Length dynamics in smelt (*Osmerus eperlanus* L.) larvae of the Curonian Lagoon in 1996–1999

Vida Žiliukienė

Institute of Ecology,
Akademijos 2,
LT-2021 Vilnius

The largest inland water body of Lithuania is the Curonian Lagoon. In the north the lagoon is connected with the Baltic Sea by a narrow strait. Regular ichthyological research of fish resources in the Curonian Lagoon has been carried out since 1949. The scientists have concentrated their attention mostly on adult fish. The larval period of fish, however, is still poorly known. The current paper presents an analysis of size dynamics in smelt (*Osmerus eperlanus* L.) larvae of the Curonian Lagoon in 1996–1999. At the end of May and at the beginning of June in 1996–1999, the length of smelt larvae in the Curonian Lagoon varied from 8.5 to 23.0 mm. The average length of smelt larvae was smallest in 1996, because spawning that year was very late. The nutrition and temperature conditions for smelt larvae development and growth were better in 1999 than in 1997. Therefore, the average length of smelt larvae in 1999 was bigger than in 1997. The high water temperature in April and May of 1998 influenced the quicker growth rate of larvae that year. Therefore their average length in 1998 was the biggest. The obtained data showed that the spawning of smelt was most intensive in the middle of the spawning period of 1996–1997. In 1998, the spawning of smelt was most intensive at the beginning and in 1999 it was most intensive at the beginning and in the middle of the spawning period. In 1997 the spawning of smelt extended for a very long period of time. In 1998, at least one half of smelt spawned almost at the same time.

Key words: the Curonian Lagoon, smelt, larvae, length, temperature, zooplankton, spawning

INTRODUCTION

The Curonian Lagoon is a comparatively large lagoon of the Baltic Sea. It covers the total area of 1610.2 km^2 (413 km^2 belong to Lithuania). In the north the lagoon is connected with the Baltic Sea by a narrow strait, in the south the Nemunas (the biggest river in Lithuania) flows into it. So the Curonian Lagoon is mainly a freshwater basin. The water salinity in its northern part can sometimes reach about 3‰, but only when the northern and northwestern winds dominate. The Curonian Lagoon is a comparatively shallow water body, the greatest natural depth reaching 5.8 m and the mean depth being 3.8 m. Most pollutants floated by the River Nemunas do not get into the Baltic Sea and stay in the Curonian Lagoon, inducing negative ecological processes such as eutrophication, oxygen deficiency, etc. Due to these factors, a very diverse complex of ichthyofauna composed of freshwater, marine and migratory fish species is found in the lagoon. At least 36 fish species were caught in the Curonian Lagoon during the studies carried out in 1996 [6]. One of the main commercial fish species in the Curonian Lagoon is smelt.

Regular ichthyological research of fish resources in the Curonian Lagoon has been carried out since 1949. The scientists have concentrated their attention mostly on adult fish. The larval period of fish, however, is still poorly known. Feeding of larvae of various fish species from the Curonian Lagoon was described by Vaškevičiūtė [17]. Carrying out the International programme "Assessment and Monitoring of Coastal Fish Resources", in 1994 in the Curonian Lagoon investigations of fish larvae were started. The obtained data have been reported by several authors [4, 5, 11–16, 18].

The current paper presents an analysis of length dynamics in smelt larvae of the Curonian Lagoon in 1996–1999.

MATERIAL AND METHODS

The studies of smelt larvae in the Curonian Lagoon were carried out in 28 May 1996, 3 June 1997, 26 May 1998 and 1 June 1999 in the district of Ventės

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Ragas from Ventė to Kintai. The depth at the survey station did not exceed 2 m.

Fish larvae were caught applying the Swedish Gulf net equipment consisting of two ichthyoplanktonic nets (mesh size 0.5 mm), and a launching-lifting gear was used. The equipment itself was installed in the front of a boat, so the turbulent water currents produced by the engine did not influence the catches. All collected fish larvae were preserved in 4% formaline and then measured to the nearest 0.5 mm in the laboratory. During 1996–1999, 613 fish larvae were analyzed.

In 1997–2000, in addition to the samples of fish larvae, we also took samples of zooplankton. For the analysis of results we also used the data on water temperature provided by the Centre of Marine Investigations.

The Statistica 5.0 programme has been used for data processing.

RESULTS AND DISCUSSION

At the end of May and at the beginning of June, the length of smelt larvae in the Curonian Lagoon varied from 8.5 to 23.0 mm (Fig. 1). The smallest mean length of smelt larvae was determined in 1996 (14.3 mm), while in 1998 it was the biggest (18.5 mm). In 1997 and 1999, their average length was 16.3 and 17.3 mm, respectively (Fig. 2).

It is known that smelt spawn at a temperature of 4–6 °C [8]. Such temperature was registered at the end of March or at the beginning of April in 1997–1999. In 1996, the water reached this temperature only in the third ten-day period of April (Fig. 3). According to some literature sources, the peak of abundance of spawning smelt occurred on April 17, *i. e.* much later [7]. Thus, on the basis of these data, we may assert that the spawning of smelt in 1996 occurred later than usual. Therefore, the smelt larvae caught in 1996 were the smallest.

Water temperature is among the most important abiotic factors limiting the growth rate of fish [20]. A lot of authors reported that growth is positively correlated to water temperature during the first year of life [1–3 et al.]. In the Curonian Lagoon the biggest smelt larvae were caught in 1998. That year temperature conditions for the development and growth of smelt larvae were very favorable – in April the average water temperature made up 8.7 °C, in May it reached 15.2 °C (Fig. 4). In other years the average water temperature was lower. In 1996 the water tempera-

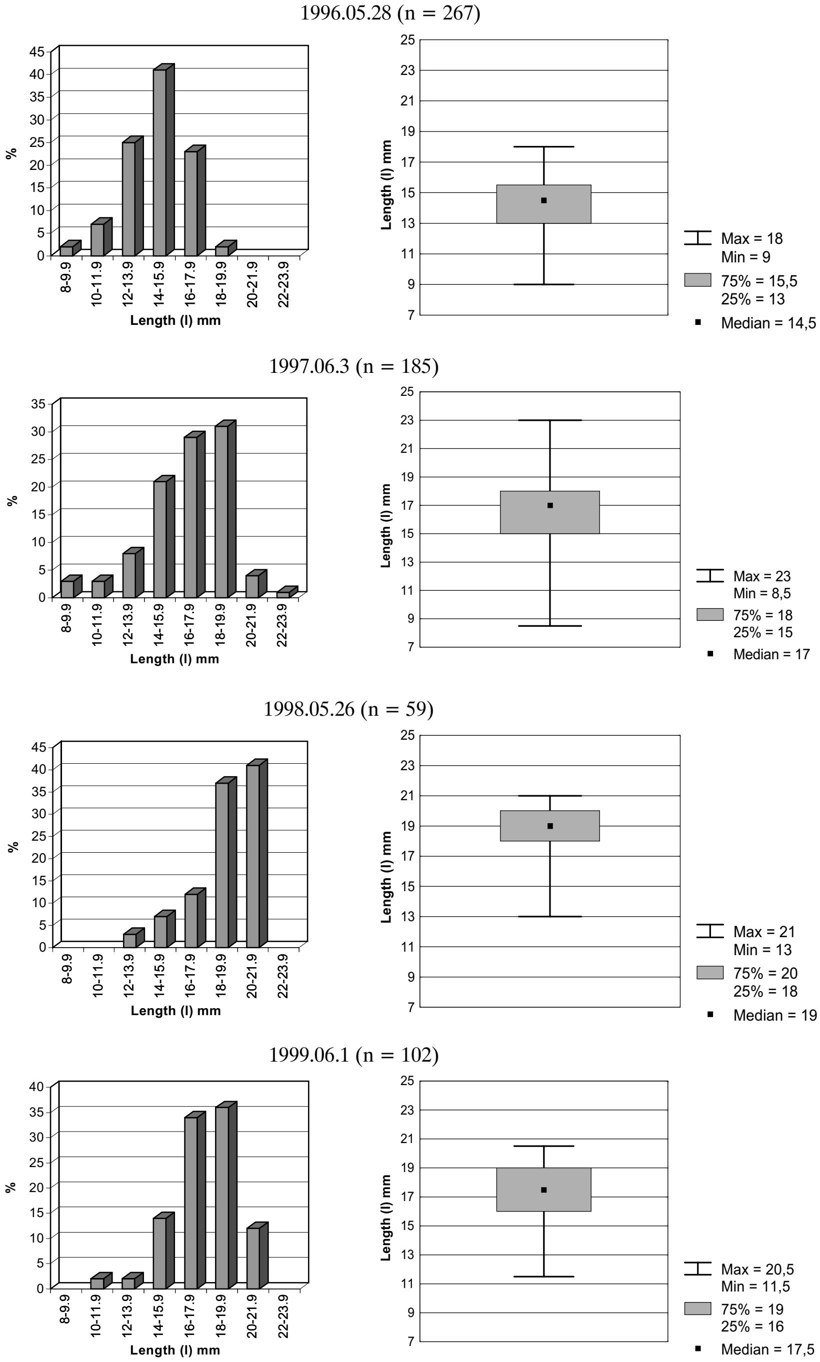

Fig. 1. Distribution of smelt larvae of the Curonian Lagoon into length groups and dispersion of their length in different years

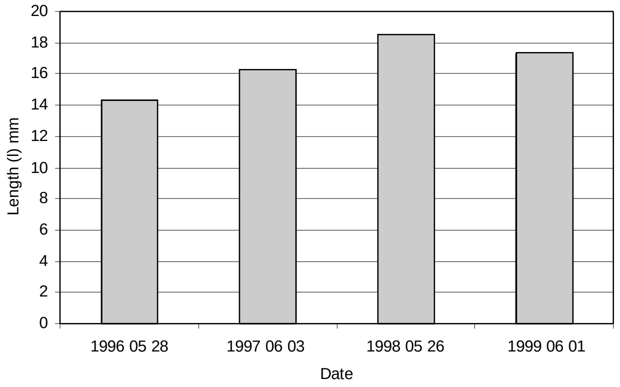

Fig. 2. Average length of smelt larvae of the Curonian Lagoon in different years

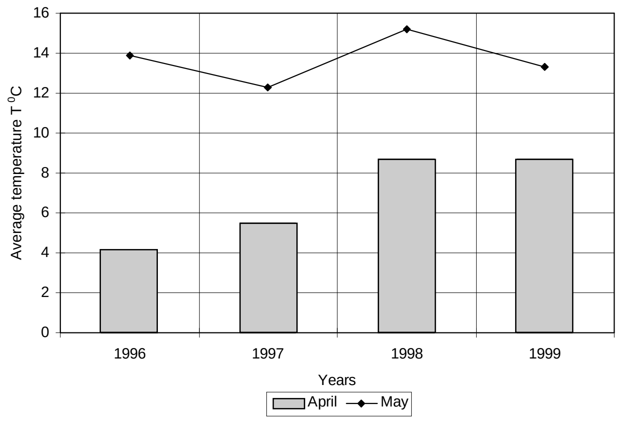

Fig. 4. Average water temperature of the Curonian Lagoon in April and May of different years

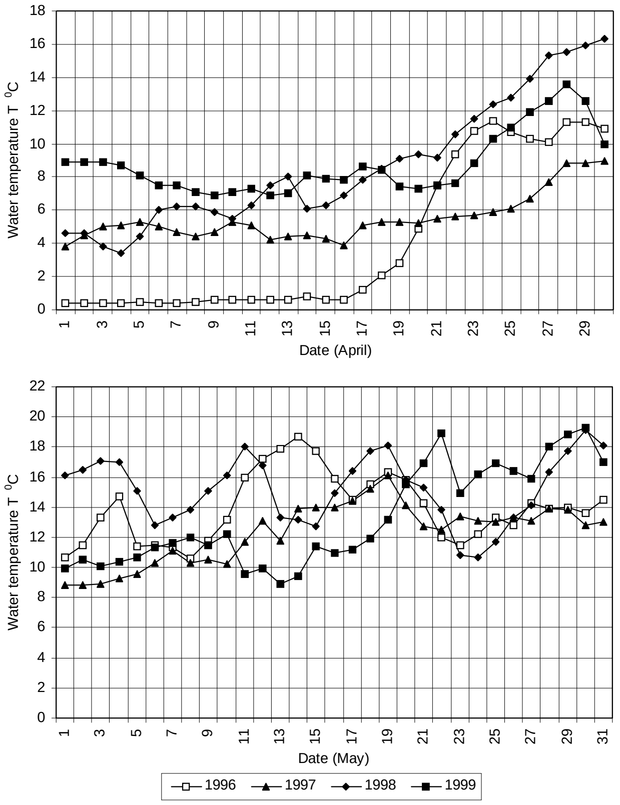

Fig. 3. Water temperature of the Curonian Lagoon in April and May of different years

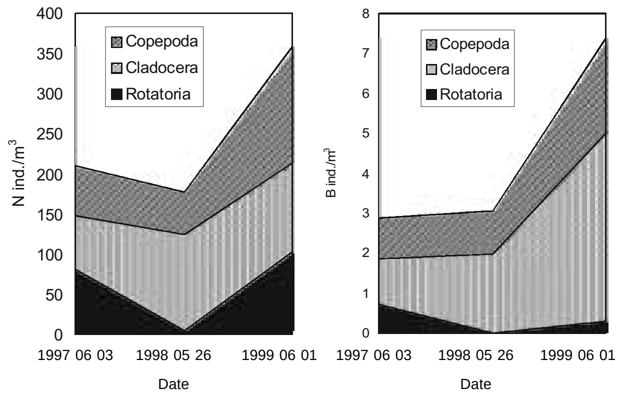

Fig. 5. Abundance (N ind./m³) and biomass (B g/m³) of zooplankton of the Curonian Lagoon in different years

ture after smelt spawning was higher than in 1997 and 1999, however, the length of caught larvae was small, because spawning in that year occurred particularly late.

Fish larvae are most sensitive to changes of temperature during the period of endogenous and mixed nutrition [20]. When they change over to exogenous nutrition, the influence of this factor becomes weaker. Further development of fish and their growth rate depends upon their feeding conditions as well as upon water temperature [9, 10, 19]. The main food component of smelt larvae is copepods [16]. As is shown in Fig. 5, the best nutrition and temperature conditions for smelt larvae were in 1999. Therefore, in 1999 smelt larvae were bigger than those caught almost at the same time in 1997.

The length distribution of smelt larvae caught in the Curonian Lagoon at the end of May and at the beginning of June of different years is presented in Fig. 1. In 1998, 5 length groups were distinguished; in 1996 and 1999 we distinguished 6 and in 1997 8 length groups. Water temperature is one of the most important abiotic factors determining the course of spawning. In 1997, low water temperature (3.8–6.1 °C) was prevalent till 25 April (Fig. 3), so the spawning of smelt extended for a very long period of time.

According to the distribution of smelt into length groups and dispersion diagrams, the spawning of smelt was most intensive in the middle of the spawning period of 1996–1997. In 1998 the spawning was most intensive at the beginning and in 1999 it was most intensive at the beginning and in the middle of the spawning period (Fig. 1). The diagram of dispersion shows that the length of 50% of smelt larvae caught in 1998 varied within a very narrow range. Consequently, in 1998 at least one half of smelt spawned almost at the same time.

CONCLUSIONS

1. At the end of May and at the beginning of June 1996–1999, the length of smelt larvae in the Curonian Lagoon varied from 8.5 to 23.0 mm. The smallest average length (14.3 mm) of smelt larvae was in 1996, because spawning in that year was very late.

2. The nutrition and temperature conditions for smelt larvae development and growth were better in 1999 than in 1997. Therefore, the average length of smelt larvae on 1 June 1999 was bigger than on 3 June 1997 (17.3 and 16.3 mm, respectively). The high water temperature in April and May of 1998 influenced the quicker growth rate of larvae that year. Therefore their average length on 26 May 1998 reached 18.5 mm.

3. The obtained data show that the spawning of smelt was most intensive in the middle of the spawning period of 1996–1997. In 1998 the spawning of smelt was most intensive at the beginning of the spawning period, and in 1999 it was most intensive at the beginning and in the middle of the spawning period. In 1997 the spawning of smelt extended for a very long period. In 1998, at least one half of smelt spawned almost at the same time.

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References

1. Karas P. Recruitment of perch (*Perca fluviatilis* L.) from Baltic coastal waters. *Arch. Hydrobiol.* Stuttgart,1996. Vol. 138(1). P. 99–121.
2. Karas P., Neuman E. First-year growth of perch (*Perca fluviatilis* L.) and roach (*Rutilus rutilus* (L.)) in a heated Baltic bay. *Rep. Inst. Freshwat. Res*. 1981. Vol. 59. P. 48–63.
3. Karas P., Thoresson G. An aoolication of a bioenergetics model to Eurasian perch (*Perca fluviatilis* L.). *J. Fish Biol*. 1992. Vol. 41. P. 217–230.
4. Repečka R. Assessment and monitoring of coastal fish resources. *Assessment and monitoring of coastal fish resources in Estonia, Latvia and Lithuania*. Swedmark Consultancy Report. 1996. P. 1–23.
5. Repečka R., Žiliukas V., Stankus S. Verslinių žuvų lervų ir mailiaus gausumas Baltijos jūros priekrantėje bei Kuršių mariose. *Žuvininkystė Lietuvoje*. Vilnius, 1996. T. II. P. 95–108.
6. Repečka R., Rudzianskienė G., Gaigalas K., Ložys L., Stankus S., Overkaitė T. Verslinių žuvų populiacijų struktūros bei gausumo monitoringas Kuršių mariose ir Nemuno deltoje. *Žuvininkystė Lietuvoje*. Vilnius, 1998. T. III (1 dalis). P. 153–174.
7. Švagždys A. Stintų gausumo kaitos priklausomybė nuo aplinkos veiksnių poveikio. *Žuvininkystė Lietuvoje*. Vilnius, 1998. T. III (1 dalis). P. 189–199. Virbickas J. *Fish of Lithuania*. Vilnius, 1986. P. 153.
8. Virbickas J. *Lietuvos □uvys*. Vilnius, 2000. 192 p.
9. Žiliukienė V. Zooplankton as one of the factors limiting growth and development of bream juveniles. *Proceedings of the 32nd–33rd sitting of the international working group on the project "Species and its productivity in the distribution area" for the UNESCO programme "Man and the biosphere"*. Vilnius, 1995. P. 35–40.
10. Žiliukienė V. Karšio jauniklių mitybos ypatumai pradinėse išsivystymo stadijose. *Žuvininkystė Lietuvoje*. Vilnius, 1996. T. II. P. 269–276.
11. Žiliukienė V. Kuršių marių ichtioplanktonas. *Žuvininkystė Lietuvoje*. Vilnius, 1998. T. III (1 dalis). P. 215–226.
12. Žiliukienė V. Rytinės Kuršių marių dalies ichtioplanktono rūšinė sudėtis ir gausumas. *Ekologija*. 1999. Nr. 2. P. 42–51.
13. Žiliukienė V. Ichthyoplankton of the Curonian Lagoon. *Freshwater fish and herring populations in the coastal lagoons*. Gdynia, 1999. P. 241–251.
14. Žiliukienė V. Ichtioplanktono struktūra ir gausumas įvairiose Kuršių marių dalyse. *Acta Hydrobiologica Lituanica*. Vilnius, 2000. P. 190–210.
15. Žiliukienė V. Ecological characteristics of early life stages of smelt from the Curonian Lagoon, Baltic Sea. Variability of the Baltic Sea environment and living resources: Responses to climate change and anthropogenic pressure. Gdynia, 2001. P. 27.
16. Žiliukienė V., Žiliukas V. Ecolological characteristics of the ichthyoplankton of the Curonian Lagoon. *Acta Zoologica Lituanica*. Vilnius, 2000. P. 32–55.
17. Вашкевичюте А. Материалы по питанию молоди рыб в заливе Куршю марес. *Куршю марес*. Вильнюс, 1959. С. 403–462.
18. Жилюкене В. Р. Пространственное распределение ихтиопланктона в литовской части Куршского залива. *Тезисы докладов VIII съезда Гидробиологического общества РАН*. Калининград, 2001. С. 98–99.
19. Жилюкене В. Р., Жилюкас В. Ю. Продолжительность эмбриогенеза щуки, плотвы и леща в естественных условиях. *Материалы 17(25) заседания рабочей группы проекта № 86 „Вид и его продуктивность в ареале“ Советского комитета по программе ЮНЕСКО: „Человек и биосфера“.* Вильнюс, 1987. С. 48–52.
20. Жукинский И. Н. *Влияние абиотических факторов на разнокачественность рыб в раннем онтогенезе*. Москва, 1986. 248 с.

Vida Žiliukienė

KURŠIŲ MARIŲ STINTŲ (*Osmerus eperlanus* L.) LERVUČIŲ MATMENINĖS STRUKTŪROS 1996–1999 M. ANALIZĖ

S a n t r a u k a

Duomenys apie stintų lervučių matmeninę struktūrą surinkti 1996 05 28; 1997 06 03; 1998 05 26 bei 1999 06 01 ties Ventės ragu. Iš viso išanalizuota 613 žuvų.

Kuršių marių stintų lervučių ilgiai tirtuoju laikotarpiu įvairavo nuo 8,5 iki 23,0 mm. Jų dydis įvairiais metais, kaip parodė duomenų analizė, priklausė nuo vandens temperatūros balandžio–gegužės mėn., zooplanktono gausumo bei žuvų neršto pradžios. Trumpiausias lervučių vidutinis ilgis (14,3 mm) nustatytas 1996 m. Tais metais dėl žemų vandens temperatūrų stintų nerštas prasidėjo kur kas vėliau negu paprastai, todėl iki gegužės pabaigos lervutės dar nebuvo kitų metų lervučių dydžio, nors vidutinė vandens temperatūra gegužės mėn., kaip ir 1999 m., buvo apie 13°C. Stintų ikrų vystymuisi ir lervučių augimui palankiausios vandens temperatūros buvo 1998 m. Gegužės pabaigoje sugautų lervučių vidutinis ilgis – 18,5 mm. 1999 m. ne tik temperatūros, bet ir mitybos sąlygos buvo geresnės negu 1997 m.: balandžio pradžioje lervučių vidutinis ilgis – atitinkamai 17,3 ir 16,3 mm.

Remiantis stintų lervučių ilgių pasiskirstymu grupėmis bei ilgių sklaida, manoma, kad 1996–1997 m. intensyviausiai stintų nerštas vyko neršto periodo viduryje, 1998 m. – neršto periodo pradžioje, o 1999 m. – neršto periodo pradžioje ir viduryje. 1997 m. stintų nerštas buvo labai ištęstas. 1998 m. per labai trumpą laiką išneršė apie 50% žuvų.

Raktažodžiai: Kuršių marios, stinta, lervutės, ilgis, temperatūra, zooplanktonas, nerštas