ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 67 19 Number 1, 2019

DIFFERENCES IN LIVE FISH MARKETING OF TRADITIONAL POND AQUACULTURE AND INTENSIVE AQUACULTURE IN CZECHIA

Antonín Vavrečka[1], Petra Chaloupková[2], Lukáš Kalous[1]

[1]Czech University of Life Sciences Prague, Faculty of Agrobiology, Food and Natural Resources, Department of Zoology and Fisheries, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic

[2]Czech University of Life Sciences Prague, Faculty of Tropical AgriSciences, Department of Economics and Development, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic

To link to this article: https://doi.org/10.11118/actaun201967010189
Received: 17. 7. 2018, Accepted: 21. 11. 2018

To cite this article: VAVREČKA ANTONÍN, CHALOUPKOVÁ PETRA, KALOUS LUKÁŠ. 2019. Differences in Live Fish Marketing of Traditional Pond Aquaculture and Intensive Aquaculture in Czechia. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67(1): 189–196.

Abstract

The seasonality of fish marketing is a very important character for aquaculture production. We analysed data regarding the situation at the Czech market in 2015 and 2016 available in the information system of the State Agricultural Intervention Fund. The most significant volumes of freshwater fish were traded by traditional pond aquaculture companies (TPA) and approx. 1/3 of the all-year production was sold at the end of the year (December). Another significant time when the supply of live fish from the TPA on the domestic market slightly increased was in March and then in April, i.e. before Easter, which represented approximately one fifth of all aquaculture production. The weakest periods in terms of marketing fish of TPA were the beginning of the year, i.e. during the first two months (January and February) and the period from May to September.

On the contrary, the situation was different in intensive fish aquaculture companies (IA) which had the most significant volumes traded between April and September and then in November and December. However, the sold volume of fish from IA was not strictly concentrated in a single period.

Keywords: companies, aquaculture, production, market, fish, consumption, ponds, recirculation systems, Czech Republic

INTRODUCTION

The total world fish production volume has been constantly increasing since 2012 and increased by 7 % between 2012 and 2014, moving from around 182 million tonnes to 195 million tonnes. From aquaculture originate 101 million tonnes and 94 million tonnes from catches (EUMOFA, 2016a). World aquaculture production has been increasing steadily and provides important social and economic services to many people in various countries (Subasinghe *et al.*, 2009; Lynch *et al.*, 2016; FAO, 2016). EU countries represent about 3.2 % of the world's catches and aquaculture production. From aquaculture originate 1.28 million tonnes (EUMOFA, 2016a). Freshwater production accounts for about 25 % of EU aquaculture output (Bostock *et al.*, 2016). The most important

species in freshwater aquaculture are rainbow trout (*Oncorhynchus mykiss* Walbaum, 1792) and common carp (*Cyprinus carpio* L.) (Lane *et al.*, 2014; FAME, 2016). EU trout production reached in total 191,000 tonnes with value of EUR 604 million in 2014. Indeed, carp volumes stood almost flat, totalling 80,000 tonnes. The main EU carp producers in 2014, Poland and Czechia, accounted for 19,000 tonnes worth EUR 38 million and 18,600 tonnes worth EUR 37 million, respectively (EUMOFA, 2016a), followed by Hungary with a total 12,000 tonnes (EUMOFA, 2016b). Production of other freshwater species amounted to 16,000 tonnes and it is composed of catfish (*Silurus glanis* L.), European eel (*Anquilla anquilla* L.), arctic char (*Salvelinus fontinalis*, Mitchill, 1815) and various sturgeons (*Acipenser sp.*) (FAME, 2016).

Czechia (the Czech Republic) is a landlocked country and the production is concentrated mainly in aquaculture representing more than 24,000 ponds with area of almost 43,000 hectares (Adámek and Kouřil, 2000; Pokorný, 2015). Apart from market fish production, pond aquaculture plays an important role in cultural and socio-economic activities of the whole society (Adámek *et al.*, 2012). In the last years, the annual production of market fish has reached nearly 21,000 tonnes (CFFA, 2015). In Czech aquaculture production, common carp dominates with 87 % of total production, followed by salmonids with approx. 5 %, herbivorous fishes (*Hypophthalmichthys molitrix,* Valenciennes, 1844, *Ctenopharyngodon idella,* Valenciennes, 1844) are represented by 4 % and tench (*Tinca tinca* L.) as a traditional export species by about 2 %. The predatory fishes (*Sander lucioperca* L., *Esox lucius* L., *Silurus glanis* L.) are represented only by approx. 1 % of the total fish production in Czechia (MoA, 2014; CFFA, 2015). A half of this production finds its way to the domestic market whereas less than the half is exported abroad, mainly to Poland, Germany, France, Slovakia, Austria and Hungary (Nebeský *et al.*, 2016).

Worldwide annual fish consumption is 19.7 kg fish per person. In comparison, the annual EU consumption per person is 25.5 kg (EUMOFA, 2016a). In Czechia, fish consumption is significantly lower, as it stagnates at less than 4 kg for a long time (Ženíšková *et al.*, 2017). Moreover, the consumption of freshwater fish in the country is less than 1.5 kg per person per year including the consumption of fish caught by recreational fishing (approx. 0.3 to 0.5 kg/person/year) (Berka, 2015).

About 30 aquaculture farms focus on salmonids, which plays an important role in most European and as well as in many non-European countries for details see Kouřil (2015). In 2016, the production of fish from salmonid aquaculture in Czechia reached 655 tonnes of live fish (Ženíšková *et al.*, 2017). Furthermore, recirculating aquaculture systems exists in Czechia and their contribution in fish production is considered as promising for the future (Kouřil, 2015). These newly built recirculation systems for salmonid, percids e.g. sander (*Sander lucioperca* L.) tropical fishes tilapia (*Oreochromis niloticus* L.) as well as for african cartfish (*Clarias gariepinus*, Burchell, 1822), etc. should lead to an increase in the range of live and processed freshwater fish on the market and ensure the flow of fish supplies throughout the year. The assumed expansion in the range of fishes and ensuring the flow of fish supplies to the Czech market during the year may lead to a gradual increase in the consumption of freshwater fish (MoA, 2014).

The purpose of this paper is to assess, whether the marketing of fish has a seasonal character in Czechia. The specific objective is to identify whether companies with pond aquaculture and intensive aquaculture complement each other.

MATERIAL AND METHODS

The data for the monitoring of the production of domestic live freshwater fish during the individual months of years 2015 and 2016 on the Czech market were collected from the information system of the State Agricultural Intervention Fund (IS SAIF) provided by the individual fishery companies. Through the IS SAIF, the collection of information on projects, applicants/recipients is ensured at all levels of the Operational Program for Fisheries 2014–2020 (OP Fisheries). Through this IS, all applications for OP Fisheries are administered. IS SAIF enables reliable financial and statistical information to be obtained for monitoring and evaluation purposes. Data on the sales of live fish in individual months 2015 and 2016 were presented on the Czech market in volume terms (in tonnes) and in financial value converted to EUR. The exchange rate provided by the Czech National Bank (CNB) was applied to the first business day of 2018 (1 EUR = 25.494 CZK to date 2nd January 2018). The exchange rate thus used was fixed.

The monitored sample included companies that were a typical traditional aquaculture production companies in Czechia focused on pond aquaculture, as well as companies engaged in intensive aquaculture. Only companies with a production of more than 50 tonnes per year were included in the sample among traditional

I: *Structure of companies included in the sample*

Group	Number of companies included in the sample
Pond aquaculture	31
Intensive aquaculture	4

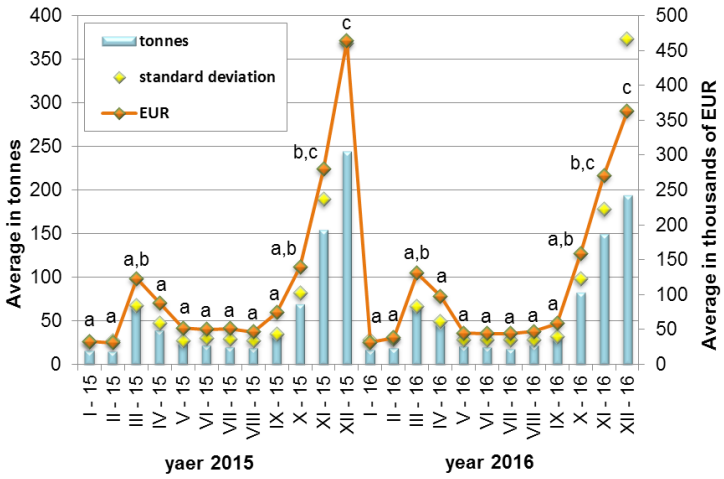
production companies. The reason for this limit was to select companies that have aquaculture as their core business. Due to the gradual introduction of intensive aquaculture, especially recirculating systems in Czechia and their limited number during the period of the study, no minimum fish production thresholds were set up for intensive aquaculture contrary to pond aquaculture. Tab. I shows the total number of companies included in the sample divided according to fish farming method.

The register of the State Veterinary Administration (SVA) maintains approved 307 aquaculture production companies in Czechia (not including Czech Fishing Union) on 15th February 2018. A total of 35 companies were selected in the sample, i.e. 11 % sample of approved establishments in the Czechia by the SVA.

The results were processed in the programs Microsoft Excel and STATISTICA. The statistical evidence of differences between groups was tested by variance analysis (ANOVA) with a 95 % significance level (by LSD Test).

RESULTS

The results showed that the most significant volumes of freshwater fish were traded by companies of pond aquaculture on the Czech market at the end of the year, i.e. in the fourth quarter, and dominated by the offer in the last month of the year. Almost 33 % and 28 % of all-year aquaculture production was sold in December 2015 and 2016, respectively (Fig. 1). The month December differed statistically significantly from the other months (except November). Considering only the volume of carp sold in relation to the year-round volume of carp selling by aquaculture companies, in December 2015 and 2016, almost 37 % and 30 % of all-year aquaculture production was sold (Fig. 2). The difference comparing the other months with December was statistically significant (except November 2016). There were smaller companies with annual production of fish up to 100 tonnes, which sold their production immediately after harvesting. The results of the investigations of all 31 trading companies showed that no single one was put on the market for less than nine months a year. Regarding other fish species, the most significant volumes of freshwater fish were traded by pond aquaculture at the end of the year, i.e. in the fourth quarter, however dominated by November and followed by October. Even in year 2016, November was the strongest month with a 29 % share, followed by October with 18 % and December with a 10 % share of year-round



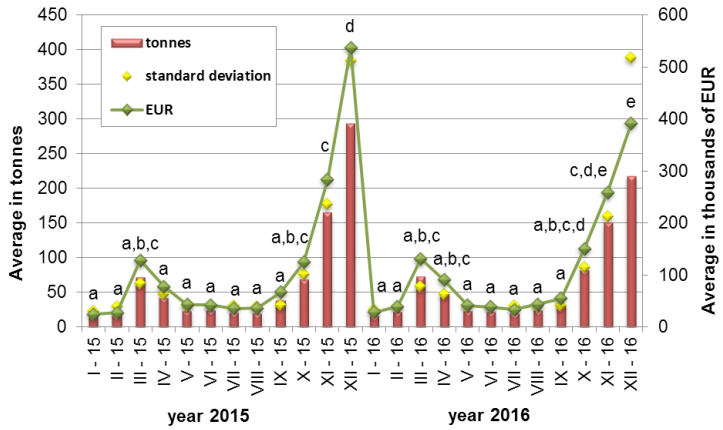
1: *Sales of all live fish in individual months 2015 and 2016 – sales in tonnes and thousands of EUR – companies with pond fish aquaculture*

* a/b/c: statistically significant at the 5 % level. The same letter means a statistically inconclusive difference. The statistical evidence of differences was tested for each year separately by LSD Test.

aquaculture production (Fig. 3). The month November differed statistically significantly from the other months (except October 2015).

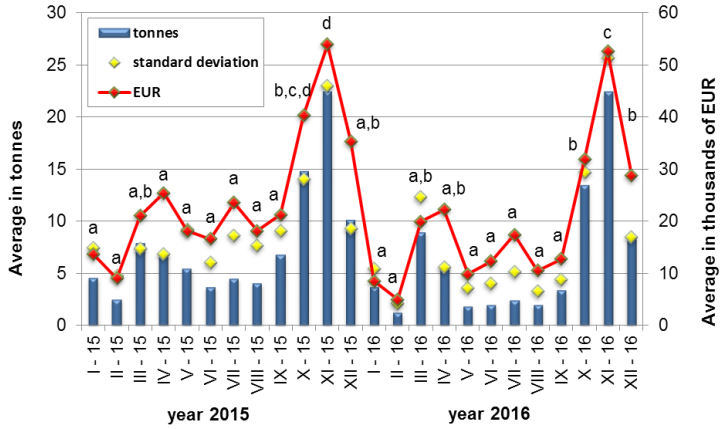
Fig. 2 shows that the value in thousands of EUR for which the live carp was marketed replicates the volume. In contrast, the value of other fish species sold in thousand EUR was independent on the volume and quantity sold evident in Fig.3. The price of carp of the first weight group is approximately 2 EUR/kg in the long term (Ženíšková *et al.*, 2017). Due to this reason, the value in thousand EUR copies volume. The price for other fish species varies depending on the type of fish (Fig. 3).

Another significant period, when live fish supply grew slightly in the domestic market in 2015 and 2016, was March and then April, which means before Easter. Spring harvests also take place during this period. Almost 18 % and 17 % of all-year aquaculture production was sold in March and April 2015 and 2016, respectively (Fig. 1). When we consider only the number of carp sold in connection with the year-round volume of carp sold by companies with classical fish farming in ponds, almost 14 % and 16 % of all-year aquaculture were sold in March and April 2015 and 2016, respectively (Fig. 2). The situation of other fish species was similar as, the supply of other species of live fish to the internal market was increased in March and April (Fig. 3). Sales of other fish species were comparable to carp sales. Almost 16 % and 20 % from all-year aquaculture production was sold in March and April 2015 and 2016, respectively (Fig. 3).



2: *Sales of live carp in individual months of 2015 and 2016 – sales in tonnes and thousands of EUR – companies with pond fish aquaculture*

*a/b/c/d/e: statistically significant at the 5 % level. The same letter means a statistically inconclusive difference. The statistical evidence of differences was tested for each year separately by LSD Test.



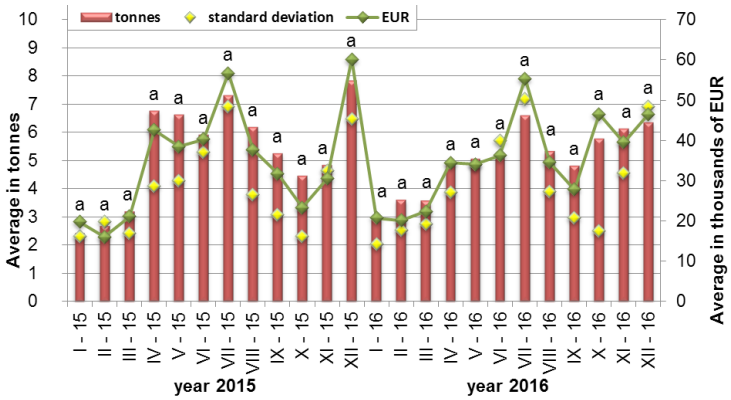
3: *Sales of other live fish (except carp) in individual months of 2015 and 2016 – sales in tonnes and thousands of EUR – companies of pond aquaculture*

* a/b/c/d: statistically significant at the 5 % level. The same letter means a statistically inconclusive difference. The statistical evidence of differences was tested for each year separately by LSD Test.

The weakest period in terms of marketing domestic fish production was during the first two months (January and February) in both years 2015 and 2016. The average share (for both months) of the total annual sales in 2015 did not reach 4 % while in 2016 it did not reach 5 % (Fig. 1). In addition, the standard deviation shows that most companies had only a tiny average, meaning that most companies had greatly reduced sales. When we consider only the volumes of carp sold in relation to the year-round volume of carp sold by companies of pond aquaculture, it was almost 4 % sold in January and February (both for the two months) 2015 and in 2016 were sold 5 % (Fig. 2). The situation for other fish species was different when the sale was higher in the first two months (January and February), in 2015 by 5 % and in 2016 by only 2 %. The volumes of other fish species sold in relation to the year-round volume of these fish by companies with classical pond aquaculture were almost 9 % sold in January and February (both for the two months) 2015, and 7 % sold in 2016 (Fig. 3).

Another weak period in the marketing of domestic fish production was during May to September. The sales of companies with classical pond aquaculture between May and September 2015 and 2016 were very low in terms of average and were evenly balanced in the share of year-round production. The share of marketed fish in annual production fluctuated in the range 2.3 –5.9 % in 2015, with a slight decrease from May to July. September was a month when the sales started growing, and larger companies started autumn harvesting of pond during this period. This share was in the range of 2.7–4.4 % in 2016, with a slight decline from May to July. In August, sales increased slightly, and September brought a further increase (Fig. 1). When we consider only the share of sold carp in relation to year-to-year volume of carp sold by companies with pond aquaculture from May to September, the share was in the interval 2.4–4.8 % in 2015 and 2.7–4.3 % in 2016 (Fig. 2). As shown in Fig. 3, the situation for other fish species was different in 2015, with a share of traded fish from annual production between May and September in the interval 5.3 % and 7.4 %. Compared to the sold carp, the sale of other species was twice higher in 2015. However, year 2016 did not confirm the fact that other species of fish were marketed more in the period from May to September. This share was in the interval 2.6–3.9 % in 2016.

The companies with intensive aquaculture either in halls or roofless systems were included in the analysis and they did not breed carp but other fishes. The most significant volumes of freshwater fish (produced by intensive systems) were traded on the Czech market between April and September and then November and December of the given year (in 2016 even in October). The volume of fish sold was not strictly concentrated in one period, as it was the case of pond aquaculture. The volumes of fish marketed were spread throughout the year. The highest market share 12 % and 11.7 % of all-year aquaculture production was sold in December 2015 and in July 2016. About 10 % of all-year aquaculture production was sold in October, November and December 2016. An important period was also April to September, when the production was almost the same. Nearly 8 % of all-year aquaculture production was sold, in April to September 2016 (except July). Around 11 % of the production was marketed in April, May and July 2015, while 9 % in June and August 2015 and



4: *Sales of all live fish in individual months of 2015 and 2016 – sales in tonnes and thousands of EUR – companies with intensive aquaculture*

* a: statistically significant at the 5 % level. The same letter means a statistically inconclusive difference. The statistical evidence of differences was tested for each year separately by LSD Test.

8 % in September 2015. It means that the weakest months were January, February and March, representing the share in the interval 3.1–4.6 % in 2015 and 4.9–6.7 % in 2016.

DISCUSSION

When comparing the situation with the placing of production on the market and especially with the consumption of fresh fish in the surrounding countries, we found that the marketing of fish production and the consumption of fish is less seasonal (EUMOFA, 2017). For example, the consumption of freshwater fish is less seasonal in Germany than in Czechia. Similarly to the Czechia, the consumption of fish increased in autumn and during Christmas (BMEL, 2014) however carp is also consumed in other periods of the year – spring and summer. Increased consumption of fresh fish is also associated with a significantly higher consumption of salmonids, which is uniform throughout the year. There is also advantage of consuming trout all-year-round both in households and restaurants (Centenera, 2014).

For comparison, Polish companies are also interesting in this point of view since they have their own fish processing plants, shops selling fish and fish products, and even fish restaurants (Martín, 2011).

In the contrast to the situation in Czechia, the consumption of freshwater fish is less seasonal in Austria, like in Germany and Poland. In addition, there is a partly increased demand in the autumn and in Christmas period. Increased consumption of freshwater fish is also highly affected by consumption of salmonids during the year. Austria has the advantage associated with the relatively high production of market trout combined with its steady consumption (Matzinger, 2014).

In the estimation of future production figures within the EU, the annual increase of salmonids (mainly rainbow trout) will be 1.5 %, according to forecasts the production will increase by 70 thousand tonnes by 2030 (Lane *et al.*, 2014). From a non-EU countries a significant contribution is represented by Turkey, where salmonid aquaculture exceeded 100 thousand tonnes in 2015 (Ženíšková *et al.*, 2017). According to estimation within Czechia, the annual growth in fish production is expected to be 0.75 % (per year), through intensive aquaculture, especially recirculation systems, where an increase is expected by 1,300 tonnes. At the same time, percids and tropical fishes are expected to be produced by intensive aquaculture. The assumed expansion in the range of fish and ensuring the flow of fish supplies to the Czech market during the year may lead to a gradual increase in the consumption of freshwater fish (MoA, 2014). Within the EU, the recirculation systems have an upward trend in relation to trends in the production technology (Lane *et al.*, 2014).

CONCLUSION

The most significant volumes of freshwater fish were traded by traditional companies of pond aquaculture. The results showed that marketing of fish has a seasonal character in Czechia. The top seasons is a Christmas period at the end of the year as companies marketed approx. 1/3 of their production in December. On the contrary, the weakest period in terms of marketing domestic fish production was the beginning of the year (January and February) and the period from May to September.

The situation in intensive aquaculture and the production of fish is different than in pond aquaculture. The most significant volumes of fish from intensive aquaculture are traded between April and September and in November and December. The volume of sold fish from intensive aquaculture was not strictly concentrated in a single period and was equally distributed throughout the year. These results shows, that marketing of live fish from intensive aquaculture is complementary to production of pond aquaculture where the weakest period is from May to September.

Acknowledgement

We are grateful to Ministry of Agriculture of the Czech Republic and its institutions for providing primary data for our analyses. The contribution was supported by programme NAKI II number DG18P02OVV057.

REFERENCES

ADÁMEK, Z. and KOUŘIL, J. 2000. A long aquaculture tradition in the Czech Republic. *Aquaculture Europe*, 25: 20–23.

ADÁMEK, Z., LINHART, O., KRATOCHVÍL, M. et al. 2012. Aquaculture in the Czech Republic in 2012: modern European prosperous sector based on thousand year history of pond culture. *Aquaculture Europe*, 37: 5 –17.

BERKA, R. 2015. *Improving the fish market*. In: URBÁNEK, M. (Ed.). *Our fishery* [in Czech: *Zlepšení trhu s rybami: Naše rybářství*]. 2nd Edition. České Budějovice: Czech Fish Farmers Association, pp. 129–141.

BMEL (FEDERAL MINISTRY OF FOOD AND AGRICULTURE IN GERMANY). 2014. *Multiannual national plan for the development of sustainable aquaculture*. Berlin: BMEL.

BOSTOCK, J., LANE, A., HOUGH, C. and YAMAMOTO, K. 2016. An assessment of the economic contribution of EU aquaculture production and the influence of policies for its sustainable development. *Aquaculture International*, 24: 699 –733.

CENTENERA, R. 2014. *Fisheries in Germany.* Directorate – General for Internal Policies, Policy department B, Structural and cohesion policies – Fisheries.

CFFA (CZECH FISH FARMERS ASSOCIATION). 2015. Aquaculture in the Czech Republic. *The information brochure of Czech aquaculture*. České Budějovice: Nakladatelství Typ.

EUMOFA. 2016a. *The EU fish market*. Directorate – General for Maritime Affairs and Fischeries of the European Commission. Brussels: European Commission.

EUMOFA. 2016b. *Case study - Price structure in the supply chain for fresh carp in Central Europe*. European Market Observatory for fisheries and aquaculture products. Brussels: European Commission.

EUMOFA. 2017. *EU Consumer Habits Regarding Fishery and Aquaculture Products*. European Market Observatory for fisheries and aquaculture products. Brussels: European Commission.

FAME SU. 2016. *Summary of the Multiannual National Aquaculture Strategic Plans – final draft.* Directorate – General for Maritime Affairs and Fisheries, European commission. Brussels: European Commission.

KOUŘIL, J. 2015: *The breeding of salmonid fish in Czech Republic*. In: URBÁNEK, M. (Ed.). Our fishery [in Czech: Chov lososovitých ryb v podmínkách ČR: Naše rybářství]. České Budějovice: Czech Fish Farmers Association, pp. 95–105.

LANE, A., HOUGH, C. and BOSTOCK, J. 2014. *The Long-Term Economic and Ecologic Impact of Larger Sustainable Aquaculture.* Directorate General for Internal Policies, Policy department B, Structural and cohesion policies – Fisheries, European Commission. Brussels: European Commission.

LYNCH, A. J., COOKE, S. J., DEINES, A. M. et al. 2016. The social, economic, and environmental importance of inland fish and fisheries. *Environmental Reviews*, 24(2): 115–121.

MARTÍN, I. J. 2011. *Fisheries in Poland*. Directorate – General for Internal Policies, Policy department B, Structural and cohesion policies – Fisheries, European Commission. Brussels: European Commission.

MATZINGER, T. 2014. *Ponds in the Landscape - Meaning, Function and Threat*. A series of publications by the Federal Bureau of Water Management, 36: 34. Federal Bureau of Water Management.

MOA (MINISTRY OF AGRICULTURE OF THE CZECH REPUBLIC). 2014. *Multi-Annual National Strategic Plan for Aquaculture* [in Czech: *Víceletý národní strategický plán pro akvakulturu*]. [Online]. Prague: Ministry of Agriculture of the Czech Republic. Available at: http://eagri.cz/public/web/mze/dotace/operacni-program-rybarstvi-na-obdobi-1/zakladni-informace/programove-dokumenty/ [Accessed: 2018, March 10].

NEBESKÝ, V., POLICAR, T., BLECHA, M. *et al.* 2016. Trends in import and export of fishery products in the Czech Republic during 2010–2015. *Aquaculture International*, 24: 1657–1668.

PHILLIPS, M., SUBASINGHE, R., TRAN, N., KASSAM, L. and CHAN, Y. 2016. *Aquaculture Big Numbers*. Fisheries and Aquaculture Technical Paper No. 601. Rome: FAO.

POKORNÝ, J. 2015. Perspective of ponds and small water reservoirs in the 21st century. In: URBÁNEK, M. (Ed.). *Czech Ponds and Fisheries in the 20th century* [in Czech*: Perspektiva rybníků a malých vodních nádrží v 21. Století: České rybníky a rybářství ve 20. století*]. České Budějovice: Czech Fish Farmers Association, pp. 307–309.

SUBASINGHE, R., SOTO, D. and JIA, J. 2009. Global aquaculture and its role in sustainable development. *Reviews in Aquaculture*, 1: 2–9.

SVA (STATE VETERINARY ADMINISTRATION). 2018. *Database - Aquaculture production enterprises*. Available at: https://www.svscr.cz/registrovane-subjekty-svs/ [Accessed: 2018, February 15].
ŽENÍŠKOVÁ, H., CHALUPA, P. and HEIMLICH, R. 2017. *Fish—annual report of Ministry of Agriculture*. [Online]. Prague: Ministry of Agriculture of the Czech Republic. Available at: http://eagri.cz/public/web/mze/voda/rybarstvi/situacni-a-vyhledove-zpravy-ryby/ [Accessed: 2018, January 15].

Contact information
Antonín Vavrečka: Vavrecka.Antonin@seznam.cz
Petra Chaloupková: chaloupkova@ftz.czu.cz
Lukáš Kalous: kalous@af.czu.cz