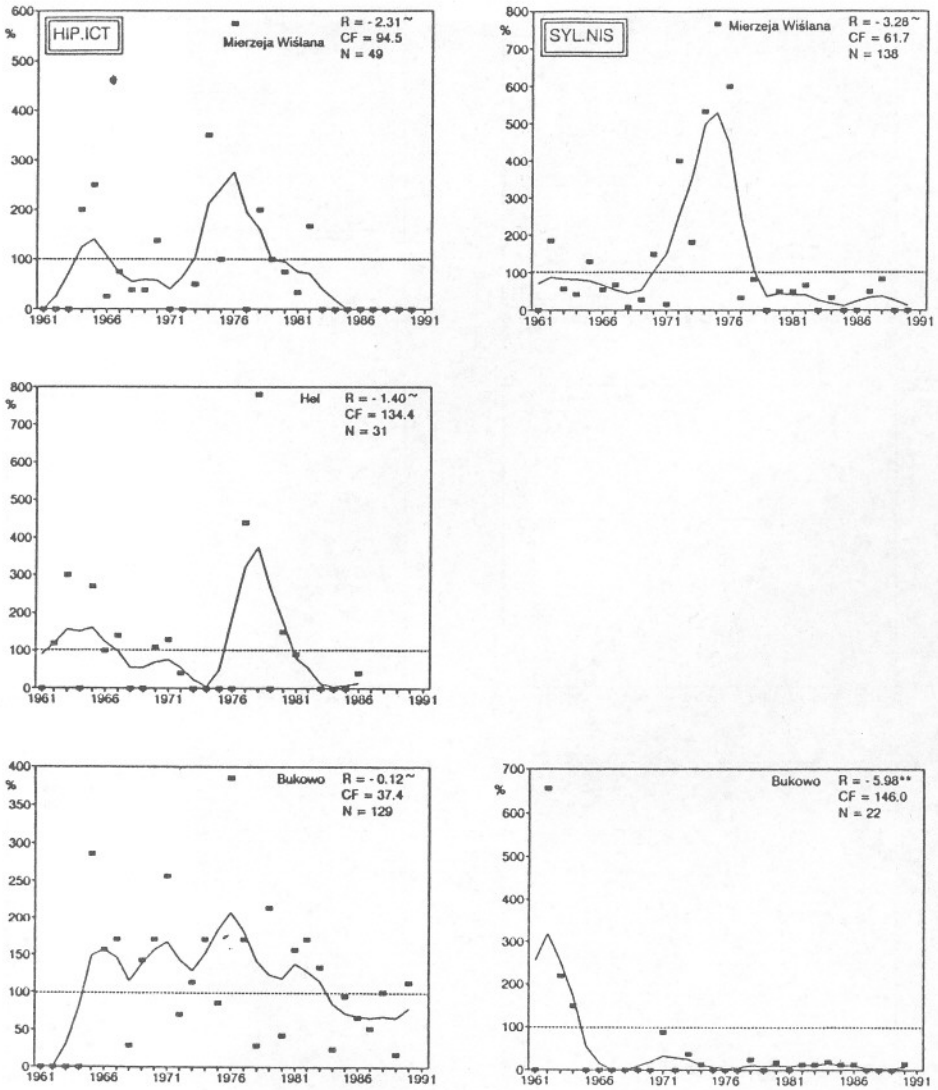


Fig. 10. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. HIP.ICT – *Hippolais icterina*, SYL.NIS – *Sylvia nisoria*. Other explanations as at Fig. 2.

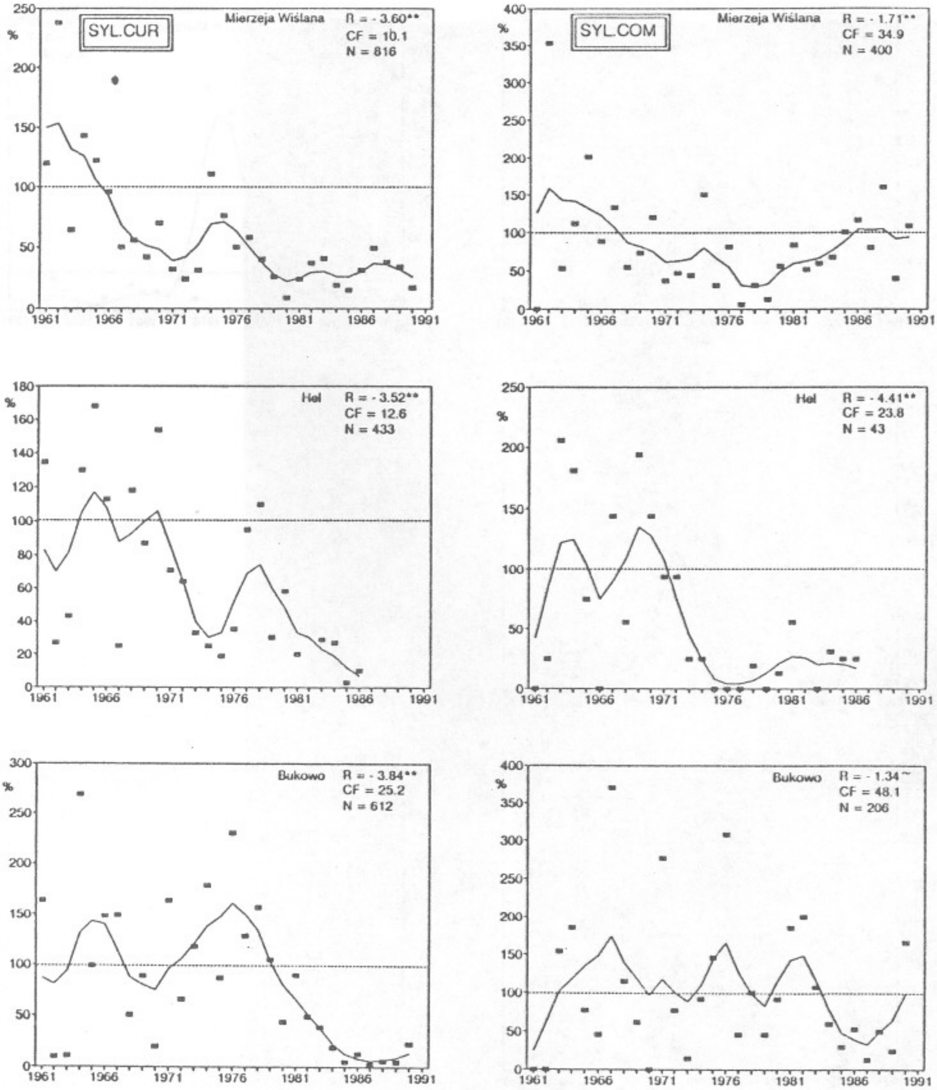


Fig. 11.Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. SYL.CUR – *Sylvia curruca*, SYL.COM – *Sylvia communis.* Other explanations as at Fig. 2.

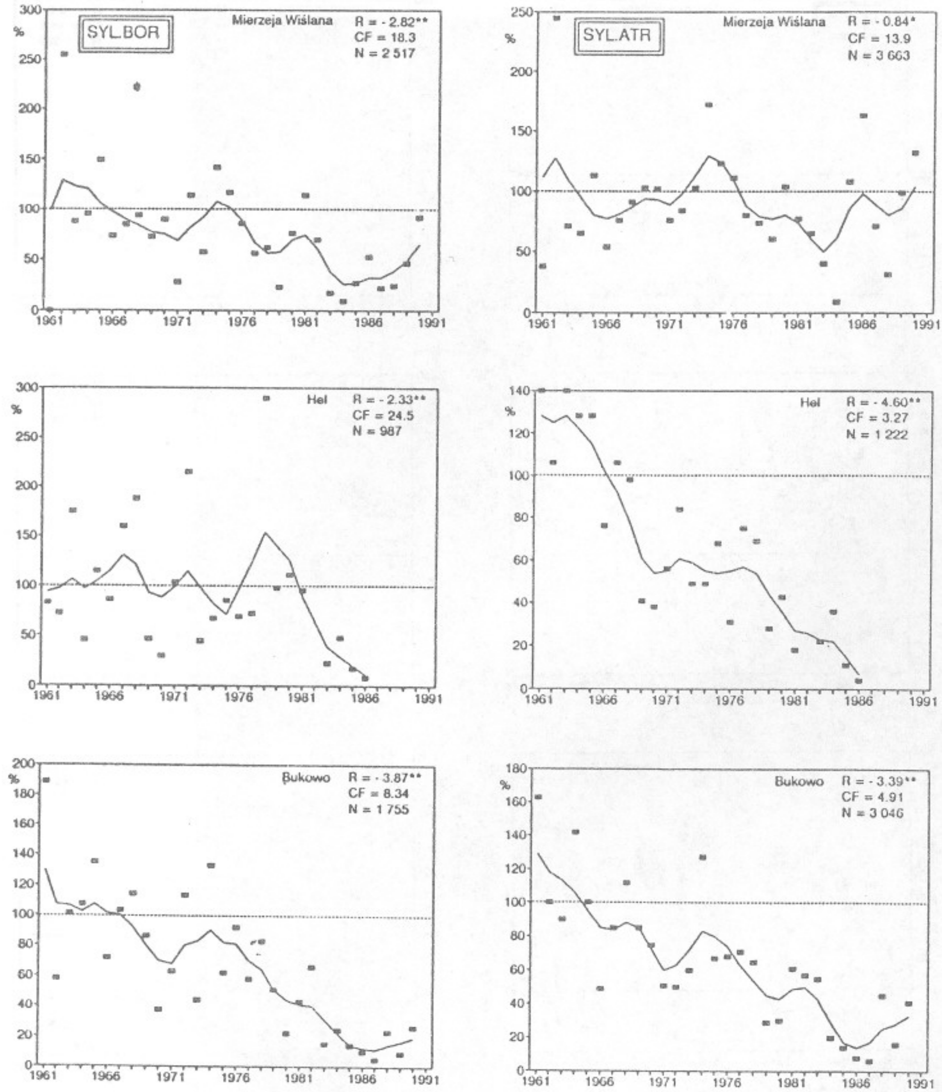
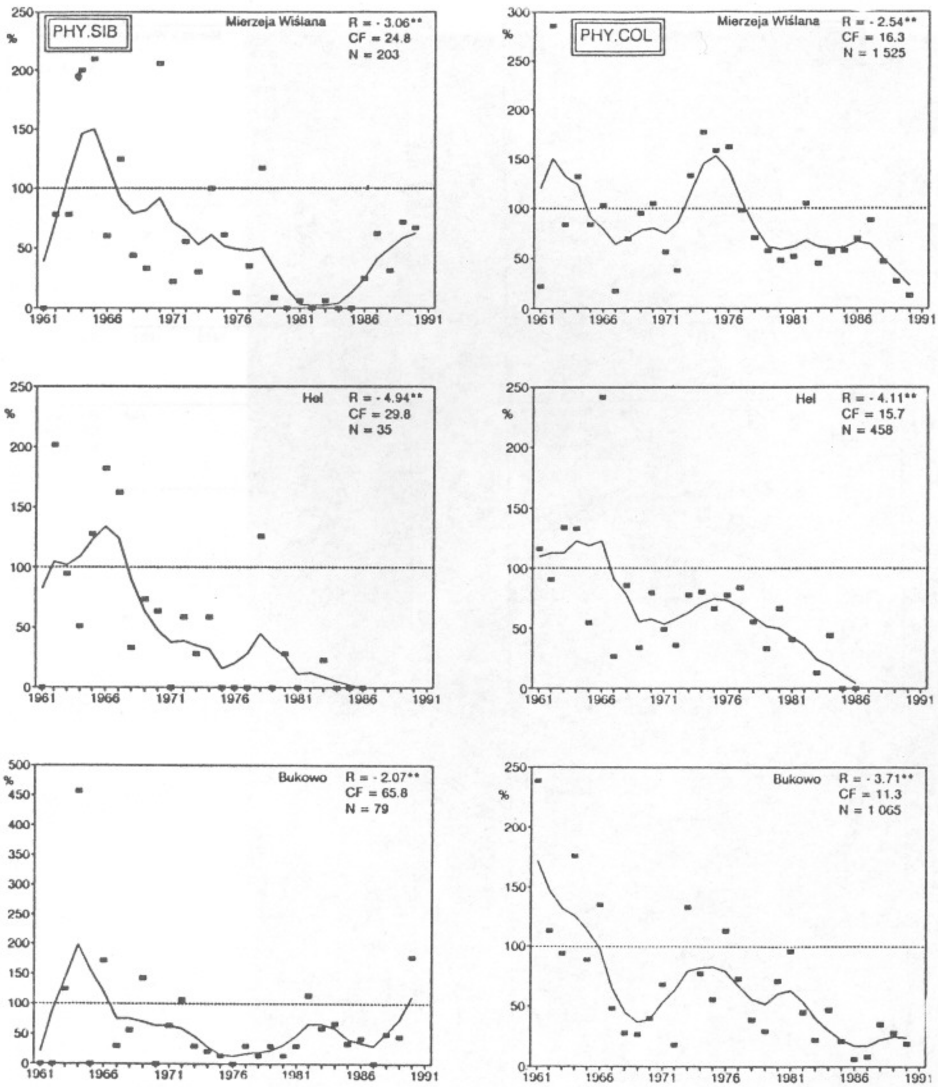


Fig. 12. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. SYL.BOR – *Sylvia borin*, SYL.ATR – *Sylvia atricapilla*. Other explanations as at Fig. 2.



Fug. 13. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. PHY.SIB – *Phylloscopus sibilatrix*, PHY.COL – *Phylloscopus collybita*. Other explanations as at Fig. 2.

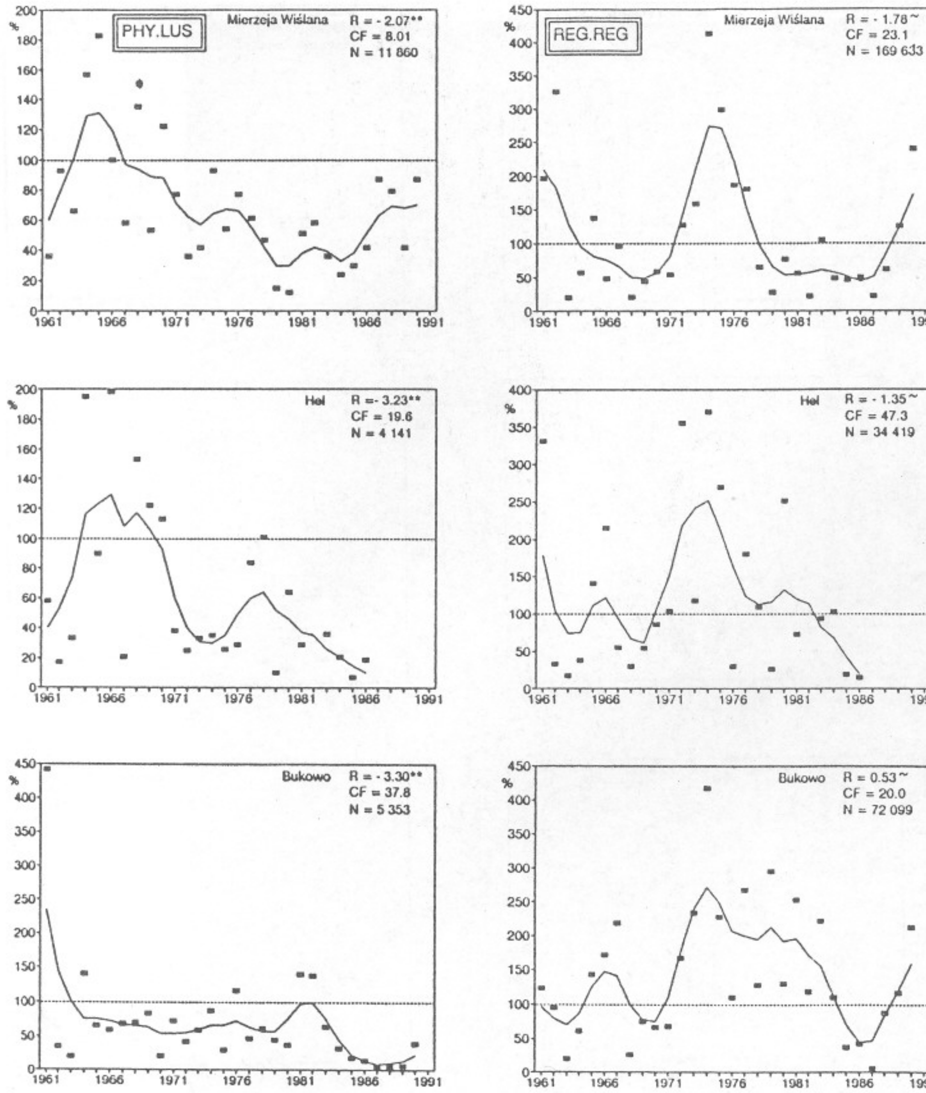


Fig. 14. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. PHY.LUS – *Phylloscopus trochilus*, REG.REG – *Regulus regulus*. Other explanations as at Fig. 2.

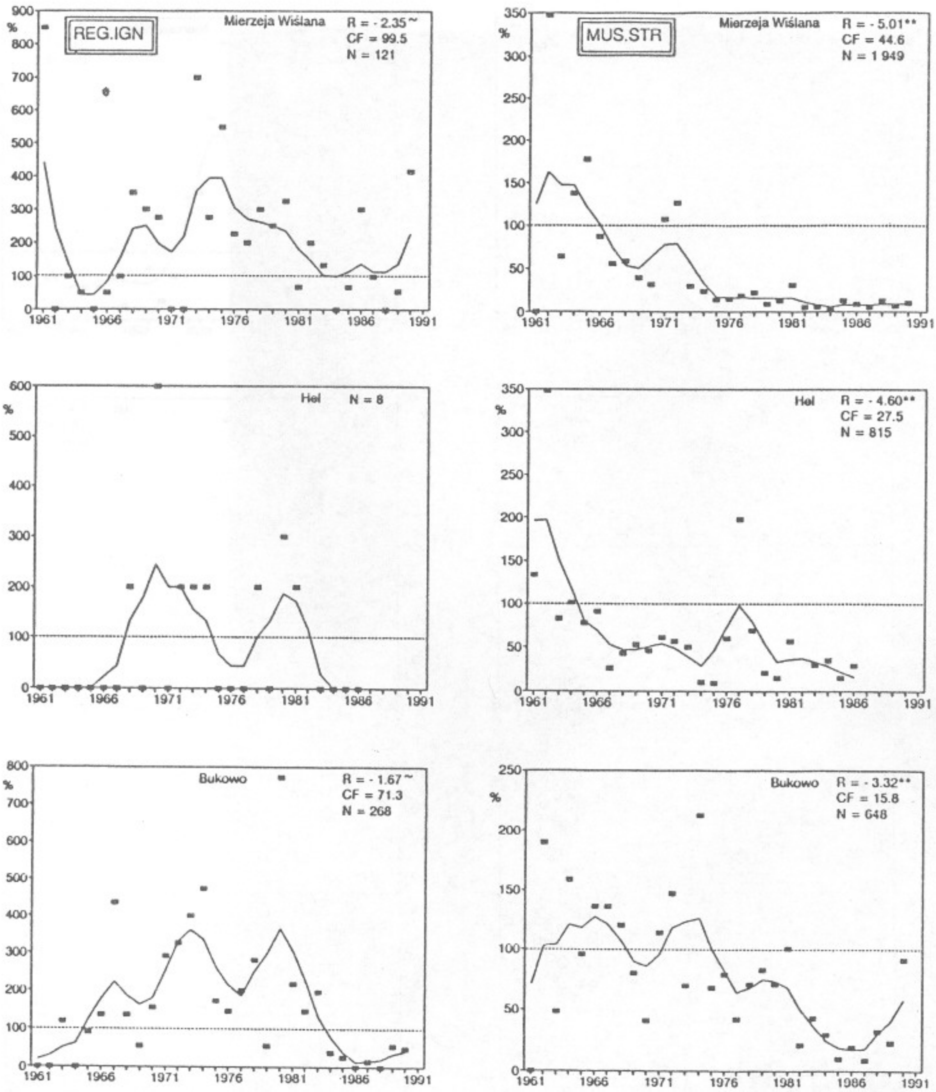


Fig. 15. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. REG.IGN – *Regulus ignicapillus*, MUS.STR – *Muscicapa striata*. Other explanations as at Fig. 2.

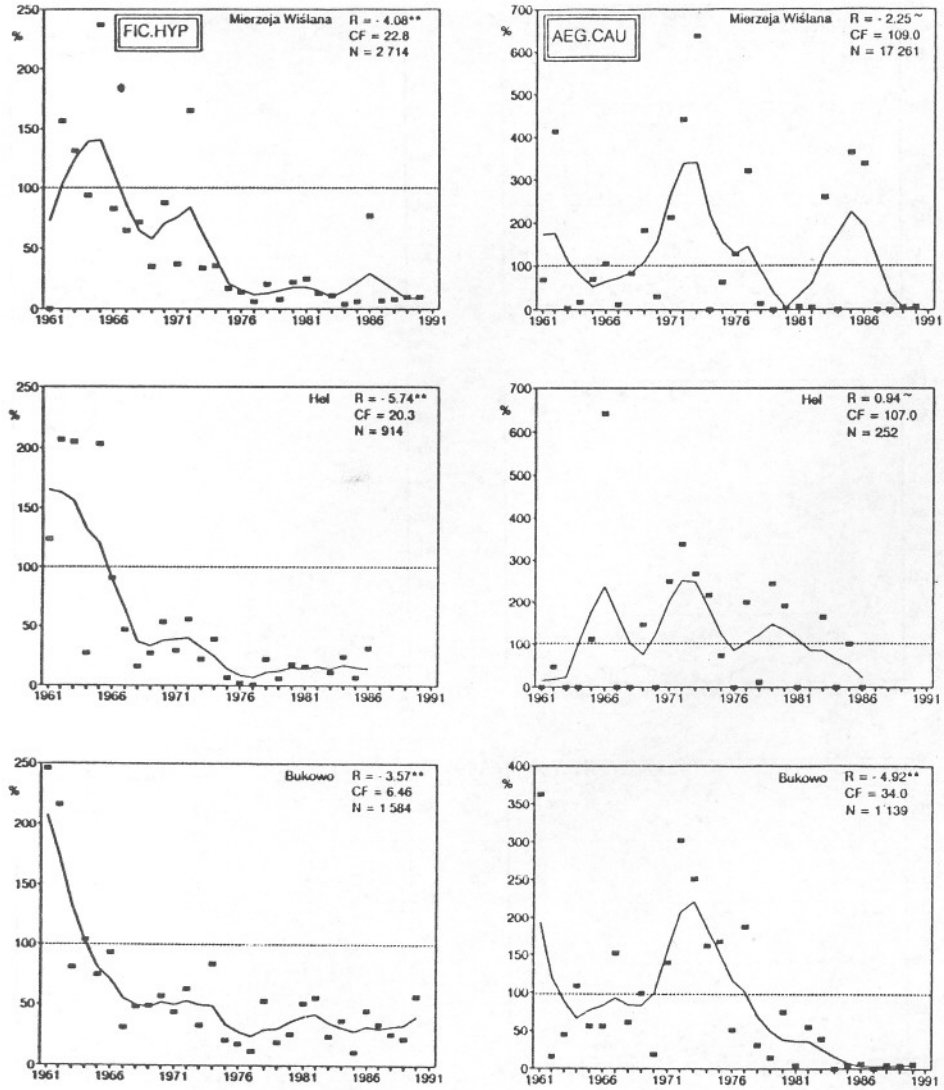


Fig. 16. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. FIC.HYP – *Ficedula hypoleuca*, AEG.CAU – *Aegithalos caudatus*. Other explanations as at Fig. 2.

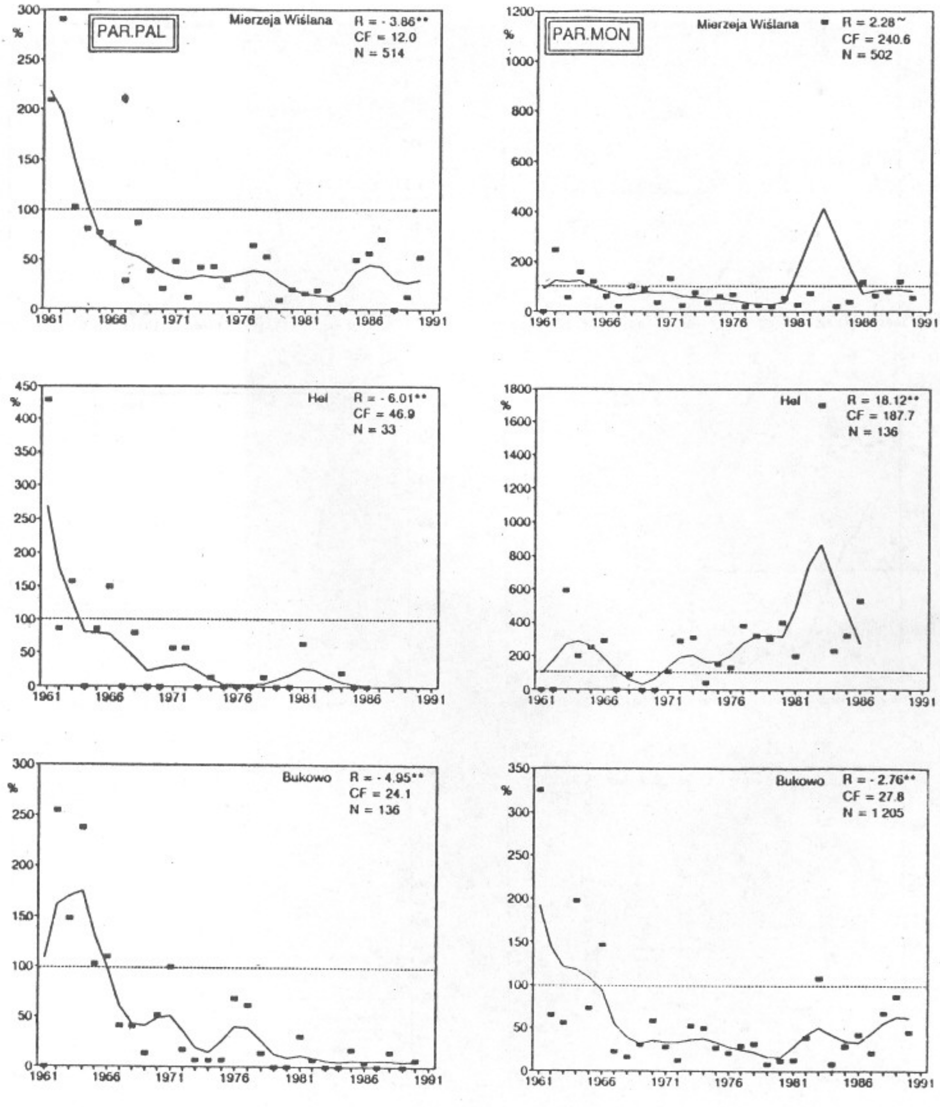


Fig. 17. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. PAR.PAL – *Parus palustris*, PAR.MON – *Parus montanus*. Other explanations as at Fig. 2.

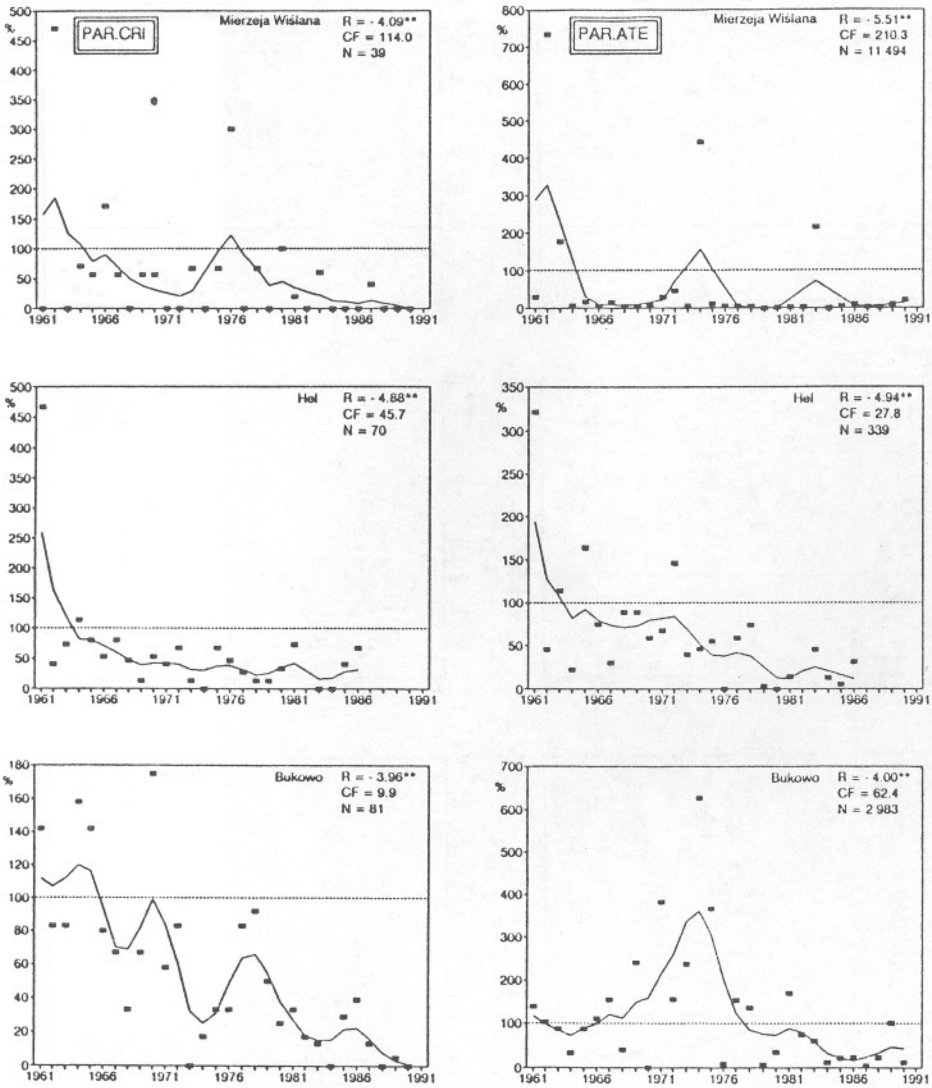


Fig. 18. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. PAR.CRI – *Parus cristatus*, PAR.ATE – *Parus ater*. Other explanations as at Fig. 2.

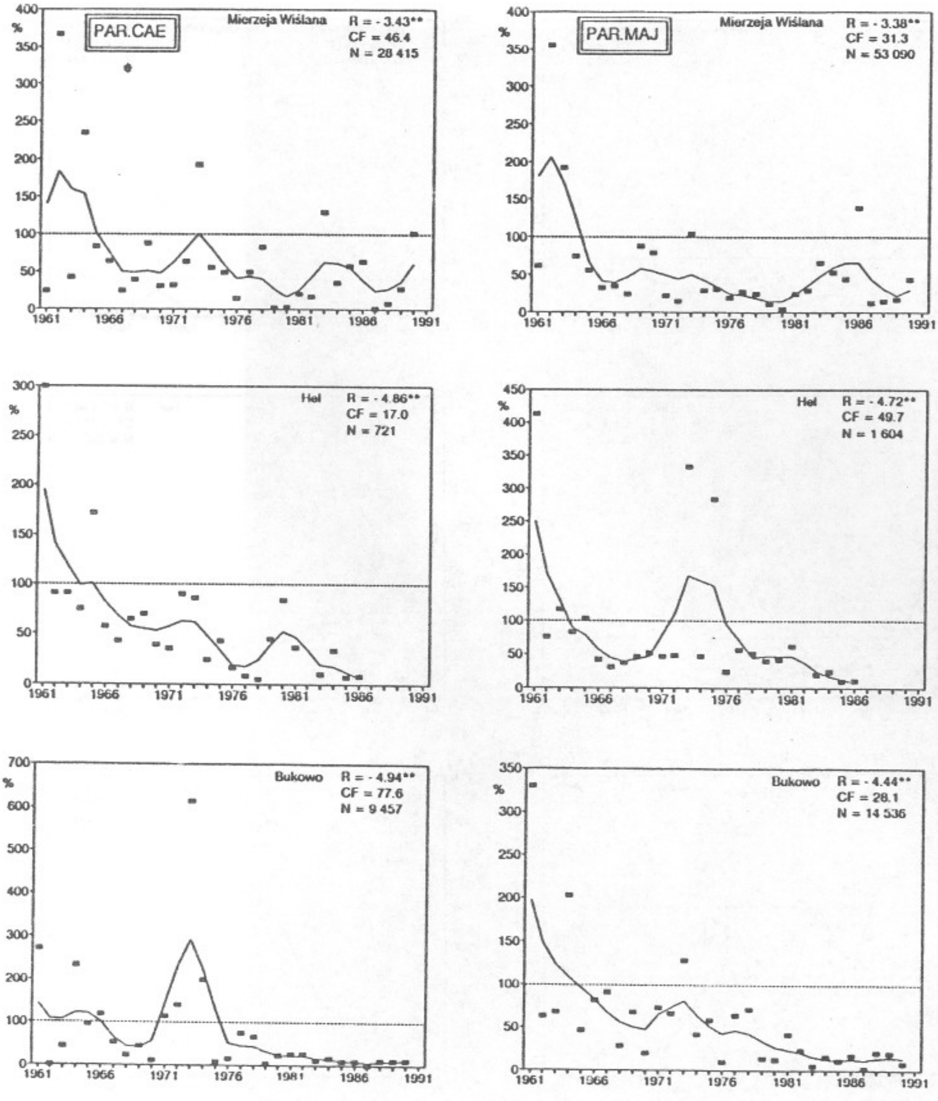


Fig. 19. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. PAR.CAE – *Parus caeruleus*, PAR.MAJ – *Parus major*. Other explanations as at Fig. 2.

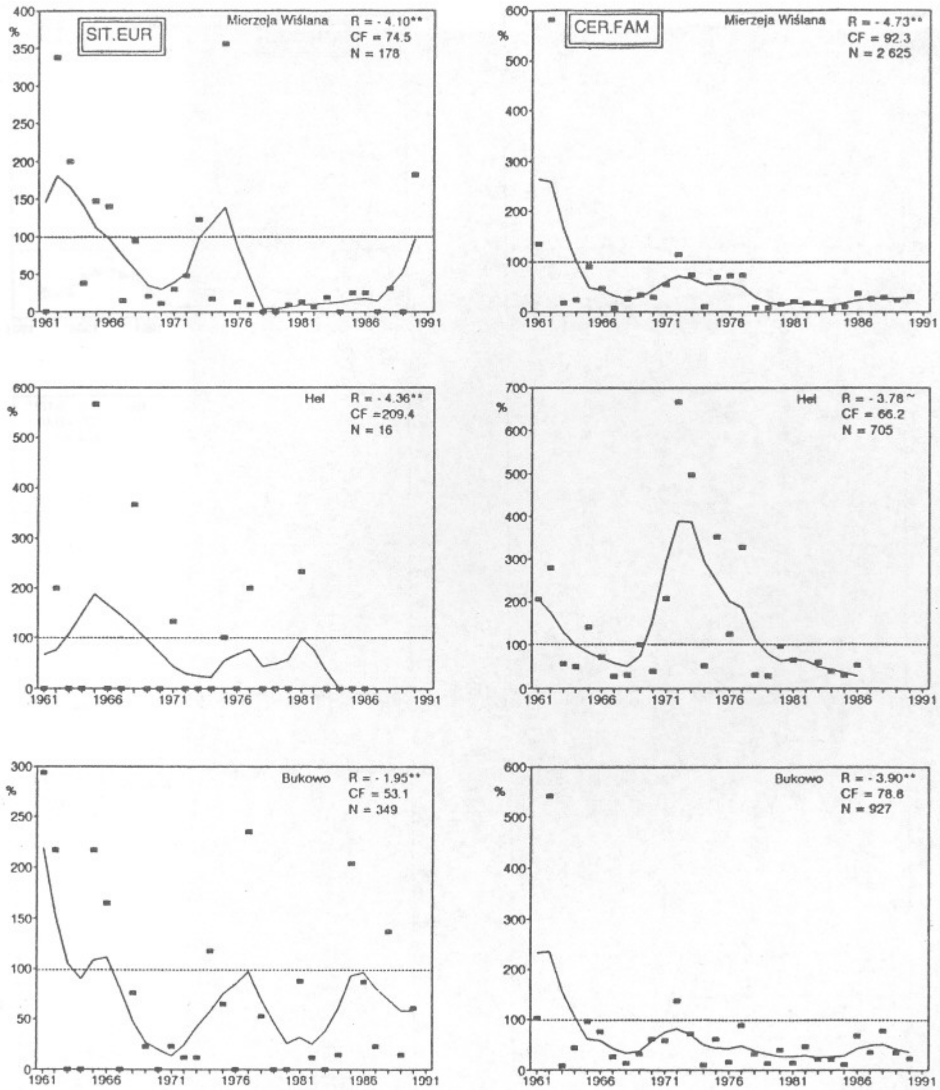


Fig. 20. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. SIT.EUR – *Sitta europaea*, CER.FAM – *Certhia familiaris*. Other explanations as at Fig. 2.

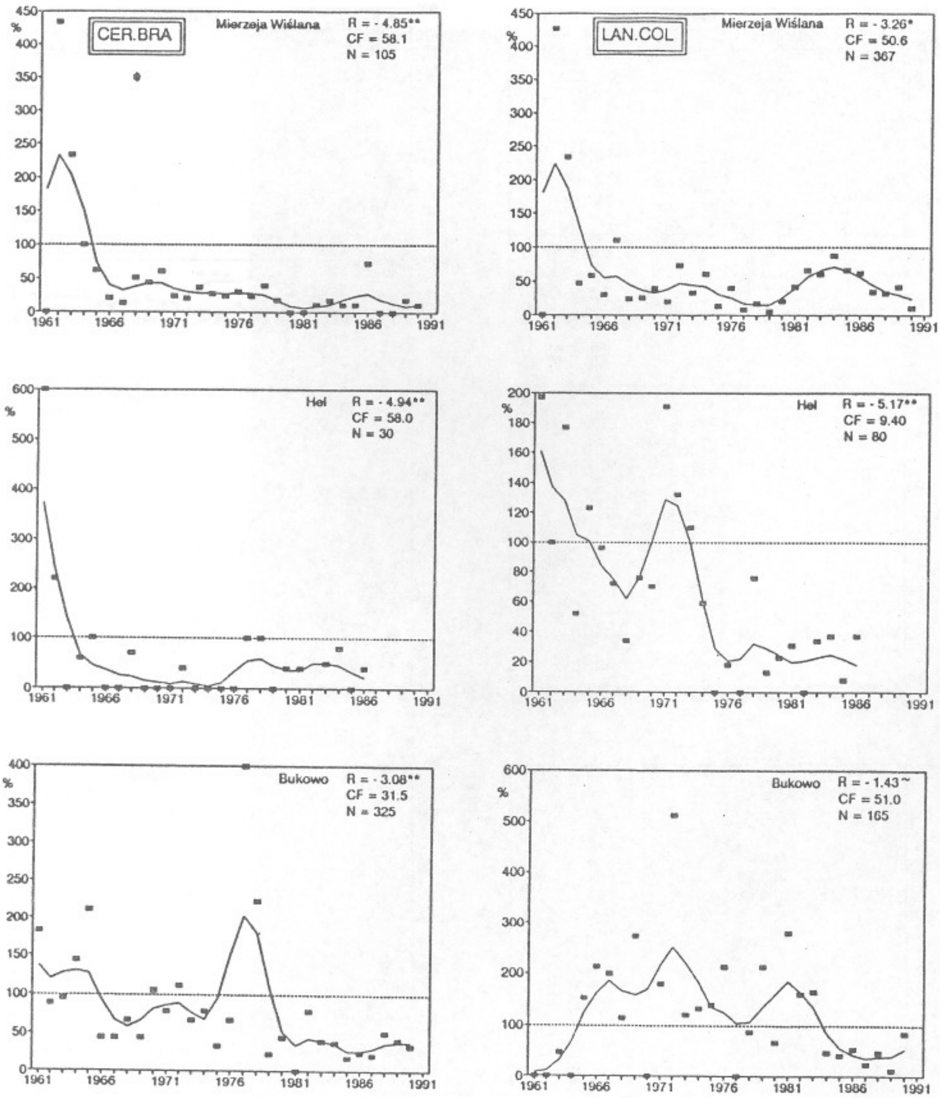


Fig. 21. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. CER.BRA – *Certhia brachydactyla*, LAN.COL – *Lanius collurio*. Other explanations as at Fig. 2.

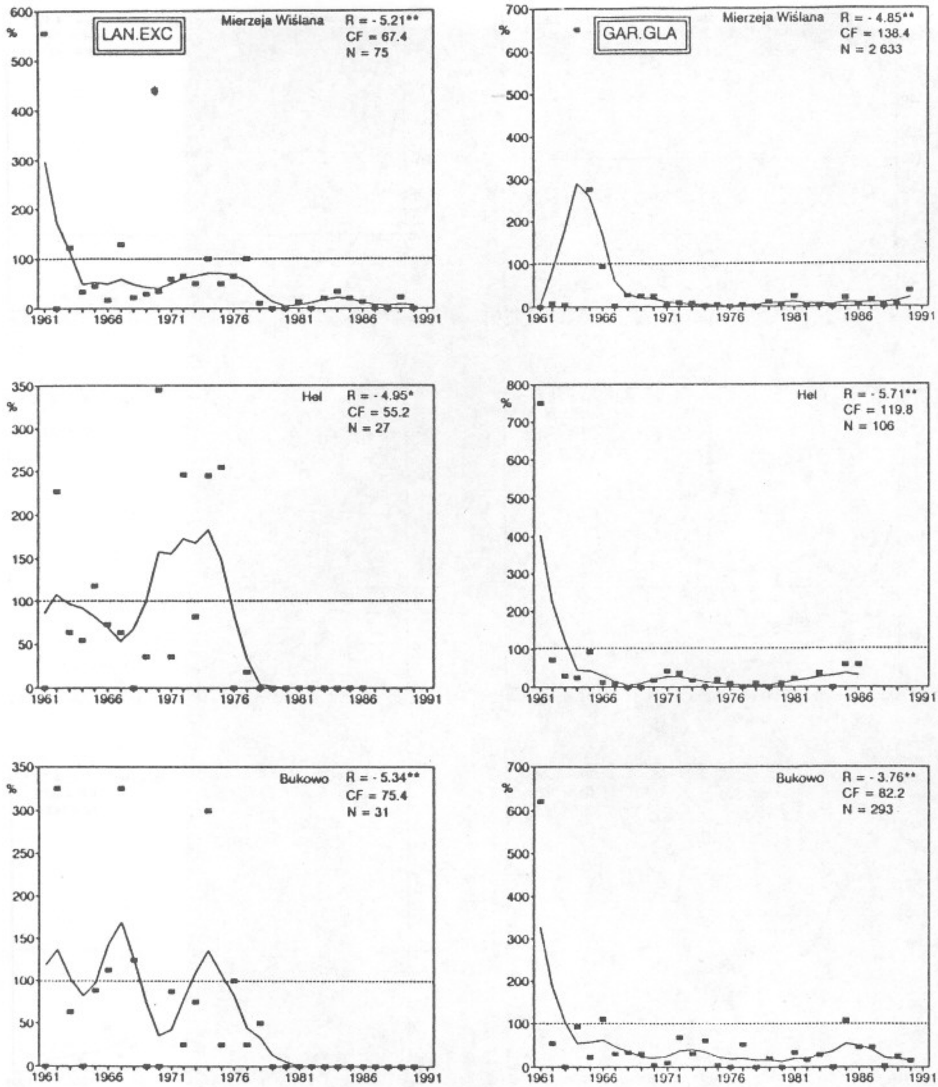


Fig. 22. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. LAN.EXC – *Lanius excubitor*, GAR.GLA – *Garrulus glandarius*. Other explanations as at Fig. 2.

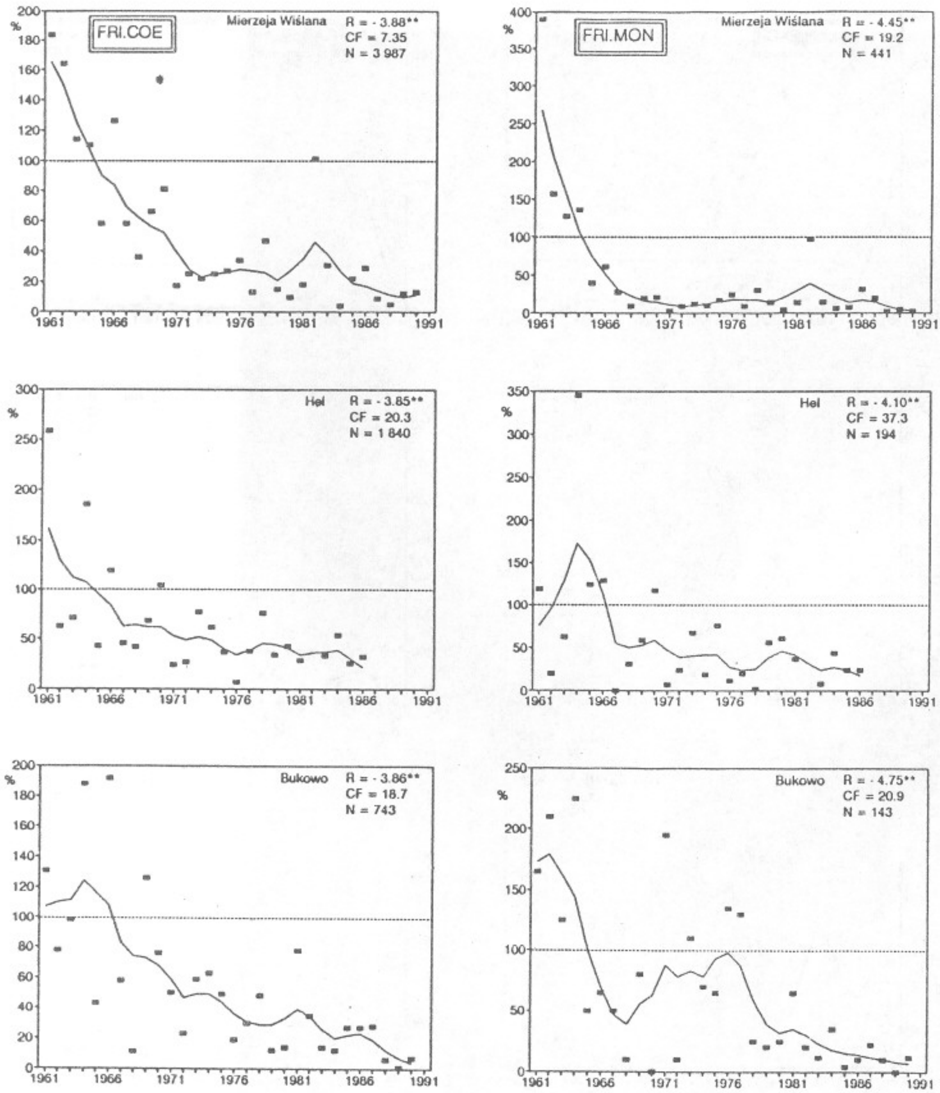


Fig. 23. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. FRI.COE – *Fringilla coelebs*, FRI.MON – *Fringilla montifringilla*. Other explanations as at Fig. 2.

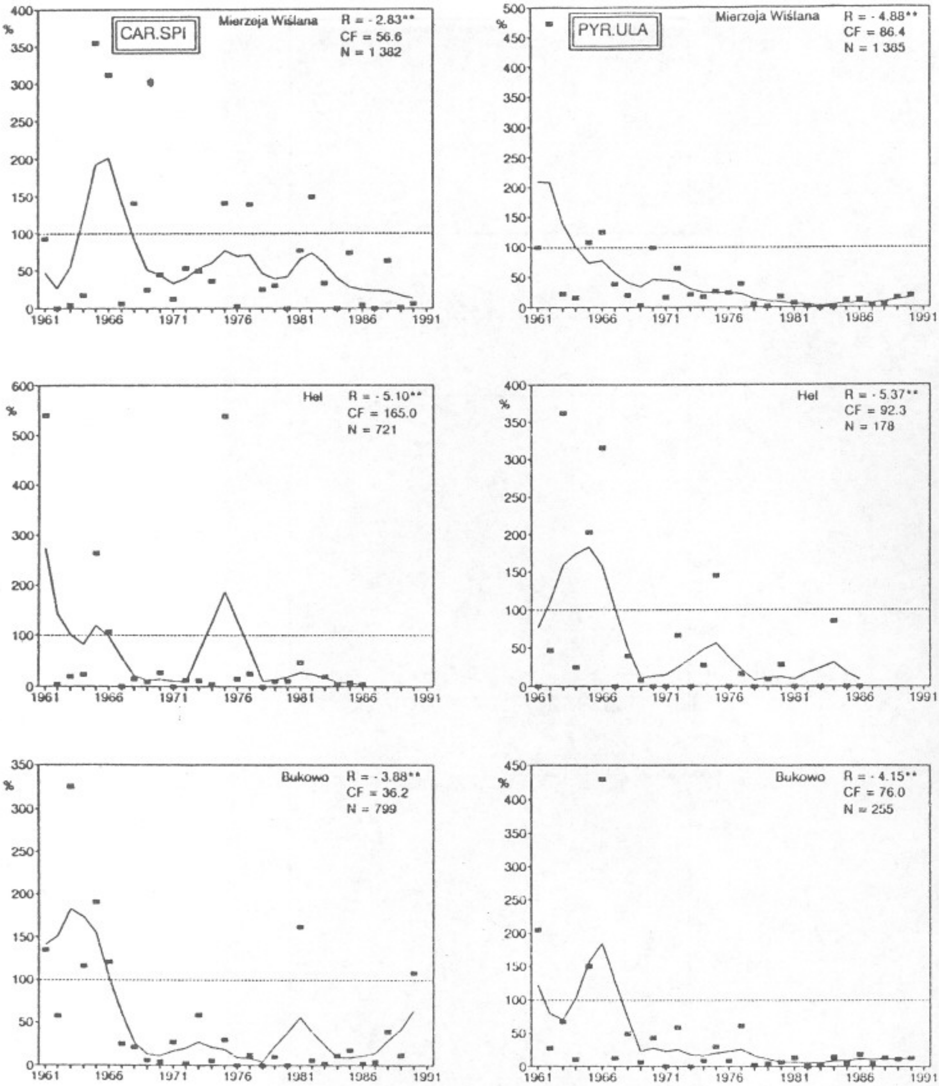


Fig. 24. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. CAR.SPI – *Carduelis spinus*, PYR.ULA – *Pyrrhula pyrrhula*. Other explanations as at Fig. 2.

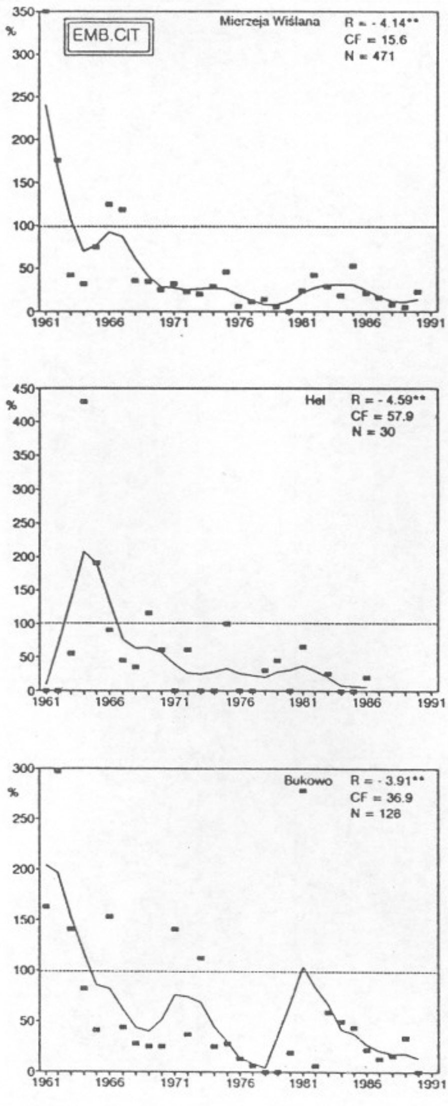


Fig. 25. Raw data (squares) and smoothed population dynamics curves at three Operation Baltic stations 1961–1990, expressed in percent of 1961–1970 station average for the species. EMB.CIT – *Emberiza citrinella*. Other explanations as at Fig. 2.

Wryneck (*Jynx torquilla*) - Fig. 2 and 26. Unusual influx at Bukowo in 1971; high number at Mierzeja Wiślana in 1970 coincides with relatively high number at Bukowo.

Great Woodpecker (*Dendrocopos major*). Fig. 3 and 26. Species clearly invasive - last well pronounced invasions in 1974 (registered at Mierzeja Wiślana and Bukowo) and, smaller, in 1981 (noted at all three stations).

Tree Pipit (*Anthus trivialis*) - Fig. 3 and 26. Unusually high catches at Mierzeja Wiślana in 1962 and 1988 (not occured at other stations).

Wren (*Troglodytes troglodytes*) - Fig. 4 and 26. Exceptional species with rapid number growth at Mierzeja Wiślana (R = +9.70) not followed at other stations (Hel - R = -0.29, Bukowo - R = -0.54). Local number peak in the mid of seventies (esp. 1975) coincides at all stations.

Dunnock (*Prunella modularis*) - Fig. 4 and 26. Highest numbers in the early sixties (1961 - Mierzeja Wiślana, Hel, 1962 - Bukowo, 1963 - Hel, Bukowo), then at Mierzeja Wiślana in 1974-1975.

Robin (*Erithacus rubecula*) - Fig. 5 and 27. Second most commonly caught species. Very high numbers noted in the early sixties (1961-1962), then high catches only in 1972 at Hel and 1974 at Mierzeja Wiślana.

Black Redstart (*Phoenicurus ochruros*) - Fig. 5 and 27. Not common species. Higher catches coincides at all stations, mainly in the years 1963-1967, 1971-1978 and 1982-1989.

Redstart (*Phoenicurus phoenicurus*) - Fig. 6 and 27. Species with steady falling down number at all stations. Exceptionally high catches in 1961 (Bukowo), 1962 (Mierzeja Wiślana) and 1977 (Hel).

Whinchat (*Saxicola rubetra*) - Fig. 6. Caught regularly only at Mierzeja Wiślana where additional nets were located in the reedbeds. The highest numbers in 1962 and 1981, very low number in the seventies.

Wheatear (*Oenanthe oenanthe*) - Fig. 7 and 27. Most common at Mierzeja Wiślana where highest numbers were noted in 1962 and 1970. Good years at Bukowo grouped in the early seventies.

Blackbird (*Turdus merula*) Fig. 7 and 27. Pronounced decline at all stations with simultaneous temporary recovery in mid seventies. Very low values of CF coefficient which suggests that dynamics is presented very exactly.

Song Thrush (*Turdus philomelos*) - Fig. 8 and 27. The pattern similar to that of Blackbird, with less pronounced local peak in the early seventies. *CF* coefficient values even lower than for Blackbird.

Redwing (*Turdus iliacus*) - Fig. 8 and 28. Pattern similar to that of other Thrush species, but higher fluctuations.

Marsh Warblers (*Acrocephalus* - sp.) - Fig. 9. Group of species regularly caught only in reedbeds at Mierzeja Wiślana: Sedge Warbler (*Acrocephalus schoenobaenus*) had good periods in the sixties and eighties, with positive value of regression coefficient. Marsh Warbler (*Acrocephalus palustris*) is least common at Mierzeja Wiślana and good catches were only in 1970 and 1987. Reed Warbler (*Acrocephalus scirpaceus*) is the most common of this group; its population dynamics was discussed in separate paper (Szostakowski 1989). Great Reed Warbler (*Acrocephalus arundinaceus*) shows similar general pattern to that of Sedge Warbler. However, very high catches in 1963 and 1966 caused that regression coefficient is negative despite that in the eighties there was a year (1982) with high catching result.

Icterine Warbler (*Hippolais icterina*) - Fig. 10 and 28. This is a very early migrant, so absence in the early sixties at Mierzeja Wiślana and Bukowo could be explained by later starting the work there; however, it occured at Hel in that time and next long period of absence at Mierzeja Wiślana was noted during the eighties. In average, the best period for this species was in the mid of seventies.

Barred Warbler (*Sylvia nisoria*) - Fig. 10 and 28. It is another early migrant but its highest occurence at Bukowo was in the early sixties, while a pronounced peak of number at Mierzeja Wiślana was in the first half of the seventies.

Lesser Whitethroat (*Sylvia curruca*) - Fig. 11 and 28. species with pronounced decline, especially in the eighties at Bukowo. Fluctuations rather low at Mierzeja Wiślana and Hel, much higher at Bukowo.

Whitethroat (*Sylvia communis*) - Fig. 11 and 28. A slight decline can be found for pooled data, but very differentiated are the curves for separate stations - dramatical decline of this species reported from the western Europe in the early seventies was not confirmed by data from Mierzeja Wiślana and Bukowo, whole number of this species noted at Hel shows really low level from mid of the seventies. It is worth to note that at the westernmost station Bukowo the population level is close to stable, although with very high number fluctuation.

Garden Warbler (*Sylvia borin*) - Fig. 12 and 28. Species with low number during the eighties with the most sure decline at Bukowo (high *R* and low *CF* values). Unusualy high catches at Mierzeja Wiślana in 1962 and Hel in 1978.

Blackcap (*Sylvia atricapilla*) - Fig. 12 and 29. Very clear and sure decline at Hel and Bukowo (very low *CF* values), while number level of migration at Mierzeja Wiślana stable and more fluctuating.

Wood Warbler (*Phylloscopus sibilatrix*) - Fig. 13 and 29. At all stations there were periods of very low number of this species: Mierzeja Wiślana - 1979-1985; Hel - 1975-1986, 1978; Bukowo - 1973-1981. During the late eighties there was some recovery.

Chiffchaff (*Phylloscopus collybita*) - Fig. 13 and 29. Declining, with relatively higher numbers in the mid of seventies - this period was, however, the best at Mierzeja Wiślana (higher number was only in a single year - 1961 - outside that period). It should be mentioned that pooled data show low level of fluctuations.

Willow Warbler (*Phylloscopus trochilus*) - Fig. 14 and 29. Very differentiated patterns of number dynamics with relatively high level of fluctuations, not usual for long distance migrating common species; however, very high *CF* value for Bukowo is caused by extremely high catching result in 1961 - possibly delayed migration caused overestimation of number obtained in recalculations.

Goldcrest (*Regulus regulus*) - Fig. 14 and 29. Most common migrant among caught birds. Very high number fluctuations at all stations, but clearly wave like character of smoothed curves. The highest number level in the first half of the seventies.

Firecrest (*Regulus ignicapillus*) - Fig. 15 and 29. Not common migrant, at Hel even rare, but single occurences there coincide with higher numbers at other stations. Extremely high level of yearly fluctuations.

Spotted Flycather (*Muscicapa striata*) - Fig. 15 and 30. Clear decline and high level of fluctuations. Extremely high catches in 1962 at all stations, then high catching results 1974 at Bukowo and 1977 at Hel.

Pied Flycatcher (*Ficedula hypoleuca*) - Fig. 16 and 30. High numbers in the early sixties, except in 1961 at Mierzeja Wiślana, then more stabilized low number level with few exceptions only (1972 and 1986 at Mierzeja Wiślana).

Long-tailed Tit (*Aegithalos caudatus*) - Fig. 16 and 30. Invasive species with extremely high *CF* values at Mierzeja Wiślana and Hel. The strongest irruptions at Mierzeja Wiślana: 1962, 1972-1973, 1977, 1983 and 1985-1986; Bukowo is rarely reached by invasions (high numbers in 1972-73 and 1977).

Marsh Tit (*Parus palustris*) - Fig. 17 and 30. Most common in the early sixties; then much lower but stabilized level. Low *CF* values (*CF* value for pooled data very low) suggest that at all stations only local bird caught.

Willow Tit (*Parus montanus*) - Fig. 17 and 30. Invasions of this species reach Polish coast very seldom - practically the only one invasion influenced all stations in 1983, when number of birds caught was around twelve and seventeen times higher than normal for Mierzeja Wiślana and Hel respectively. Unusually high number of Willow Tit was caught at Bukowo in 1961, but it is difficult to explain as there were no birds at Mierzeja Wiślana and Hel. Because of these deviations, calculated coefficients are of low informative value.

Crested Tit (*Parus cristatus*) - Fig. 18 and 30. Most of the birds caught seem to be local birds, especially at Bukowo, where number of these birds is the highest and fluctuations - the lowest. At Mierzeja Wiślana were two exceptionally high catches - 1962 and 1976.

Coal Tit (*Parus ater*) - Fig. 18 and 31. This species is known as an irruptive species. Big invasions were noted at Mierzeja Wiślana in 1962, 1974 and 1983; but only 1974 irruption was prolonged to Bukowo station. At Hel and Bukowo the number dynamics curves show only local population changes - at Bukowo the highest population level was in the late sixties - early seventies, while at Hel numbers were moderately declining with relatively low fluctuations. The only exception at Hel was 1961 when highest number of Coal Tits were caught.

Blue Tit (*Parus caeruleus*) - Fig. 19 and 31. Migrates through Polish Baltic coast every year, but with high level of fluctuations. The highest numbers of Blue Tits were noted at Mierzeja Wiślana, while Hel is omitted by migrants. Few outstanding irruptions were noted: 1962 (Mierzeja Wiślana), 1965 (Mierzeja Wiślana, Hel), 1973 (all stations, but the highest at Bukowo) and 1983 (Mierzeja Wiślana). Methodological problems with interpretation of catching data of this diurnal migrant were discussed by Cofta (1985).

Great Tit (*Parus major*) - Fig. 19 and 31. General pattern of the passage by Polish Baltic coast is similar to that of Blue Tit, but Great Tit is more regular on migration (lower *CF* values). The highest numbers were in 1961 (Hel, Bukowo), 1962 (Mierzeja Wiślana), 1973 (all stations), 1975 (Hel) and 1986 (Mierzeja Wiślana). For methodological discussion see Cofta (1985).

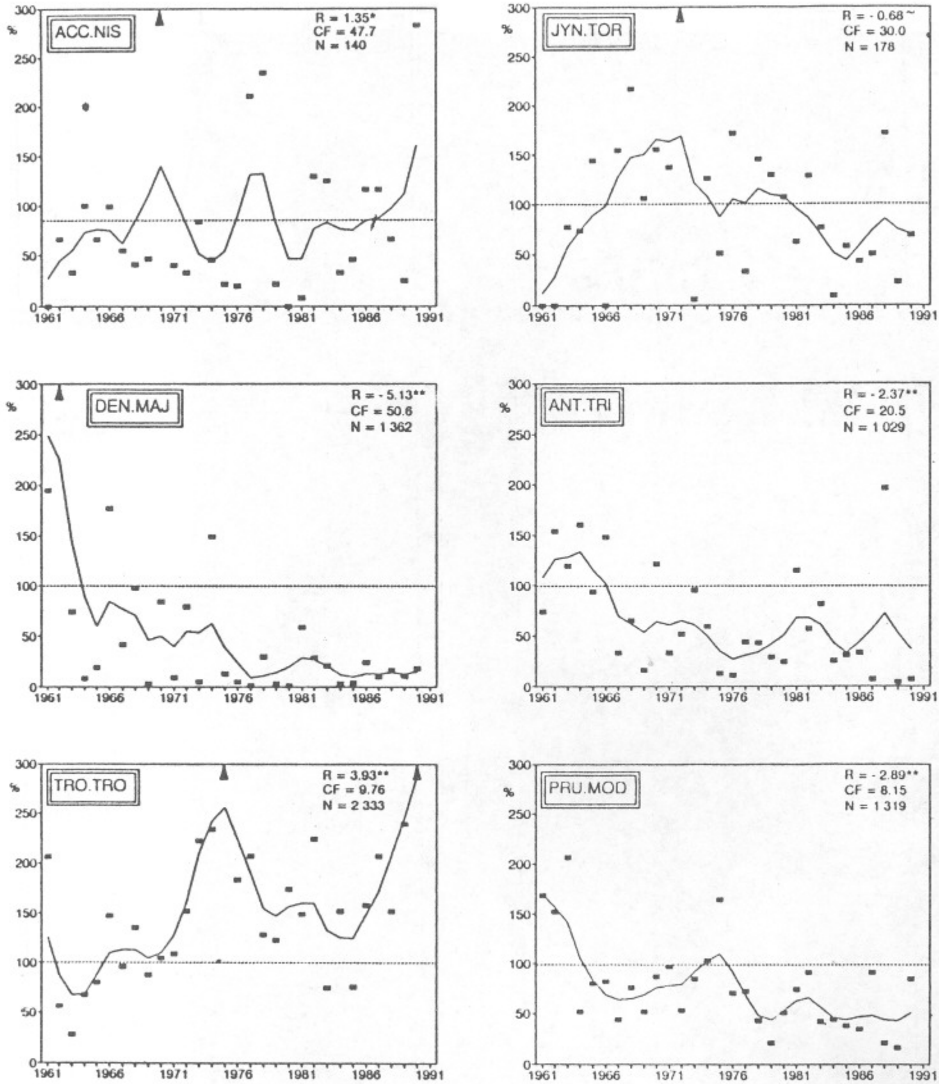


Fig. 26. Population dynamics data pooled for three stations. Squares – data for years, eurve – smoothed data.ACC.NIS – *Accipiter nisus*, JYN.TOR – *Jynx torquilla*, DEN.MAJ – *Dendrocopos major*, ANT.TRI – *Anthus trivialis*, TRO.TRO – *Troglodytes troglodytes*, PRU.MOD – *Prunella modularis*. Other explanations as at Fig. 2.

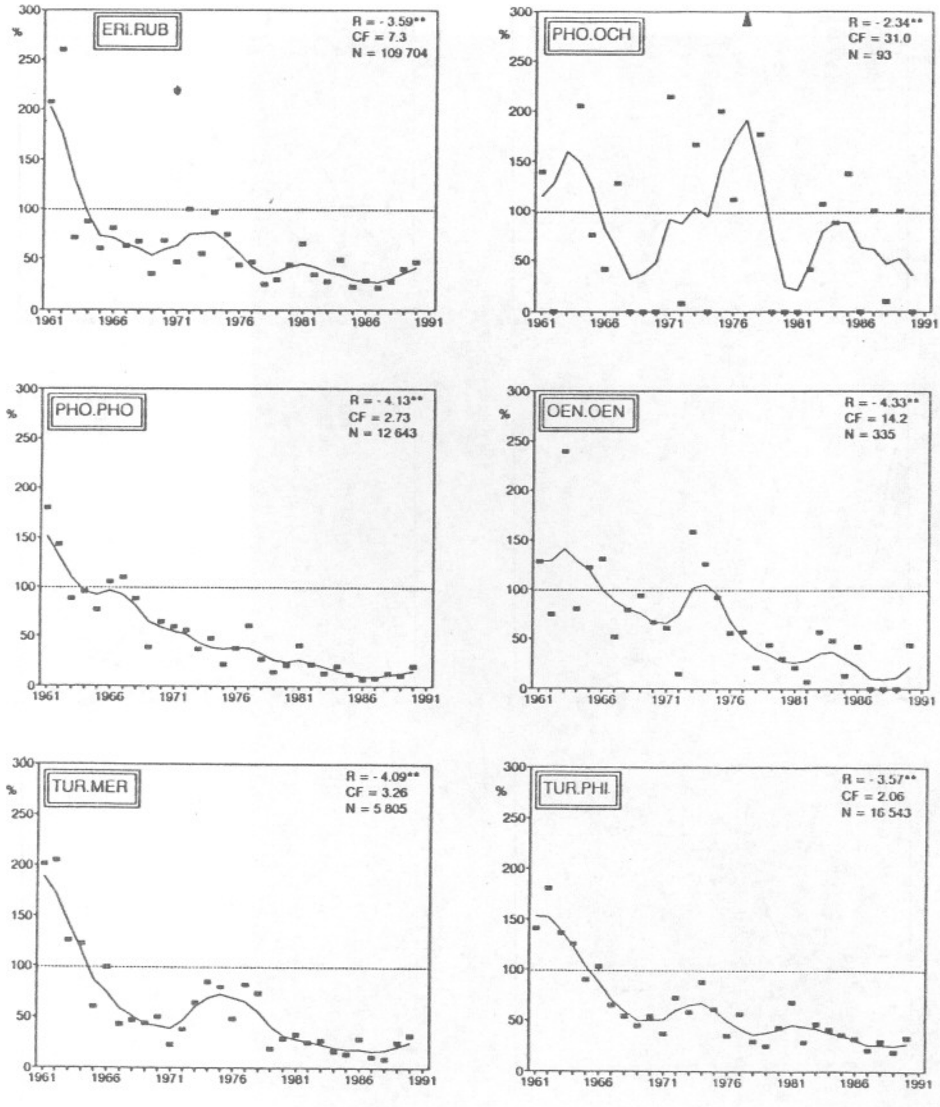


Fig. 27. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. ERI.RUB – *Erithacus rubecula*, PHO.OCH – *Phoenicurus ochruros*, PHO.PHO – *Phoenicurus phoenicurus*, OEN.OEN – *Oenanthe oenanthe*, TUR.MER – *Turdus merula*, TUR.PHI – *Turdus philomelos*. Other explanations as at Fig. 2.

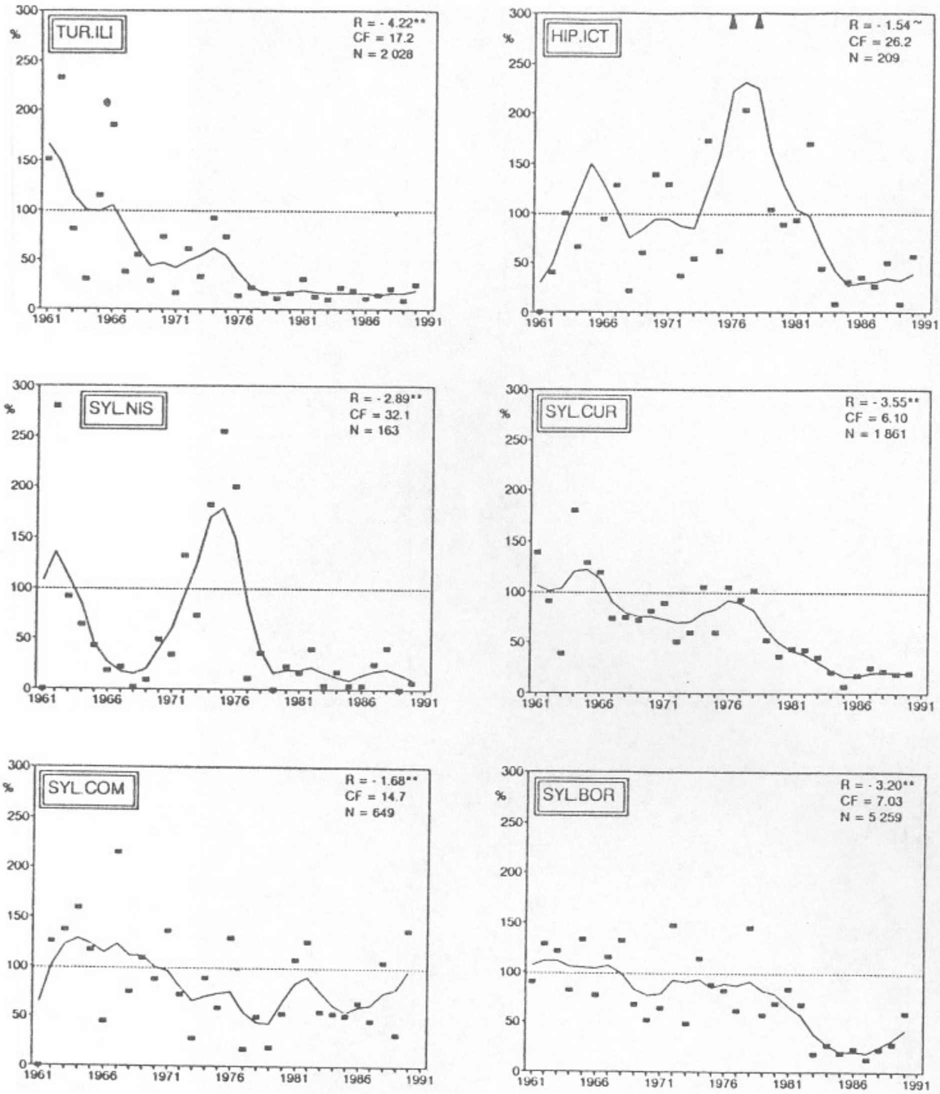


Fig. 28. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. TUR.ILI – *Turdus iliacus*, HIP.ICT – *Hippolais icterina*, SYL.NIS – *Sylvia nisoria*, SYL.CUR – *Sylvia curruca*, SYL.COM – *Sylvia communis*, SYL.BOR – *Sylvia borin*. Other explanations as at Fig. 2.

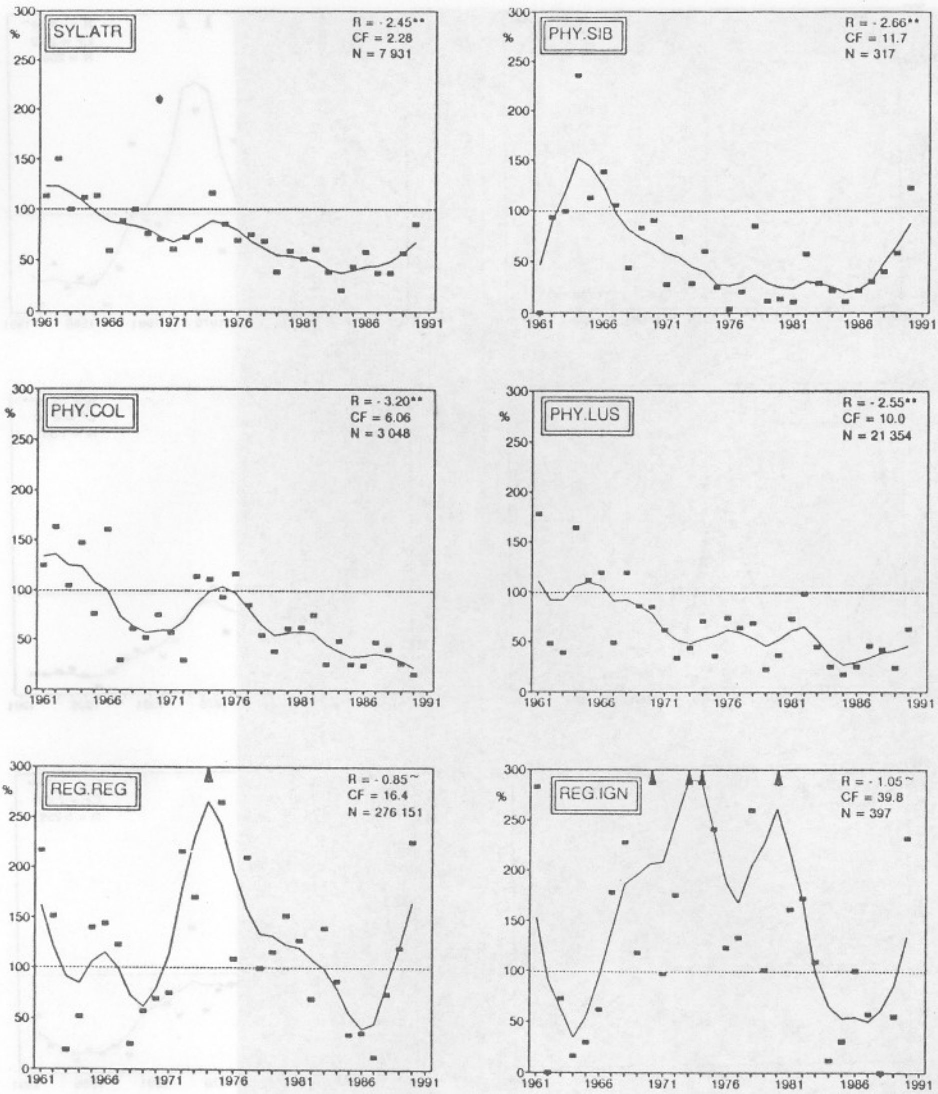


Fig. 29. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. SYL.ATR – *Sylvia atricapilla*, PHY.SIB – *Phylloscopus sibilatrix*, PHY.COL – *Phylloscopus collvbita*, PHY.LUS – *Phylloscopus trochilus*, REG.REG – *Regulus regulus*, REG.IGN – *Regulus ignicapillus*. Other explanations as at Fig. 2.

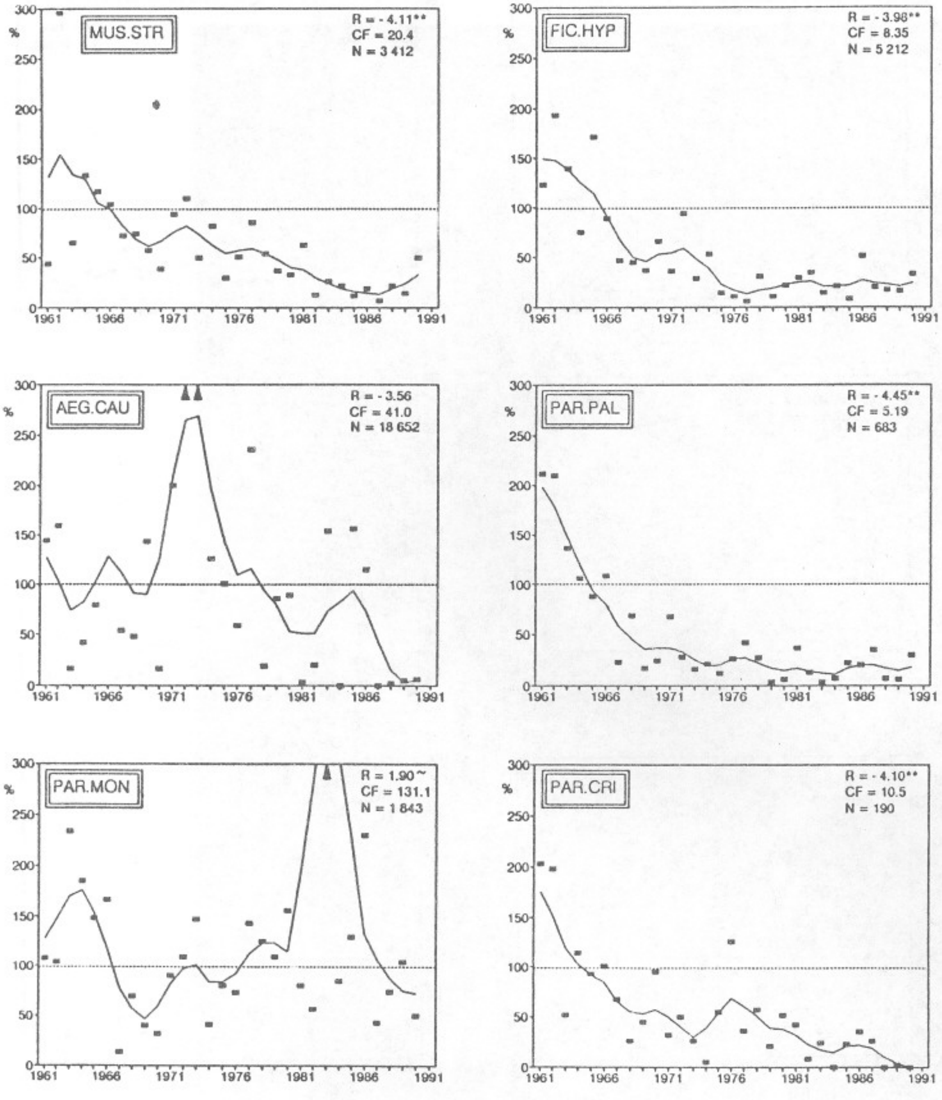


Fig. 30. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. MUS.STR – *Muscicapa striata*, FIC.HYP – *Ficedula hypoleuca*, AEG.CAU – *Aegithalos caudatus*, PAR.PAL – *Parus palustris*, PAR.MON – *Parus montanus*, PAR.CRI – *Parus cristatus*. Other explanations as at Fig. 2.

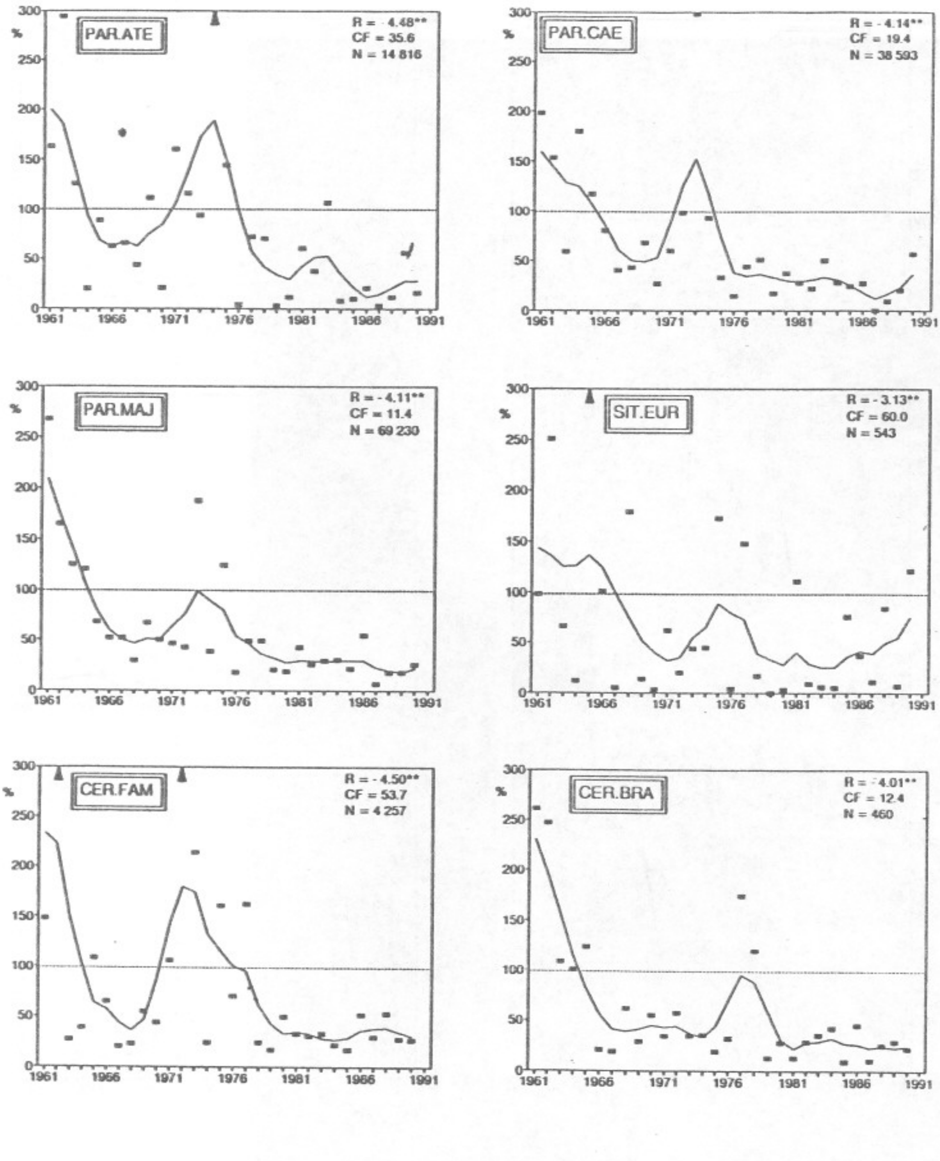


Fig. 31. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. PAR.ATE – *Parus ater*, PAR.CAE – *Parus caeruleus*, PAR.MAJ – *Parus major*, SIT.EUR – *Sitta europaea*, CER.FAM – *Certhia familiaris*, CER.BRA – *Certhia brachydactyla*. Other explanations as at Fig. 2.

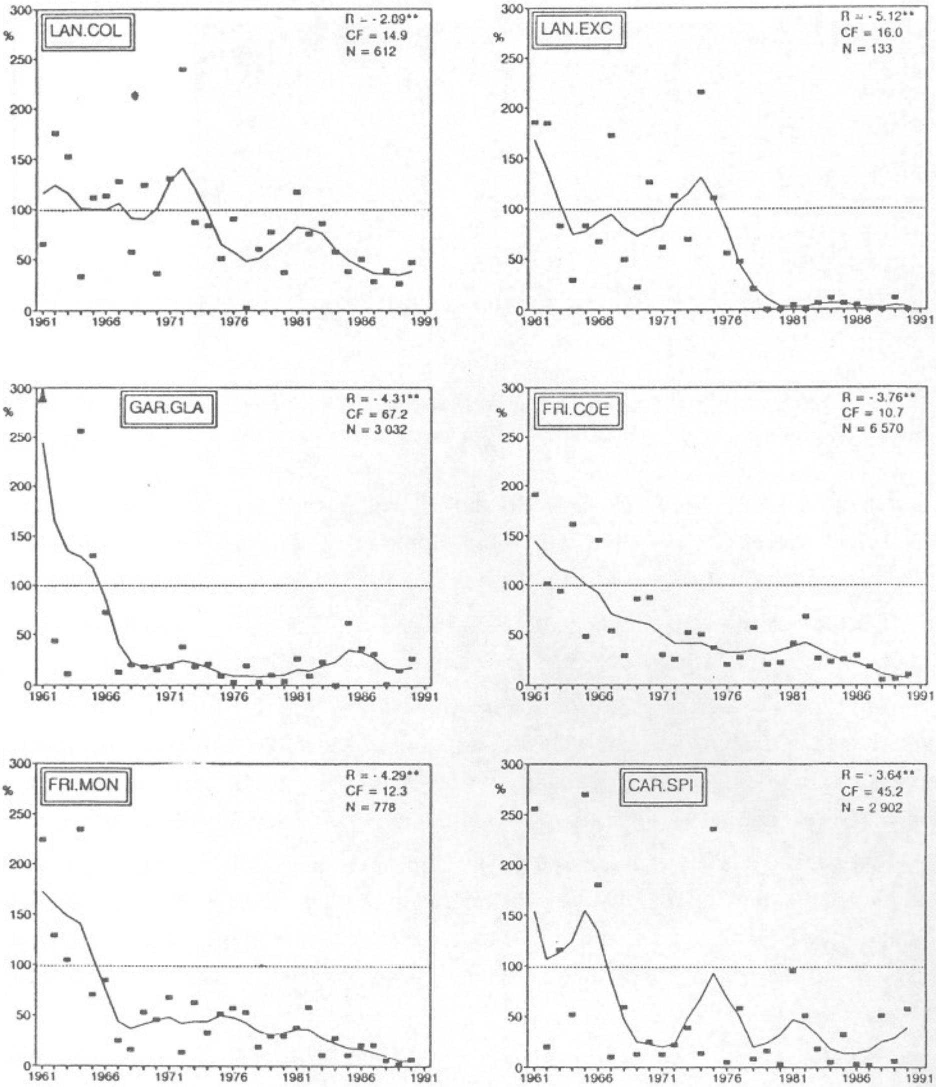


Fig. 32. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. LAN.COL – *Lanius collurio*, LAN.EXC – *Lanius excubitor*, GAR.GLA – *Garrulus glandarius*, FRI.COE – *Fringilla coelebs*, FRI.MON – *Fringilla montifringilla*, CAR.SPI – *Carduelis spinus*. Other explanations as at Fig. 2.

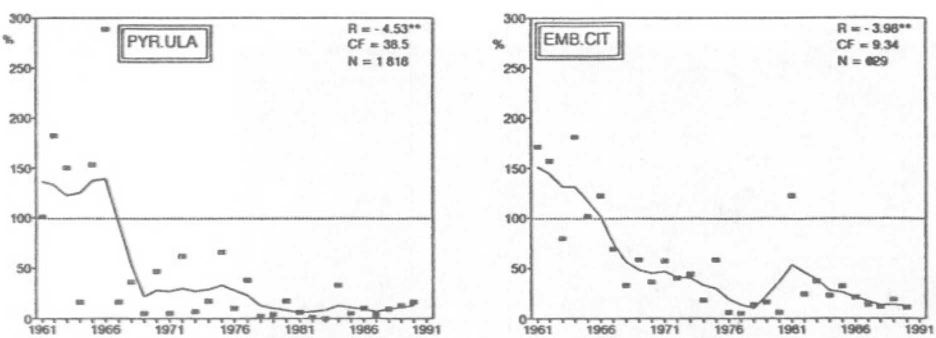


Fig. 33. Population dynamics data pooled for three stations. Squares – data for years, curve – smoothed data. PYR.ULA – *Pyrrhula pyrrhula*, EMB.CIT – *Emberiza citrinella*.Other explanations as at Fig. 2.

Nuthatch (*Sitta europaea*) - Fig. 20 and 31. Nuthatches are not common, at Hel even scarce. Level of fluctuations very high. Some extreme catches can be suspected to be invasions, e.g. that in 1965 at all stations or 1975 at Mierzeja Wiślana.

Treecreeper (*Certhia familiaris*) - Fig. 20 and 31. Very high fluctuations at all stations. Few irruption years can be noted at all stations (1962 and 1972-73).

Short-toed Treecreeper (*Certhia brachydactyla*) - Fig. 21 and 31. Much less numerous than Treecreeper, but with the same high level of fluctuations. The highest numbers were in the begining of sixties (1961 - Hel, 1962-63 - Mierzeja Wiślana) and mid of the seventies (1977-78 Bukowo); additionally in 1986 at Mierzeja Wiślana.

Red-backed Shrike (*Lanius collurio*) - Fig. 21 and 32. Population dynamics differentiated. After Busse (1994 b) birds migrating through Mierzeja Wiślana and Hel belong to the eastern group characterized by clear decline in number, while these from Bukowo - to the western one having relatively stable population dynamics. The level of fluctuations is very high.

Great Grey Shrike (*Lanius excubitor*) - Fig. 22 and 32. In the mid of seventies this species disappeared from catches at Hel and Bukowo, while at Mierzeja Wiślana the number was much reduced. After Busse (1994 b) this is phenomenon observed at all bird stations from Helgoland in the West to Latvia in the East. Level of fluctuations is very high.

Jay (*Garrulus glandarius*) - Fig. 22 and 32. Irruptive species with the highest irruptions in 1964-65. High catches for Hel and Bukowo were 1961, but average number level at these stations much lower than at Mierzeja Wiślana. As it could be expected - very high level of fluctuations if irrruptions are included.

Chaffinch (*Fringilla coelebs*) - Fig. 23 and 32. It is very common diurnal migrant, but not too frequently caught. At all stations clear decline can be observed. As fluctuations are relatvely low, the trend can be treated as well documented.

Brambling (*Fringilla montifringilla*) - Fig. 23 and 32. The number dynamics pattern similar to that of the Chaffinch; good number in 1982 at Mierzeja Wiślana, common with the Chaffinch. Fluctuations little bit higher than in Chaffinch.

Siskin (*Carduelis spinus*) - Fig. 24 and 32. Species with high level of fluctuations, but migrating every year through Polish coast. It is not clear how exactly catching data reflect migration intensity - here it could be expected that there are problems similar to these discussed by Cofta (1985) for other diurnal migrants - tits. Few irruption years common for all stations can be listed: 1965-66, 1975, 1981 and additionally 1982, 1985, 1988 at Mierzeja Wiślana, 1961 at Hel and 1963, 1990 at Bukowo.

Bullfinch (*Pyrrhula pyrrhula*) - Fig. 24 and 33. This is late migrant, so high level of fluctuations can be partly caused by too early end of station work. However, higher catches were noted in the early sixties than later.

Yellowhammer (*Emberiza citrinella*) - Fig. 25 and 33. Declining trend with low level of fluctuations can be noted for pooled data. At separate stations few high deviations were observed: 1961 (Mierzeja Wiślana), 1962 (Bukowo), 1963 (Hel, but in relation to low average) and 1981 (Bukowo). The birds caught are probably mainly from local populations.

SUMMARY

The paper gives basic migration monitoring data from three bird stations working 1961-1990 at the Polish Baltic coast. They were situated near sea shore in narrow stripes of forest between sea and open areas unsuitable for forest birds. This caused concentration of these migrants into narrow stream of diurnal migration and forced night migrants moving during day-time to pass catching area always along the same line. This caused that continuous adaptation of catching sites to changing local conditions did not chang catching probability too much. The numbers of individuals caught were recalculated to the standard period and one net in use as they were differentiated a little bit. General methodological discussion of migration monitoring was published elsewhere (Busse 1980, 1990). The graphs presented in the paper give "raw data", being comparable between stations as they are yearly per-cent values in relation to 1961-70

average catching at the station. The "smoothed data" are the 5-year moving averages of the raw data. Coefficients of regression *R* and fluctuations *CF* are given as indices of trend and yearly fluctuations around smoothed curve respectively.

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