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THE MANAGEMENT OF GLASS EELS IN THE SHANNON ESTUARY, IRELAND

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A B S T R A C T. Fisheries Conservation Hydro Group of the Electricity Supply Board have been trapping elvers on the Shannon since 1959, for subsequent planting in lakes throughout the Shannon catchment as part of the E.S.B. conservation programme and to sustain the yellow and silver eel fisheries in some of these areas.

With the numbers of elvers caught declining in recent years, an assessment of the current stocks of glass eels entering the Shannon Estuary was deemed necessary to improve and maintain the supply of elvers to stock the Shannon lakes. This study, which began in October 1992, is to examine abundance and distribution of glass eels in the estuary and evaluate the possibility of developing a fishery for glass eels for the continued stocking of the Shannon lakes. Experimental methods for developing a more efficient fishery using a trawling net, hand nets and a Portuguese botirão were explored.

Catch data shows the main movement of glass eels to occur at the begining of April.

Details on morphometrics and stage of pigmentation revealed that the length of glass eels of similar pigment stage decreases while weight increases from February through till April. There is also very little variation in the length and weight of the different pigment stages examined on the same date after the V_B stage and before the VI_B stage.

Key words: GLASS EEL, MANAGEMENT, RIVER SHANNON, ESTUARY

INTRODUCTION

The Electricity Supply Board, Fishery Conservation, Hydro Group have been trapping elvers at Ardnacrusha Dam on the Shannon since 1959 and larger elvers („bootlace eels") have been trapped at Parteen weir from about the same time. The captured elvers were subsequently planted in lakes throughout the Shannon catchment as part of the E.S.B. conservation programme and to sustain the yellow and silver eel fisheries in some of these areas. Elvers were also trapped on the Rivers Feale and Maigue (Fig. 1) for a limited period.

The numbers of elvers trapped at the head of the tidal stretch at Ardnacrusha has been falling particularly in recent years. A stocking level of 10.6 million elvers (2650 kg) is estimated to be required to maintain the yellow and silver eel fishery on the Shannon system (Moriarty 1982). This level has not been met since 1982 (Fig. 2). Be-

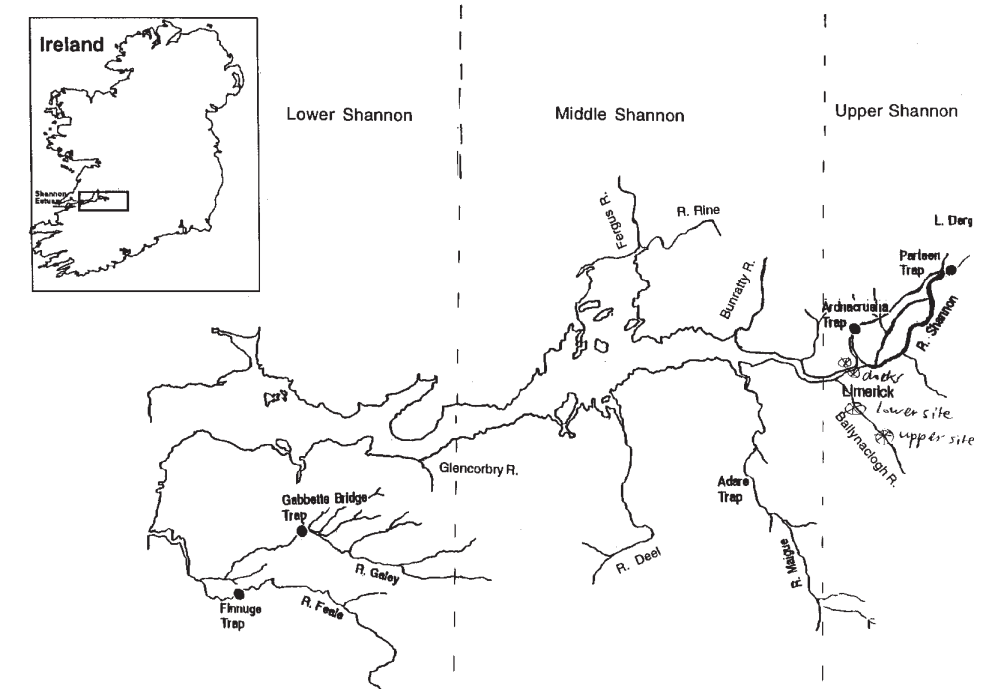

Fig. 1. Shannon estuary and sampling location

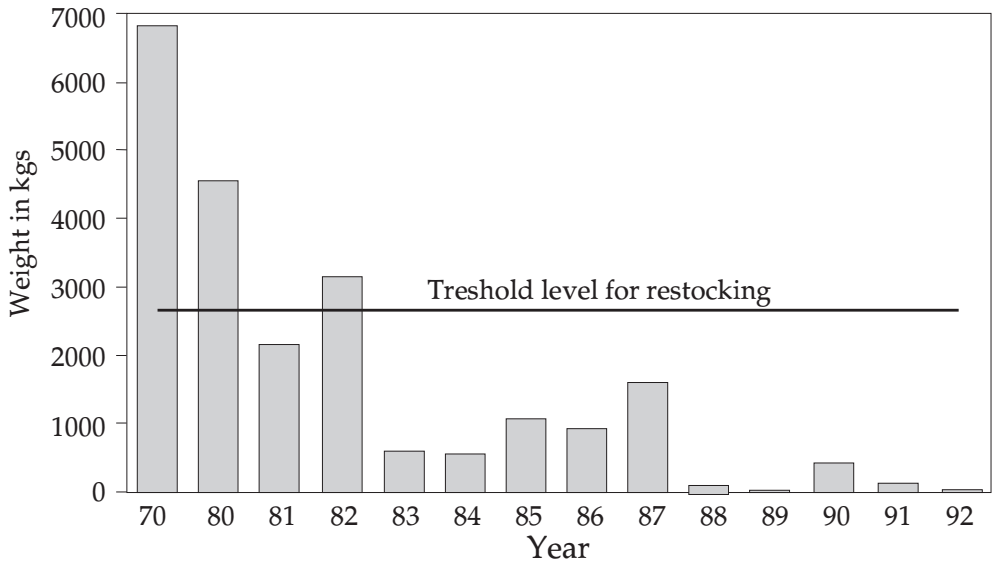

Fig. 2. Yearly catch of elvers at Ardnacrusha from 1979-1992

cause of this decline, an assessment of the glass eel population in the estuary is being carried out at present with a view to developing a glass eel fishery for subsequent re-stocking of the Shannon lakes. Details of the biology are also being explored with regard to length and weight analysis and pigmentation.

METHODS

I. FISHING TECHNIQUES

Since October 1992 exploratory shore surveys and trawls have been carried out throughout the Shannon Estuary every two weeks. Trawls using a 1 mm mesh conical net 2 m in length attached to a circular frame of 1 m diameter have been carried out in several parts of the estuary but with most emphasis in the upper estuary at Limerick docks and Ballynaclogh River (Fig. 1). The net was fished by trawling it from a rigid inflatable boat, by towing if from a dock side or by suspending it from a bridge into the incoming tide. The shore surveys involved simply turning over rocks and stones in search of glass eels particularly at the fresh water inflows to the estuary.

A Portuguese botirão net (a fixed trap adapted to catch glass eels, Jorge & Sobral 1989) was set across small rivers or tidal channels at low tide and then placed to face

TABLE 1

Pigment stages of glass eels (*Anguilla anguilla*) and corresponding reference number allocated to each stage

Pigment stage	Number allocated
V_A	1
V_BEARLY	2
V_BLATE	3
VI_{A0}EARLY	4
VI_{A0}LATE	5
VI_{A1}EARLY	6
VI_{A1}LATE	7
VI_{AII}	8
VI_{AIII}	9
VI_{AIV}	10
VI_BELVER	11

the incoming flood tide. Finally hand nets, 0.5 m square with a 1-2 mm mesh, were scooped into the incoming tide to collect the glass eels in the water column.

To quantify glass eel abundance, three standard trawls of five minutes duration using the conical net above were taken at night from the same location on the Ballynaclogh River at the begining of the flooding tide one day before the full and new moon, from March through till May (except March 9th when sample was taken one day after the full moon). The net was set by suspending it from a bridge into the incoming tide. The middle of the river was sampled first then the left side and finally the right side.

Since March 8th quadrat shore surveys have provided quantitative estimates of glass eel abundance at selected sites.

II. CATCH DATA

All the eels caught with the above methods were preserved in alcohol and their length, weight and stage of pigment noted. The scale of pigmentation used is derived from Strubberg (1913) and Elie et al. (1982), renumbered for convenience (Tab. 1).

III. LENGTH AND WEIGHT ANALYSIS

To examine possible changes in length and weight over time a total of 398 glass eels at the same pigment stages (7 and 8) were taken from two sites (Limerick docks and Ballynaclogh River), 4.5 km apart, with a tidal range of 3.1 m - 5 m and with a salinity of 0.1 ppt - 0.2 ppt (both at low and high tide). These samples were compared over time using a two-way Anova for both length and weight.

Lengths and weights of 79 samples of similar pigment class (7 and 8) were also compared for upper and lower stretches of Ballynaclogh River on the same date. A comparison of these samples was also made with 46 glass eels of similar pigment class taken on the same date from Limerick docks.

IV. PIGMENT ANALYSIS

The average pigment stage of total of 784 glass eels taken from the lower part of the Ballynaclogh River was recorded for each pigment stage from the same location on the Ballynaclogh River on the same date using a one-way Anova.

RESULTS

I. FISHING. TECHNIQUES

No glass eels were found in either shore surveys or trawls until January 5th, when one specimen was taken in a hand net at Glin on the Glencorbry River (Fig. 1). Following this 7 glass eels were captured during January from a number of locations up as far as the Bunratty River. Not until mid-February were glass eels found in Limerick, but from this date on the numbers caught increased dramatically at all sites, with estimates of up to 30 glass eels per meter square in February on suitable stony substrates.

The botirão proved difficult to use in the estuary due to two main problems; firstly, the difficulty of setting and retrieving the net in many of the channels due to the nature of the glutinous mud and secondly, due to the strong tidal surges.

The hand nets were very labour intensive yielding only 1 eel per minute in March. The most successful method of fishing both for catch and ease of use was to fish the conical net either from a bridge or along the shore against the incoming tide.

II. CATCH DATA

The largest catch taken in standard trawls was found at the begining of April (Fig. 3). The overall catch was also largest during this time period, suggesting the main movement of glass eels into the upper part of the estuary occurs in early April. The data show a reasonable abundance of glass eels from early March until May with shore surveys giving low counts in February.

III. PIGMENT ANALYSIS

Figure 6 shows that the mean pigment stage of the samples taken from the lower part of Ballynaclogh River increases with time, from February to April. The mean lengths for each pigment stage showed no statistical difference (Fig. 7). The weight of each pigment stage also shows no statistical variation after stage 2 ($p=0.78$), but before this stage the weight is higher (Fig. 8).

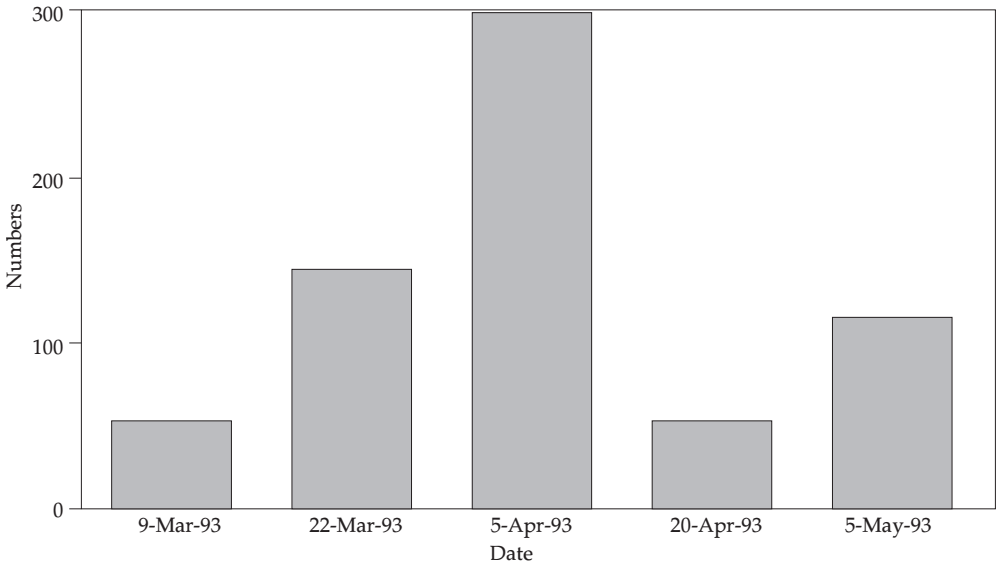

Fig. 3. Standard catches of glass eels on Ballynaclogh River

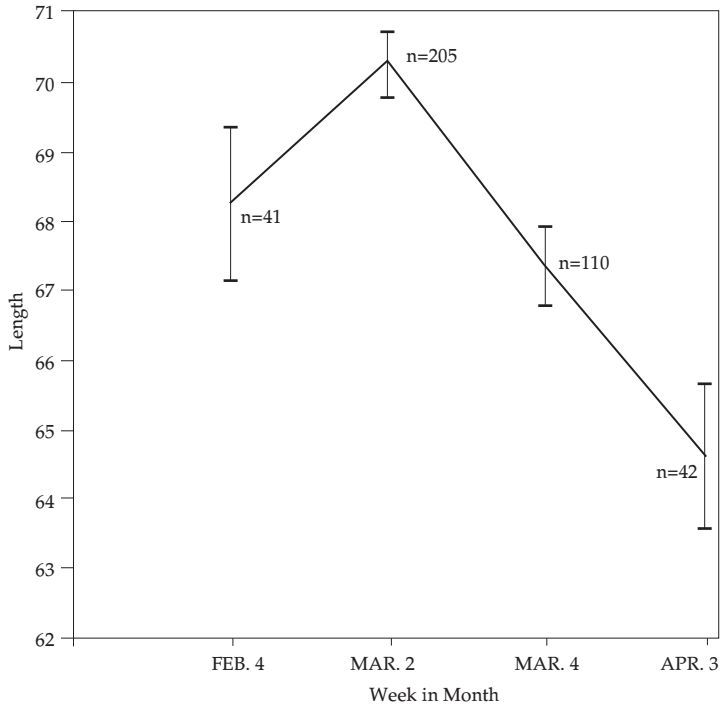

Fig. 4. Glass eel mean length in each month taken from Ballynaclogh River, with 95% C.I.

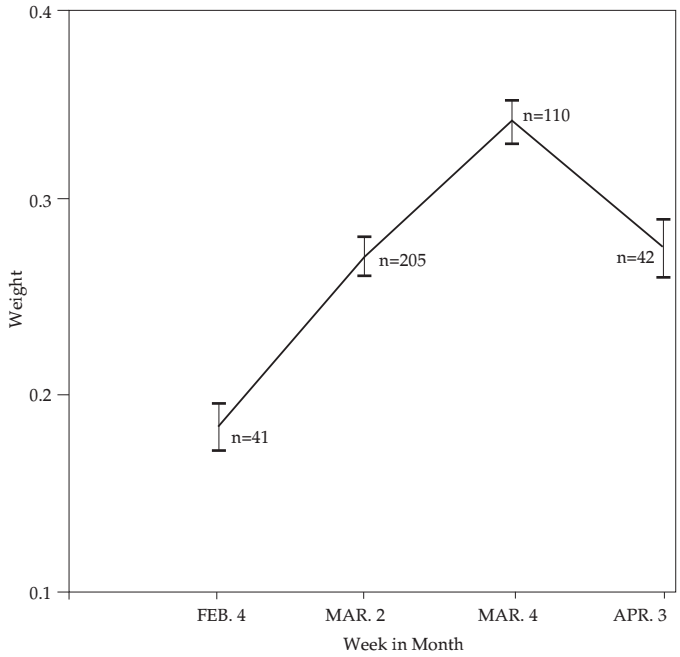

Fig. 5. Glass eel mean weight in each month taken from Ballynaclogh River, with 95% C.I.

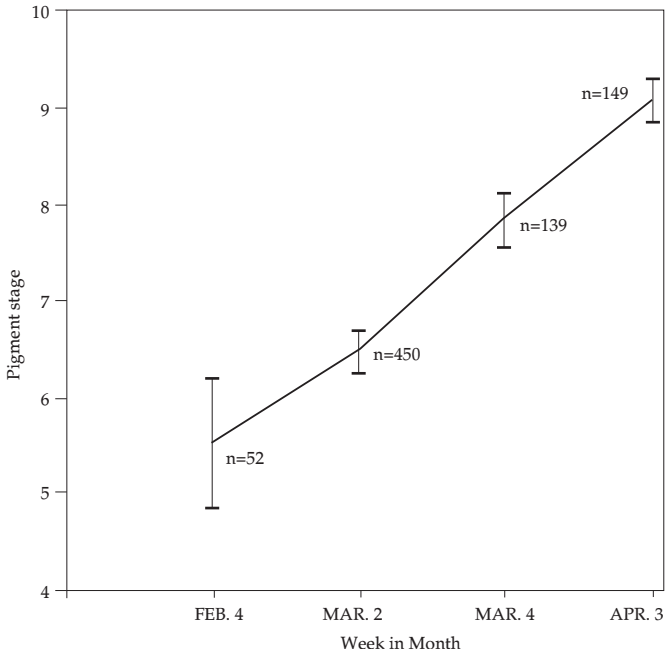

Fig. 6. Glass eel mean pigment stage in each month taken from Ballynaclogh River, with 95% C.I.

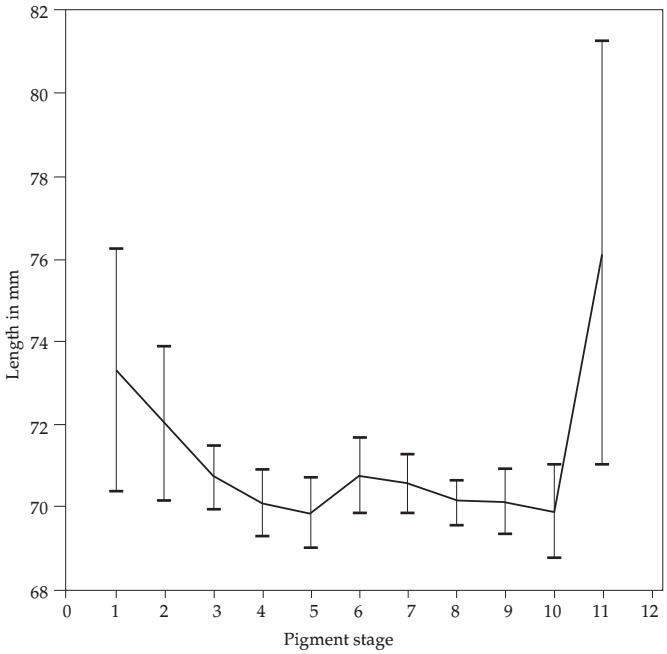

Fig. 7. Pigment stage of glass eels caught on March 8-9th vs. mean length with 95% C.I.

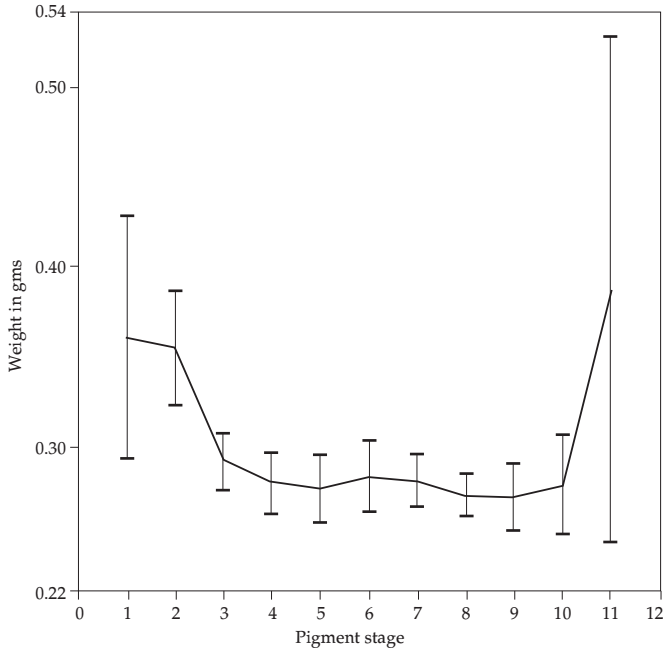

Fig. 8. Pigment stage of glass eels caught on March 8-9th vs. mean weight with 95% C.I.

IV. LENGTH AND WEIGHT ANALYSIS

No significant statistical difference was found between the mean lengths of all the pigment stages taken from the same site on the same date ($p=0.19$); the mean weight, past stage 2 also showed no statistical difference ($p=0.78$). All the pigment stages showed a similar pattern of reduction in length and increase in weight over time.

Pigment stages 7 and 8 were chosen for further analysis because they comprised the largest sample size for all the dates. The results from the two-way Anova examining changes in length and weight in relation to time and site revealed that the two sites (Limerick docks and Ballynaclogh River) showed no overall statistical difference in length ($p=0.69$) and weight ($p=0.23$) but there was a significant difference in length ($p=0.05$) and weight ($p=0.05$) over time. Figures 4 and 5 showthe pattern of this relationship, with an increase in length from February to March, then a drop in length at the end of March till the third week in April. The weight relationship is different, increasing from February till the fourth week in March then dropping in April.

A comparison of samples of pigment classes 7 and 8 from the lower part of Ballynaclogh River with 15 glass eels from a site 3 km upstream revealed that the upstream eels were shorter (mean difference 1.7 mm) ($p=0.05$) while there was no statistically significant change in weight ($p=0.31$). When the same pigment classes were compared for the three main sites sampled (upper and lower Ballynaclogh River and Limerick docks), the Anova showed no statistical difference between the sites for either length ($p=0.29$) or weight ($p=0.42$).

DISCUSSION

The catch data suggest that the main immigration of glass eels is in early April. The similarity between the two sample sites in the upper estuary suggests that these glass eels are from the one population, and possibly arriving together in this part of the estuary.

The glass eels captured show a general trend of a reduction in length and a general increase in weight over time. At any one site, eels of the same pigment stage also show this change over time. Since the samples are taken from the same locations each time this may suggest two possibilities;

(a). Successive „waves" of eels arriving are progressively smaller and heavier.

(b). The eels remain for some time in these locations and change in length and weight, while only slowly becoming pigmented.

A reduction in length of glass eels from a number of areas in western Europe was also noted by Tesch (1977) from January through till May. The idea of different „waves" of glass eels arriving throughout the season has been discussed by Guérault et al. (1990). The different mean lengths and weights of glass eels observed in the Shannon may represent successive „waves" of eels which may be related to tidal cycles or to successive micro-cohorts derived from discontinuous spawning or periodic metamorphosis of leptocephali.

As the mean pigment level at each site increases over time towards a more pigmented population (Fig. 6), this suggests that the eels do not remain at the same pigment stage while changing in length and weight.

Although the mean lenghts of all pigment stages show no overall statistical difference it should be noted that the sample size is small for stages 1,2 and 11 (n = 5, 15 and 13 respectively), and there seems to be firstly a reduction in length in stages 1 and 2 and then an increase at stage 11. This shrinkage in stage 1 and 2 would seem to be a continuation of the reduction in length and weight from the transition of the leptocephalus stage to the glass eel form (Tesch 1977). There is strong statistical evidence that the length and weight of the glass eel does not differ after this until stage 11, probably due to an increase in feeding at this stage (Tesch 1977). This finding is in contrast to observations made by Strubberg (1913) who suggested that length and weight varied between the intermediate pigment stages, but his samples were kept in aquaria for varying lengths of time and at various temperatures prior to examination.

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STRESZCZENIE

GOSPODARKA WĘGORZYKIEM SZKLISTYM W OBSZARZE PRZYUJŚCIOWYM RZEKI SHANNON, IRLANDIA

Węgorzyki montee poławia się w rzece Shannon (Irlandia) od 1959 roku i używa do zarybiania jezior położonych w zlewni tej rzeki. Z uwagi na zaobserwowany w ostatnich latach spadek dopływu węgorzyka montee do ujścia Shannon podjęto badania, których ostatecznym celem jest opracowanie zasad gospodarki węgorzem w zlewni rzeki. Badania rozpoczęto w październiku 1992 roku oceniając zasoby węgorzyka szklistego w obszarze przyujściowym oraz określając możliwości zwiększenia intensywności połowów węgorzyka celem utrzymania programu zarybiania jezior. Przeanalizowano metody odłowu węgorzyka szklistego przy użyciu narzędzi ręcznych oraz portugalskiego narzedzia „boitrao". Analizy wykazały, że szczyt dopływu węgorzyka przypada na kwiecień. Badania morfometryczne i ocena stopnia pigmentacji ujawniły, że długość osobnicza dopływajacego węgorzyka spadaja natomiast jego masa zwiększa się w okresie od lutego do kwietnia. Z drugiej strony zróżnicowanie osobnicze po stadium V_B a przed stadium VI_B jest bardzo niewielkie.