POPULATION ANALYSIS OF THE IBERIAN NOSE (CHONDROSTOMA POLYLEPIS STEIN, 1865) IN THE JARAMA RIVER

Javier Lobon-Cervia

VIE MILIEU, 1982, 32 (3) : 139-148

POPULATION ANALYSIS OF THE IBERIAN NOSE (*CHONDROSTOMA POLYLEPIS* STEIN, 1865) IN THE JARAMA RIVER

Javier LOBÓN-CERVIÁ

Museo Nacional de Ciencias Naturales
Castellana 80, Madrid 6 – España

CH. POLYLEPIS
CROISSANCE
REPRODUCTION
FLEUVE JARAMA

RÉSUMÉ. – Les écailles de 405 spécimens ont été utilisées pour l'âge et le rétro-calcul. Les anneaux annuels se forment dès les derniers jours d'avril jusqu'aux derniers jours de mai. Les femelles croissent plus rapidement que les mâles à partir de leur cinquième année et vivent trois ans de plus. Les paramètres de la courbe de croissance de von Bertalanffy sont : femelles. – $L_{00} = 272.7$, $K = 0.146$, $T_0 = -0.144$ et mâle. – $L_{00} = 222.1$, $K = 0.198$ et $T_0 = 0.066$. Le coefficient de condition augmente lorsque la longueur augmente et semble subir l'influence du développement printanier des gonades. La proportion des sexes pour toute la population est en équilibre : femelle (1) : mâle (0.91). La ponte se produit en mai (début ou mi-mai). Le poids des gonades et le diamètre ovocytaire augmentent progressivement entre septembre et mai. L'âge, la longueur et le poids des Poissons sont corrélés à la fécondité, le poids des gonades, le diamètre des œufs et le nombre des œufs par gramme de gonade. La mortalité a été estimée à $Z_1 = 1.005$, $Z_2 = 1.708$ et $Z_3 = 1.609$ pour trois localités semblables.

CH. POLYLEPIS
GROWTH
REPRODUCTION
JARAMA RIVER

ABSTRACT. – Scales of 405 specimens were used for age and back-calculations. Annual rings (annuli) are formed from last days of April until last days of May. Females grow faster than males from their fifth birthday and they live three years more. Parameters of the von Bertalanffy growth curve are : female. – $L_{00} = 272.7$, $K = 0.146$, $T_0 = -0.144$ and male. – $L_{00} = 222.1$, $K = 0.198$ and $T_0 = 0.066$. Condition coefficient increase when the length increases and it looks to be influenced by the spring gonad development. Sex ratio for all the population is balanced (female/male 1 : 0.91). Spawning occurs in May (early or mid-May). Gonad weight and egg diameter increase from September to May. Age, length and weight of fish are correlated with fecundity, gonad weight, diameter of eggs and number of eggs per gram of gonad. Mortality was estimated in three similar localities as $Z_1 = 1.005$, $Z_2 = 1.708$ and $Z_3 = 1.609$.

1. INTRODUCTION

Basic information on the ecological parameters of the populations of the Iberian Nose (*Ch. polylepis* Stein.) is really low specially when we compare them with the populations of the European Nose (*Ch. nasus* L.) (i.e. Hensel, 1960 ; Prawochenski, 1963 ; Lusk, 1967 ; Klimczyk-Janikowska, 1973 ; Philippart, 1975 and others) or with other European cyprinid populations.

The only available information dealing with the biology and ecology of our species may be seen in Lobón-Cerviá & Elvira (1981), Granado & García-Novo (1981) and Lobón-Cerviá & Penczak (1983).

The goal of this paper is to present the results on the growth, reproduction and vital statistics of *Ch. polylepis* obtained during a general study on the fishes from Jarama River. Some of these results are the basis of computing of production values previously presented by Lobón-Cerviá & Penczak (1983).

2. STUDY AREA, MATERIAL AND METHODS

Data presented in this paper were obtained during a general study of the fishes from Jarama River. Characteristics of the studied area, sampling locations, sampling methods and species composition may be seen in Lobón-Cerviá & Penczak (1983) and Lóbón-Cerviá & Torres (1983).

Monthly samples of *Ch. polylepis* were taken with a electro-shocker (250 V and 1-1.5 Amp) from March 1980 to March 1982.

After captures, fishes were fixed in formalyne (7 %) and days later gonads were transfered to Gilson fluid (according to the formula given by Bagenal (1977)). Gonads were extracted and sex determined. The sex in specimens smaller than 8-9 cm was determined by means of gonad tissue preparations studied with microscope. At least four females per month were used for egg-size distribution analysis.

3. RESULTS AND DISCUSSION

3.1. Age and growth

3.1.1. Seasonal Growth

Monthly length frequency distributions of the 0+ age-class were recorded from samples taken during a two years period (Fig. 1). The growth in weight was studied according to the length – weight relationships calculated for every month or groups on months for this age-class (Table IIIb).

Mean lengths and 95 % confidence limits of these distributions were calculated and plotted in Fig. 2. According to this plot the annual cycle may be divided into three periods. The first one from June to October – is characterized by a fast growth in length and weight. In the second period (October-March) there is no growth and in the third one – from March to May – there is a clear evidence of growth, faster in weight than in length (Fig. 2).

Observation on the annulus formation in the studied period shows that in this age-class there is a unique formation of an annulus in spring (last days of April and during May) and therefore demonstrates its validation as an annual estimator.

When analyzing the seasonal growth of the scale margin in the 2+ and 3+ age-classes, studied with the index of marginal scale growth (G_i) :

$$G_i = \frac{R - r_n}{r_n - r_{n-1}}$$

where R represents the total scale radius, r_n the radius to the n annulus and r_{n-1} the radius to the $n-1$ annulus, only two periods of growth are recognized in both year classes. These periods are : the first – from June to September – with a fast growth of the margin of the scale and the second, – from September to April – in which there is no evidence of growth (Fig. 3).

3.1.2. Age and back-calculations

Age of specimens was determined from scale (Lobón-Cerviá & Elvira, 1981). Six to ten scales were taken from the first row of scales above the lateral line in the second half of the body. They were cleaned in NaOH (7 %) and washed in distilled water.

Annual rings (annuli) may be verify by a "crossing – over" (Cragg-Hine & Jones, 1969) between the rings of a winter with those of the next summer, by a thin separation between the rings of one winter (generally very close) and those of the next fast growth summer period and/or by a thin area between two consecutive years. This last feature is more characteristic of the fishes older than IV years. One, two ore three features may appear in the same scale.

In the general morphology, the scales of *Ch. polylepis* look similar to those of the Polish populations of *Ch. nasus* (L.) studied by Prawochenski (1963, p. 169-170).

The first annulus has to be carefully studied to avoid overlooking since it uses to be formed very close to the focus of the scale. False annuli are scarse (2,5 % of the specimens older than 3+) and they may be readily distinguished by their incomplete appearance. They appear only on one side of the scale or on its anterior part.

When there were difficultness to age some specimens (specially fishes older than six years), opercular bones were used for comparison. These opercular bones confirmed the previous age estimated with scales in 100 % of the cases. Besides, a second reader (Dr. Z. Marciak, Inland Fisheries Institute, Olsztyn, Poland), redeterminated the scale reading of 50 specimens with a 100 % of agreement (no previous contact between readers was done to avoid "a priori" suggestions).

In fishes older than 0+ age-class, annulus is also formed in the last days of April and during May.

May 15th was taken as the population birthday. One of those six to ten scales taken from 405 specimens was used for back-calculations. The only criteria to choose the scale was to be the easiest readible.

A plot of standar length (L_s) : scale radius (L_{es}) gave the line of best fit as a potential curve (Fig. 4) with the equation :

$$\text{Log } L_s = 0{,}8366 + 0{,}7968 \,.\, \text{Log } L_{es} \qquad (r = 0{,}97)$$

therefore back-calculations was performed according to :

$$L_r = L_R \, (r/R)^{0,7968}$$

where L_r represents the length of the fish in the r annulus and L_R the length of the captured fish which has a scale radius equal R.

The back calculated lengths were adjusted according to the above relationships and results are summarized in Table I.

Mean length for age of female and male were used to calculate the theoretical von Bertalanffy's growth curve (von Bertalanffy, 1957). This model for length (L_T) at age T as a function of T is written :

$$L_T = L_{00} \, (1 - e^{-K(T+T_0)})$$

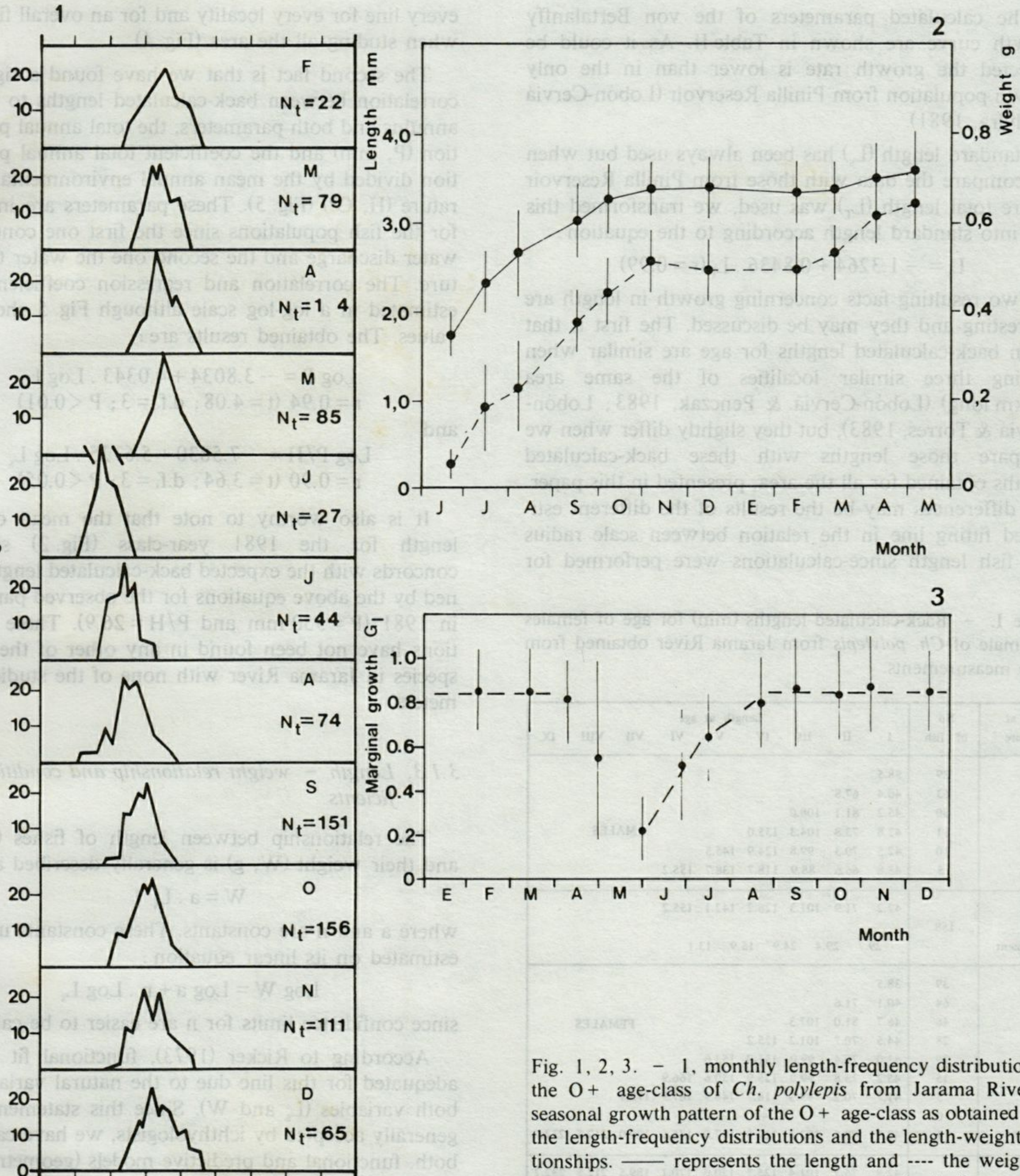


Fig. 1, 2, 3. – 1, monthly length-frequency distributions of the O+ age-class of *Ch. polylepis* from Jarama River. 2, seasonal growth pattern of the O+ age-class as obtained from the length-frequency distributions and the length-weight relationships. —— represents the length and ---- the weight. 3, seasonal growth of the margin of the scale in the 2+ and 3+ age-classes of *Ch. polylepis* from Jarama River.

where L_{00} represents the mathematical asymptote of the curve, K (*cf.* anabolism) a measure of the rate at which the growth curve approaches the asymptote, T_0 a time scaler equivalent to the hypothetical starting time at which the fish would have been cero-sized and E (*cf.* catabolism) is equal to $K \times L_{00}$.

To fit the curve and to estimate its parameters, the Ford – Walford plot (Ford 1933; Walford 1947) was used. L_{00} was calculated from the intercept with the 45° slope line (Y = X), K was obtained as – Ln b, where b is the slope of the lines obtained in the Ford-Walford plot :

Females : $L_{t+1} = 37.767 + 0.864 \,.\, L_t$

and

Males $L_{t+1} = 39.971 + 0.820 \,.\, L_t$

and to was estimated according to the Gulland's equation (Gulland, 1964).

$$T_0 = T + 1/K.\ \mathrm{Ln}\ (L_{00} - L_T/L_{00})$$

where L_T was taken for T = 1. The solitary IX + years old female was not used for these calculations.

The calculated parameters of the von Bertalanffy growth curve are shown in Table II. As it could be expected the growth rate is lower than in the only known population from Pinilla Reservoir (Lobón-Cerviá & Elvira, 1981).

Standard length (L_s) has been always used but when we compare the data with those from Pinilla Reservoir where total length (L_T) was used, we transformed this one into standard length according to the equation :

$$L_s = -1.3264 + 0.8436 \cdot L_t \ (r = 0.99)$$

Two resulting facts concerning growth in length are interesting and they may be discussed. The first is that mean back-calculated lengths for age are similar when studing three similar localities of the same area (15 km long) (Lobón-Cerviá & Penczak, 1983; Lobón-Cerviá & Torres, 1983), but they slightly differ when we compare those lengths with these back-calculated lengths obtained for all the area, presented in this paper. The differences may be the results of the different estimated fitting line in the relation between scale radius and fish length since-calculations were performed for every line for every locality and for an overall fitted line when studing all the area (Fig. 4).

Table I. – Back-calculated lengths (mm) for age of females and male of *Ch. polylepis* from Jarama River obtained from scale measurements.

Age at capture	No of fish	Length at age I	II	III	IV	V	VI	VII	VIII	IX
I+	39	38.5								
II+	63	40.4	67.8							
III+	30	45.2	81.1	108.0						
IV+	11	42.8	73.8	104.3	135.0			MALES		
V+	10	42.5	70.3	99.8	124.9	145.5				
VI+	5	43.8	66.6	88.9	118.7	138.7	155.2			
Mean		42.2	71.9	101.3	126.2	142.1	155.2			
Total	158									
Increment			29.7	29.4	24.9	15.9	13.1			
I+	39	38.5								
II+	64	40.1	71.6							
III+	46	46.7	81.0	107.3				FEMALES		
IV+	28	44.5	70.7	101.2	125.2					
V+	29	43.0	70.4	99.0	131.0	153.6				
VI+	15	45.2	73.8	99.0	125.9	150.6	166.9			
VII+	5	41.7	70.2	99.3	118.7	148.9	167.9	179.9		
VIII+	0	–	–	–	–	–	–	–		
IX+	1	42.7	89.6	102.4	127.6	147.0	175.6	199.0	212.5	232.2
Mean		42.8	75.3	101.4	125.7	150.0	170.1	189.5	212.5	232.2
Total	227									
Increment			32.5	26.1	24.3	24.3	20.1	19.4	23.0	19.7

Table II. – Estimates of ultimate length (L_{00}) and the von Bertalanffy coefficients E and K of *Ch. polylepis* in the Jarama River compared with those from Pinilla Reservoir.

		T_0	K	L_{oo}	E
Jarama River	Females	-0.144	0.146	272.7	40.54
	Males	-0.066	0.198	222.1	43.98
Pinilla+ Reservoir	Females	0.161	0.218	291.6	63.56
	Males	0.171	0.240	266.7	64.00

+. - Data from Lobón-Cerviá & Elvira (1981)

The second fact is that we have found a significant correlation between back-calculated lengths to the first annulus and both parameters, the total annual precipitation (P, mm) and the coefficient total annual precipitation divided by the mean annual environmental temperature (H, C°) (Fig. 5). These parameters are important for the fish populations since the first one controls the water discharge and the second one the water temperature. The correlation and regression coefficients were estimated in a log-log scale although Fig. 5 shows real values. The obtained results are :

$$\text{Log } P = -3.8034 + 4.0343 \cdot \text{Log } L_s$$
$$r = 0.94 \ (t = 4.08 ; \text{d.f.} = 3 ; P < 0.01)$$

and

$$\text{Log } P/H = -7.5830 + 5.6725 \cdot \text{Log } L_s$$
$$r = 0.90 \ (t = 3.64 ; \text{d.f.} = 3 ; P < 0.05)$$

It is also worthy to note that the mean observed length for the 1981 year-class (Fig. 2) smoothly concords with the expected back-calculated length obtained by the above equations for the observed parameters in 1981 (P = 350 mm and P/H = 26.9). These correlations have not been found in any other of the present species in Jarama River with none of the studied parameters.

3.1.3. Length – weight relationship and condition coefficients

The relationship between length of fishes (L_s, cm) and their weight (W, g) is generally described as :

$$W = a \cdot L_s^{\ n}$$

where a and n are constants. These constants use to be estimated on its linear equation :

$$\text{Log } W = \text{Log } a + n \cdot \text{Log } L_s$$

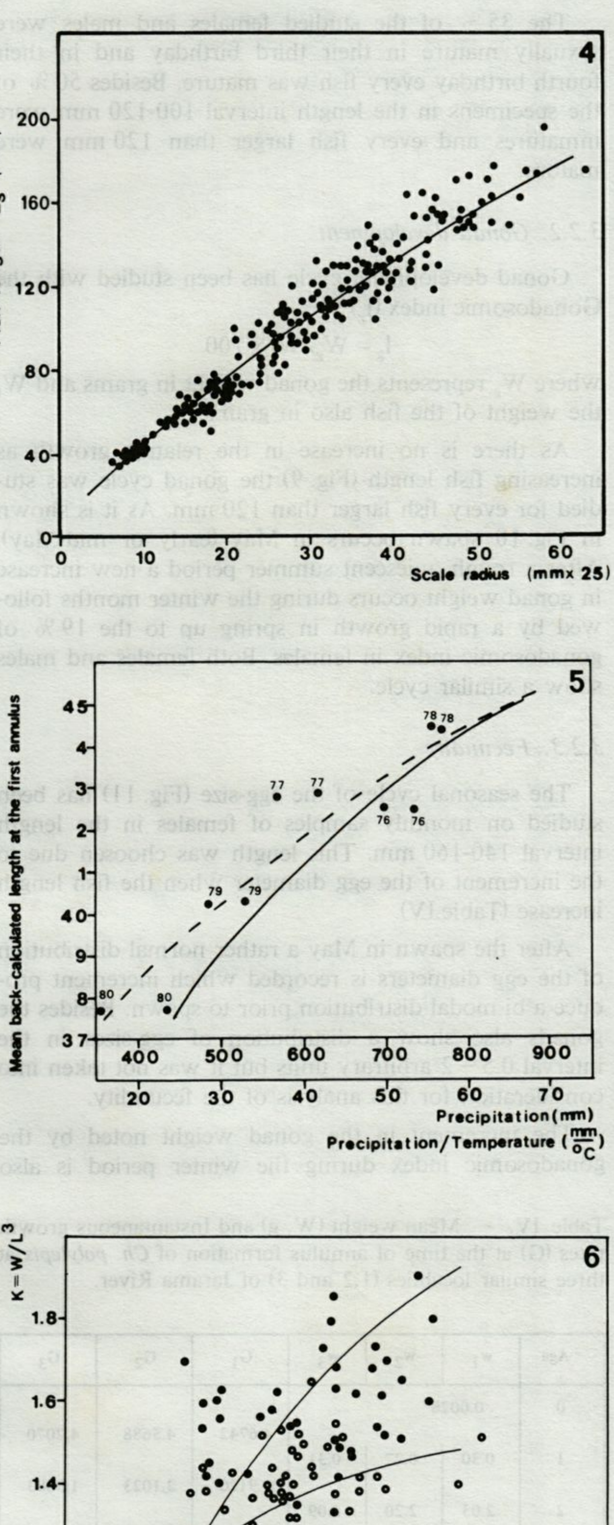
since confidence limits for n are easier to be calculated.

According to Ricker (1973), functional fit is more adequated for this line due to the natural variability of both variables (L_s and W). Since this statement is not generally accepted by ichthyologists, we have calculated both, functional and predictive models (geometric mean and least squares respectively).

Both models are related by means of the correlation coefficient (r) : r = b/v where b is the slope in the line fitted by least squares and v the slope obtained by geometric mean. The standard error of v is equal to the standard error of b (Ricker, 1973) :

$$S_v = S_b = \sqrt{\frac{v^2(1-r^2)}{N-2}} = \sqrt{\frac{S^2 yx}{x^2}}$$

Length-weight regression coefficient have been calculated for the 0+ age-class, for adult males, adult females and for the group adult females + adults males + inmatures older than 0+ in different months of the year or groups of months.



Correlation coefficients in every studied case were close to one and were always significant in $P < 0{,}05$.

Obtained regression coefficients are shown in Table III a and Table III b. The first for adult males, females and inmatures older than 0 + and the second for the 0 + age-class.

The condition coefficient (K) was calculated for individual fish according to the equation :

$$K = W / L^3 \times 100$$

where symbols are the same as in the length – weight relationships.

As this coefficient increases when the length increases, seasonal variation were studied for adult males in the length interval 130-150 mm, for adult females in the length interval 140-170 mm and for the 0 + age-class. Results are plotted in Fig. 7. The youngest group (0 + age-class) shows a maximum in July and a minimum in September; a low winter increase is noted. Obtained values for adult females are always higher than for adult males. Both have a similar cycle with a maximum in April prior to spawn. The condition coefficient in male and female increases during the spring period when the gonad weight increases.

3.1.4. Instantaneous Growth Rate

Instantaneous growth rate (G) was calculated according to :

$$G = \mathrm{Ln}\,(W_{t+1} / W_t)$$

and it was estimated for the time of annulus formation to male and female captured in three similar localities which characteristic features are given in Lobón-Cerviá & Penczak (1983). As very low differences were found between male and female, results for the three localities together with the mean weight at the time of annulus formation are given in Table IV. The mean weight for every age were established from the length-weight relationships (Tables IIIa and IIIb) and the initial weight at the time equal zero was taken as the weight of one egg. The instantaneous growth rate is rather similar in the three studied localities.

3.1.5. Sex-Ratio

Sex-ratio of the studied population was analyzed in 814 specimens larger than 8 cm captured in monthly samples. A chi-squared (χ^2) test showed that in length interval 10-15 cm the ratio female-male (1 : 1.13) is not statistically significant, while in the interval 15-20 cm

Fig. 4, 5, 6. – 4, relationship between fish length (L_s, mm) and scale radius (mm × 25) of *Ch. polylepis* from Jarama River. 5, relationship between precipitation and precipitation mean annual temperature and mean back-calculated length for the first annulus in the 1976-80 year-classes. 6, relationship between gonadosomic index (I_g) and fish length of female Jarama *Ch. polylepis*. ● spring samples (prior to spawn) and ○ winter samples (November and December).

the females are significantly dominant (1 : 0.33). When analyzing all the population the expected sex-ratio (1 : 1) showed no statistical differences with the observed sex-ratio 1 : 0.91 (427 female and 387 male) (Fig. 8).

3.2. Reproduction

3.2.1. Age and length at first spawn

Assessment of age and length at first spawn were established in spring samples of 1980 and 1981 just prior to spawn.

Table IIIa. – Length-weight regression coefficients of *Ch. polylepis* from Jarama River calculated from log W = Log a + n . Log L_s where W = weight (g), L_s = standard length (cm), a and n = constants, S_n = standard error of n, N_t = number of specimens and R = fitting method (F = functional and P = predictive).

Period	N_t	Log a	b	S_b	R	
March	36	-2.2089	3.3148	0.1002	F	Females
		-2.1465	3.2629		P	
	16	-2.1172	3.2232	0.1340	F	Males
		-2.0731	3.1839			
	72	-1.5994	2.8015	0.0574	F	Inmatures + Males
		-1.5681	2.7718			+ Females
April	17	-1.7090	2.9320	0.1296	F	Females
		-1.8590	2.8886		P	
	11	-1.9599	3.1327	0.1333	F	Males
		-1.9314	3.1070		P	
	41	-2.1382	3.3570	0.1044	F	Inmatures + Males
		-2.1143	3.3291		P	+ Females
June-September	24	-2.0838	3.1749	0.1180	F	Females
		-2.0644	3.1574			
	38	-2.1061	3.2078	0.0603	F	Males
		-2.0927	3.1959		P	
	76	-2.0741	3.1752	0.0248	F	Inmatures + Males
		-2.0692	3.1704		P	+ Females
October-February	42	-1.8822	3.0323	0.0618	F	Females
		-1.8557	3.0083		P	
	23	-2.1792	3.2944	0.1209	F	Males
		-2.0867	3.2107		P	
	75	-2.0217	3.1533	0.0386	F	Inmatures + Males
		-2.0063	3.1384			+ Females

Table IIIb. – Length-weight regression coefficients for the 0 + age-class of *Ch. polylepis* from Jarama River. Symbols as in Table IIIa.

Period	N_t	Log a	b	S_b	R
March	79	-1.9354	3.1070	0.0907	F
		-1.8394	2.9277		P
April	104	-1.9395	3.1489	0.0734	F
		-1.8902	3.0592		P
May	85	-1.9712	3.1880	0.1411	F
		-1.8207	2.9167		P
June	27	-2.0831	3.7313	0.1823	F
		-2.0533	3.6182		P
July	44	-1.9283	3.2575	0.1390	F
		-1.8822	3.1308		P
Aug.-October	381	-2.1968	3.7043	0.0906	F
		-2.1641	3.6258		P
Nov.-February	197	-2.0838	3.3006	0.0719	F
		-2.0357	3.2570		P

The 35 % of the studied females and males were sexually mature in their third birthday and in their fourth birthday every fish was mature. Besides 50 % of the specimens in the length interval 100-120 mm were inmatures and every fish larger than 120 mm were mature.

3.2.2. Gonad development

Gonad development cycle has been studied with the Gonadosomic index (I_g) :

$$I_g = W_g / W_f \times 100$$

where W_g represents the gonad weight in grams and W_f the weight of the fish also in grams.

As there is no increase in the relative growth as increasing fish length (Fig. 9) the gonad cycle was studied for every fish larger than 120 mm. As it is shown in Fig. 10 spawn occurs in May (early or mid-May). After a rough quiescent summer period a new increase in gonad weight occurs during the winter months followed by a rapid growth in spring up to the 19 % of gonadosomic index in females. Both females and males show a similar cycle.

3.2.3. Fecundity

The seasonal cycle of the egg-size (Fig. 11) has been studied on monthly samples of females in the length interval 140-160 mm. This length was choosen due to the increment of the egg diameter when the fish length increase (Table IV).

After the spawn in May a rather normal distribution of the egg diameters is recorded which increment produce a bi-modal distribution prior to spawn. Besides the gonads also show a distribution of egg-sizes in the interval 0.5 – 2 arbitrary units but it was not taken into consideration for this analysis of the fecundity.

The increment in the gonad weight noted by the gonadosomic index during the winter period is also

Table IV. – Mean weight (W, g) and Instantaneous growth rates (G) at the time of annulus formation of *Ch. polylepis* at three similar localities (1,2 and 3) of Jarama River.

Age	w_1	w_2	w_3	G_1	G_2	G_3
0	0.0028+					
				4.6742	4.5688	4.7070
1	0.30	0.27	0.31			
				1.9120	2.1023	1.9083
2	2.03	2.20	2.09			
				1.2975	1.2789	1.2643
3	7.42	7.42	7.40			
				0.9852	1.0425	0.9907
4	19.90	22.82	19.93			
				0.5181	0.5032	0.5347
5	33.42	37.25	34.02			
				0.3655	0.3915	—
6	48.15	55.10	—			

\+ weight of one egg.

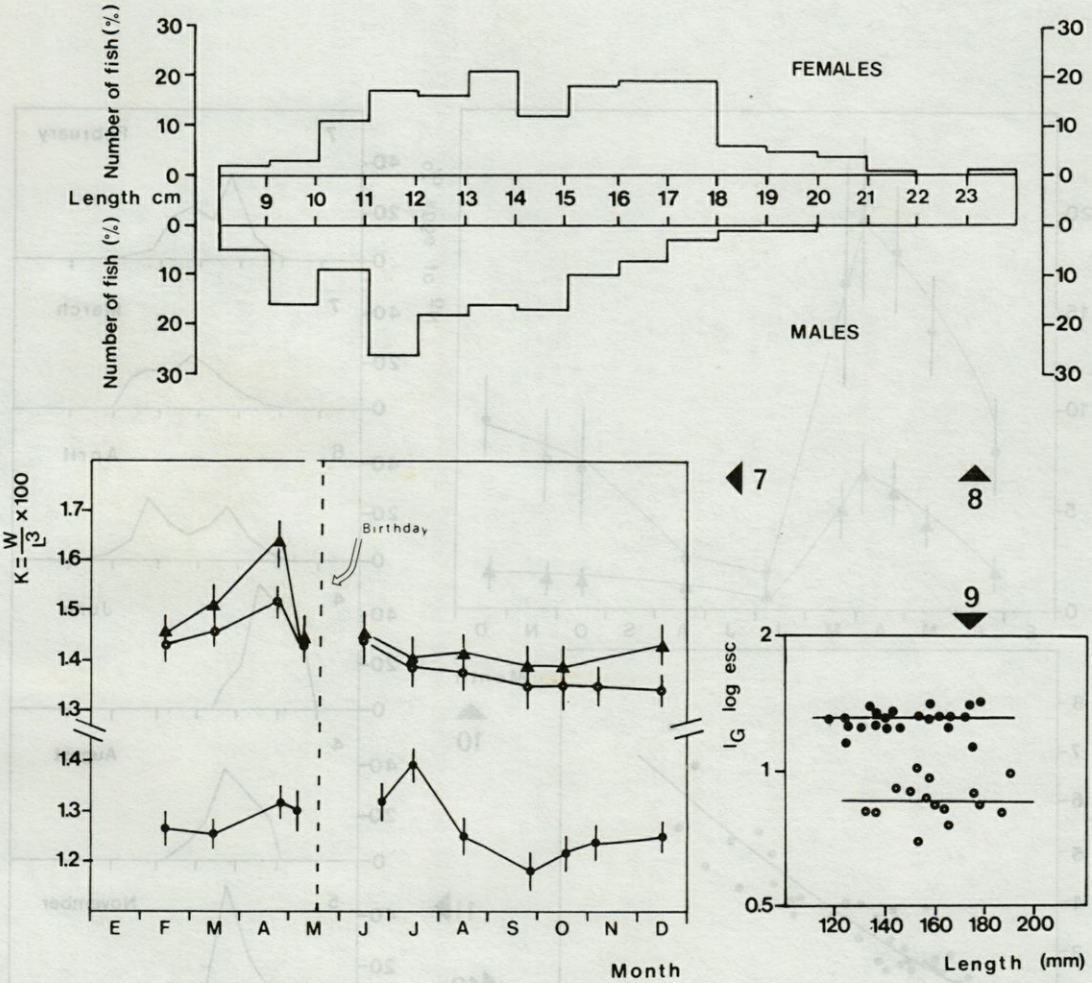


Fig. 7, 8, 9. – 7, monthly mean and 95 % confidence limits of condition coefficients (K), for females (▲), male (○) and O + age-class. 8, sex-ratio of *Ch. polylepis* from Jarama River with relation to fish length. 9, Relationship between gonadosomatic index (I_g) and fish length of female Jarama *Ch. polylepis*. ● spring samples (prior to spawn) and ○ winter samples (Nov-Dec).

present in the distributions of the egg-sizes as well as the rapid growth recorded in spring.

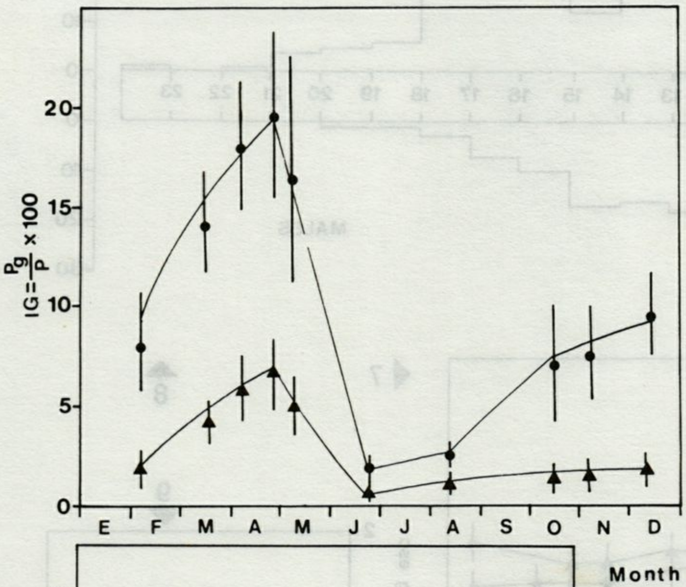
Fecundity (Bagenal, 1978) was estimated according to the gravimetric method counting all the eggs larger than 7 arbitrary units corresponding to the "high mean" in the bimodal distribution plus some white-opaque eggs smaller than 7 units included in the "low mean" distribution. A clear demonstration of that these eggs are also shed is that, in the distribution of egg-sizes in June and August (Fig. 11) there is a gup up to the higher values of the mean (rigth side of the distribution).

Fecundity was estimated in 42 females. Length, age, weight, gonad weight, egg diameter and fecundity were estimated in every specimen. A multivariant correlation analysis was performed with the logarithms of the obtained values (with the exception of the age). Results (Table V) show that every correlation are significant in $P < 0.01$ and $P < 0.05$. Thus when the fish length, age and weight increase, the gonad weight, the fecundity and the number of eggs increase significantly and the number of eggs per gram of gonad decreases significantly.

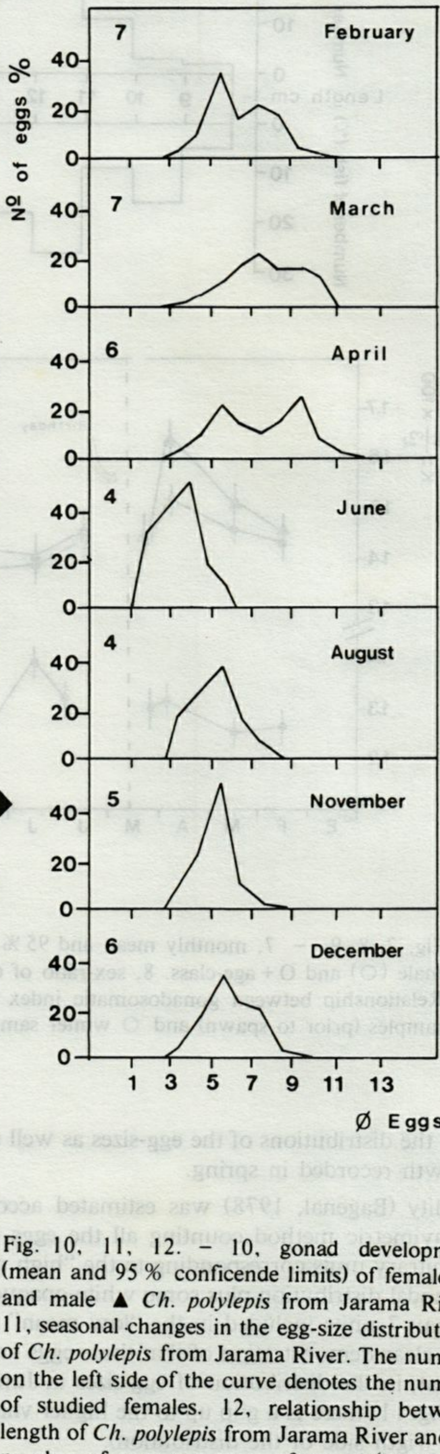
The relation between length and age and the fecundity, the number of eggs per gram of gonad and the diameter of the eggs are presented in Fig. 12 and 13.

3.3. Mortality and population structure

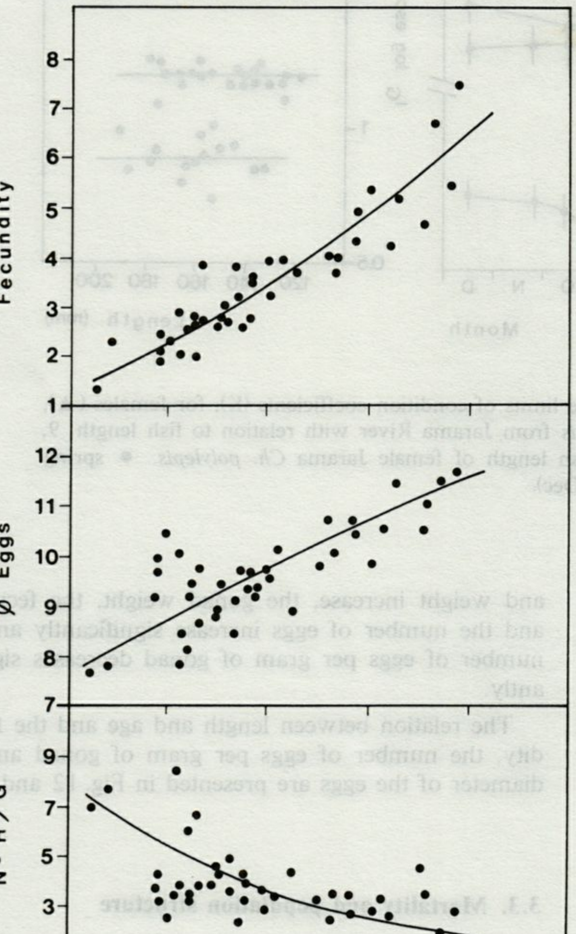
Density and biomass were estimated at three sites of Jarama River (Lobón-Cerviá & Penczak, 1983) according to the removal method. At these three sites *Chondrostoma* and *Barbus* were the dominant species. As calculated density and standing crop in individuals and kg/ha, *Chondrostoma* contributes with 5,542 ; 40,530 and



10



11



12

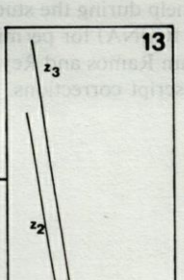
Fig. 10, 11, 12. – 10, gonad development (mean and 95 % conficende limits) of female ● and male ▲ *Ch. polylepis* from Jarama River. 11, seasonal changes in the egg-size distributions of *Ch. polylepis* from Jarama River. The number on the left side of the curve denotes the number of studied females. 12, relationship between length of *Ch. polylepis* from Jarama River and its number of eggs per gram of gonad (Nº H/G), the diameter of the eggs (Ø eggs) and the fecundity (F, × 1000). Correlation and regression coefficients in Table V.

Table V. – Regression coefficients of Log Y = Log a + b. Log X and Z = a + b. X where Y = L_s (standard length), Y = W (weight), Z = E (eggs), X = P_g (gonad weight), X = F (fecundity), X = H/G (number of eggs per gram of gonad) and X = D/H (diameter of eggs). R represents the fitting method (F = functional and P = predictive).

		P_g		F		H/G		D/H	
	R	Log a	b	Log a	b	Log a	b	Log a	b
H/G	F	—	—	—	—	—	—	1.8367	-0.3340+*
	P	—	—	—	—	—	—	1.6501	-0.2613
L_s	F	-4.7423	2.9433+*	-2.3131	2.7262+*	7.7085	-2.2993+*	-0.5758	0.7290+*
	P	-4.6410	2.8959	-1.8002	2.4866	5.3542	-1.2968	0.0457	0.4376
W	F	-1.2305	1.3105+*	2.8785	0.6815+*	3.8787	-0.7937+**	-0.1831	0.1736+*
	P	-1.0932	1.2303	2.9862	0.5660	3.4012	-0.5041	-0.1396	0.1273
		a	b	a	b	a	b	a	b
E	F	-0.6555	2.3955+*	-2046.9+	1250.4+*	1114.1	- 150.6+**	5.2810	0.9110+*
	P	-0.1485	1.6866	-1443.8	1050.2	757.3	- 74.7	6.9240	0.5680

+ Significant slope in $P < 0.01$

* Significant correlation in $P < 0.01$ and ** in $P < 0.05$



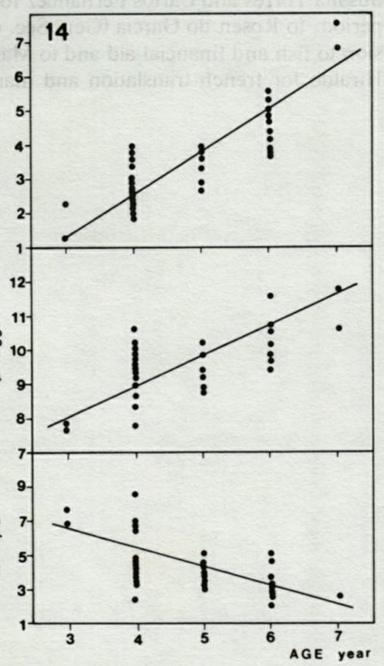


Fig. 13, 14. – 13, population structure at the time of annulus formation of *Ch. polylepis* estimated at three similar sites (1, 2 and 3) of Jarama River. Z, mortality. 14, relationship between age of *Ch. polylepis* from Jarama River and its number of eggs per gram of gonad (N° H/G) the diameter of the eggs (Ø eggs) and the fecundity (F, × 1000). Correlation and regression coefficients in Table V).

20,302 ind/ha which represents the 41.0; 25.9 and 54.7 % of the total estimated number of fish and 43.4; 81,44 and 176.4 kg/ha which represents the 36.2; 47.2 and 53.8 % of the total estimated standing crop at the three studied sites respectively.

On these three sites the frequency distribution of lengths were established and sub-samples including every length were used for age re-determinations. After extrapolating the age to all the lengths in the sample, the overlapping between age-length distributions was divided into two halves and the number of specimens per age-class counted, after to share the non captured fish in the sample. The mortality was then calculated according to :

$$N_T = N_0 e^{-Z.T}$$

or in its logarithmic form :

$$\text{Ln } N_T = \text{Ln } N_0 - Z.T$$

line which slope is equal mortality (Z).

The mortality for the three sites was estimated as $Z_1 = 1.005$, $Z_2 = 1.708$ and $Z_3 = 1.609$ respectively.

The population structure at the time of annulus formation was calculated dividing the mortality by the number of weeks in a year (52) and multipling the obtained values by the number of weeks between the time of annulus formation and the time of fish capture. Then the number of fish in every age multiply by the obtained values of mortality result the number of fish at the time of annulus formation. Population structure estimated on this basis is presented Fig. 14.

REFERENCES

BAGENAL, T., 1977. *Methods for assessment of fish production in freshwater*. I.B.P. handbook n. 3. Black. Scient. Pub., 3e ed., Oxford, 365 p.

BAGENAL, T., 1978. Aspects of fish fecundity. *In : Ecology of fish production* : 75-101 (ed. Sh.D. Gerking), Black. Scient. Pub., 519 p., Oxford.

BERTALANFFY, L. von., 1957. Quantitative laws in metabolism and growth. *Q. Rev. Biol.*, **32** : 217-231.

CRAGG-HINE, D. & J.W. JONES, 1969. The growth of Dace *Leuciscus leuciscus* (L.), Roach *Rutilus rutilus* (L.) and Chub *Leuciscus cephalus* (L.) in willow Brook, Northamptonshire. *J. Fish Biol.*, **1** : 59-82.

FORD, E., 1933. An account of the Herring investigations conducted at Plymouth during the years 1924-1933. *J. mar. Biol. Ass. U.K.*, **19** : 305-384.

GRANADO, C. & F. GARCÍA-NOVO, 1981. Cambios ictiològicos durante las primeras etapas de la sucesión en el embalse de Arrocampo (Cuenca del Tajo, Cáceres). *Bol. Inst. Esp. Ocean.*, *319*, **6** (3) : 224-243.

GULLAND, J.A., 1964. Manual of methods for fish population analysis. *FAO Fish Tech. pap.*, **40** : 1-60.

HENSEL, K., 1960. Vek a rast podustvy *Chondrostoma nasus* (L.) niektorych riek systému dunaja a odry. *Biologia, Bratislava.*, **15** (7) : 508-515.

KLIMCZYK-JANIKOWSKA, M., 1973. Swinka (*Chondrostoma nasus* L.) z rzeki Raby. *Acta hidrobiol.*, **15** (2) : 197-213.

LOBÓN-CERVIÁ, J. & B. ELVIRA. 1981. Edad, Crecimiento y Reproducción de la Boga de Río (*Chondrostoma polylepis polylepis* Stein, 1985) en el embalse de Pinilla (río Lozoya). *Bol. Inst. Esp. ocean.*, 317, **6** (3) : 200-213.

LOBÓN-CERVIÁ, J. & T. PENCZAK, 1983. Fish production in Jarama River, Central Spain. *Hol. Ecol.* (in press)

LOBÓN-CERVIÁ, J. & S. TORRES, 1983. On the growth and reproduction of two populations of Gudgeon (*Gobio gobio* L.) in Central Spain. *Acta Hidrobiol.* (in press)

LUSK, S., 1967. Population dynamics of *Chondrostoma nasus* (L.) in the Rokytna River. *Acta Sc. Nat. Brno.*, **1** : 473-522.

PHILIPPART, J.C., 1975. Dynamique des populations de poissons d'eau douce non exploitées. *In* : Problèmes d'écologie : La démographie des populations de Vertébrés (ed. Lamotte & Bourlière). Prog. Biol. Int., Masson, 443 p., Paris.

PRAWOCHENSKI, R., 1963. Wiek i tempo wzrostu Swinke *Chondrostoma nasus* (L.) z poudniowo-wschodniej cześci polski. *Rocz. nauk Rol.*, **83** (B-1) : 161-182.

RICKER, W.E., 1973. Linear regressions in fisheries research. *J. Fish. Res. Bd. Can.*, **30** : 409-434.

WALFORD, L.A. 1947. A new graphic method of describing the growth of animals. *Biol. Bull. mar. biol. Lab., Woods Hole.*, **90** : 141-147.

ACKNOWLEDGEMENTS. – I am indebted to Paloma Rovira, Susana Torres and Carlos Fernandez for help during the study period; to Rosen do Garcia (Gen. Sec. of ICONA) for permission to fish and financial aid and to Mariam Ramos and Reyes Hiraldo for french translation and manuscript corrections.