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Post-Survival and Growth in Belvidere Dam, South Dakota, USA, of Juvenile Walleye Reared in a Recirculating Aquaculture System

Andrew S. Marchant[1], Bill H. Miller[2], Gene Galinat[2], Cody Treft[3], Jill M. Voorhees[1], Michael E. Barnes[1*]

[1]South Dakota Department of Game, Fish and Parks, McNenny State Fish Hatchery, Spearfish, South Dakota, USA
[2]South Dakota Department of Game, Fish, and Parks, Outdoor Campus West, Rapid City, South Dakota, USA
[3]South Department of Game, Fish and Parks, Cleghorn Springs State Fish Hatchery, Rapid City, South Dakota, USA
Email: *mike.barnes@state.sd.us

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Abstract

Walleye (*Sander vitreus*) recreational fisheries are frequently maintained by stocking hatchery-reared fish. Producing juvenile walleye in recirculating aquaculture systems (RAS) is becoming more common, but information on the post-stocking performance of RAS-reared walleye remains limited. This study evaluated the survival and growth of RAS-reared juvenile walleye stocked into Belvidere Dam, South Dakota. Approximately 14,000 juvenile walleye were cultured in a RAS to an individual mean weight of 0.156 g and stocked into Belvidere Dam on 15 June 2023. Trap netting occurred approximately one month later. Both trap nets and boat electrofishing were conducted in 2024. No walleye were captured in the trap nets in 2023. However, in 2024, 72 walleye were caught in trap nets and 37 were captured by electrofishing. Catch per unit effort was 14.4 fish/net-night in June 2024 and 55.5 fish/h in October 2024. Median individual total length increased from 251 mm in June 2024 to 344 mm in October 2024, representing a median growth of 94 mm over approximately four months. Stock-length and quality-length walleye were present within 16 months post-stocking, and relative weights indicated excellent body condition. These results demonstrate that RAS-reared walleye can survive and exhibit rapid growth following stocking in a small reservoir system, supporting the use of RAS as an effective tool stocking for the management of recreational walleye fisheries.

Keywords

Recirculating Aquaculture Systems, RAS, Walleye, *Sander Vitreus*, Post-Stocking Survival, Intensively-Reared

1. Introduction

Walleye (*Sander vitreus*) are a highly valued sportfish that have been widely introduced beyond their native range [1]-[3]. Because of problematic natural reproduction, many walleye fisheries are frequently maintained by hatchery production and stocking [4]-[8]. An estimated one billion hatchery-reared walleye fry and juveniles are stocked annually in North America [9]-[12].

Traditional walleye culture relies on spawning wild broodstock, followed by egg incubation, and then either direct stocking of fry or additional rearing of larval fish on natural feed in outdoor ponds [13]-[19]. More recently, recirculating aquaculture systems (RAS) have emerged as an alternative approach [20]. These systems offer increased control, faster growth, and the ability to produce larger fish relative to traditional pond-based methods, while also increasing bio-security and decreasing water needs [21] [22].

Although RAS culture techniques for walleye are now relatively well-developed [20] [23]-[26], very little information exists regarding the survival and growth of RAS-reared walleye after stocking. Only two studies have documented the post-stocking survival and growth of walleye juveniles reared using RAS. Marchant *et al.* [27] provided substantial detail, while Johnson *et al.* [20] lacked detailed descriptions of environmental conditions, fish communities, or sampling design [20]. Additional evaluations of post-stocking survival and growth are needed to better understand the effectiveness of RAS-reared walleye in establishing or maintaining recreational fisheries.

The objective of this study was to evaluate the post-stocking survival and growth of RAS-reared walleye released into Belvidere Dam, a small reservoir in South Dakota, USA.

2. Methods

2.1. Study Area

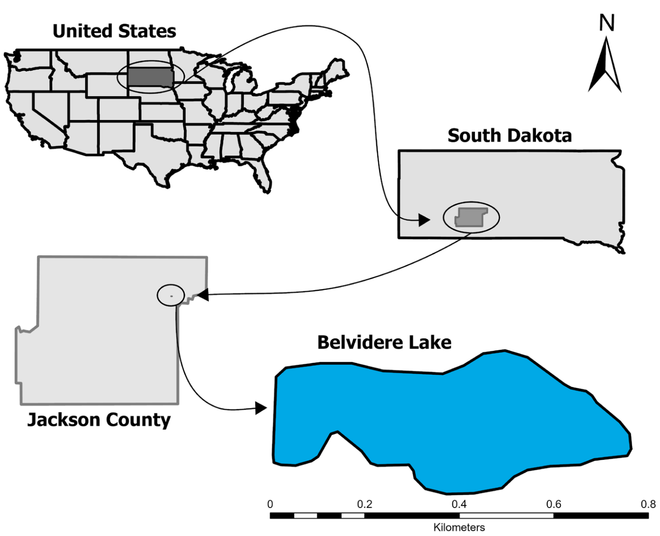

Figure 1. Location of Belvidere Dam in Jackson Country, in the state of South Dakota, USA.

Belvidere Dam (43.83475 ˚N, 101.26686 ˚W) is a 17-ha impoundment located on the east edge of the city of Belvidere, South Dakota, USA (**Figure 1**). The reservoir experienced a partial winterkill during the winter of 2022-2023, resulting in a severely degraded fish community [28]. Black bullhead (*Ameiurus melas*) were the only fish captured in Belvidere Dam following the winterkill. Besides walleye, the reservoir was restocked with adult northern pike (*Esox lucius*), adult yellow perch (*Perca flavescens*), adult channel catfish (*Ictalurus punctatus*), and juvenile largemouth bass (*Micropterus salmoides*) in the spring and summer of 2023 and juvenile largemouth bass again in the spring of 2024 [28].

2.2. Walleye Culture

Fertilized walleye eggs were incubated at Cleghorn Springs State Fish Hatchery, Rapid City, South Dakota, USA, in 2023. The eggs originated from feral broodstock collected in South Dakota. USA. After hatch, the larval walleye were grown in a recirculating aquaculture system (RAS) at the hatchery. Fish were reared in four, 2.4 m^3 circular tanks. Flow rates per tank were initially set at 0.00126 m^3/s and gradually increased to a maximum of 0.00284 m^3/s. Water temperature during rearing was initially 15.5˚C and progressively increased during the rearing period to approximately 22.2˚C. Turbidity was maintained at approximately 50 NTU using Old Mine #4 ball clay (Kentucky-Tennessee Clay Company, Gleason, Tennessee, USA) during the first 21 days of rearing. Larval walleye were initially fed Otohime B2 (Marubeni Nisshin Feed Co., Ltd., Tokyo, Japan) and gradually transitioned to a 50:50 mixture of Otohime and Gemma (Skretting Nutreco, Stavanger, Norway) weaning diets.

On 15 June 2023, 14,000 juvenile walleye were stocked into Belvidere Dam. Mean individual weight for each walleye was 0.156 g, with a total weight of 2,184 g stocked. This was an introductory stocking of walleye into Belvidere Dam; no walleye were present even prior to the winterkill event [28]. Thus, all walleye captured during this study originated from the RAS stocking.

2.3. Post-Stocking Sampling

Trap nets and boat electrofishing were used to evaluate re-capture walleye after stocking. Five standard mesh trap nets (two 0.9 × 1.5 m frames, three 0.9 m diameter hoops, a single throat, a 0.9 × 15.2 m lead, and 19 mm bar knotted mesh) were set on 20 July 2023 and 18 June 2024. Nets were set overnight in nearshore habitat for approximately 24 hours and pulled the following day, totaling five net-nights of effort during each survey. Night boat electrofishing was conducted on 7 October 2024 and consisted of 2,400 seconds (four 10-minute runs) of on-time effort. Walleye captured during netting or electrofishing were measured (total length) to the nearest mm and weighed to the nearest g.

Catch per unit effort (CPUE), an index of relative abundance [29], was defined as the number of walleye captured per hour of on-time electrofishing effort and the number of walleye captured per trap net-night [28]. In addition, CPUE for

Stock-length walleye (CPUE-S > 254 mm, [30]) was calculated. Stock length represents the size when the walleye were considered recruited to the population. Proportional size distribution of quality-length walleye (PSD) was calculated:

$$PSD = \left(\left(\text{number of fish} \geq \text{quality length}\right) / \left(\text{number of fish} \geq \text{stock length}\right)\right) \times 100$$

Walleye condition was quantified with relative weight (W_r) and was calculated as described by Blackwell *et al.* [31], with the appropriate standard weight equation used for walleye <150 mm and >150 mm.

2.4. Data Analysis

Length-frequency distributions were summarized by sampling period and method using 10-mm length bins. Differences in size structure between sampling periods (June and October 2024) were evaluated using boxplots of total length, with individual fish lengths overlaid to illustrate variation among sampling methods. Median total length by survey date was used to visualize growth trajectories following stocking.

Data were analyzed using R [32]. Because length variances differed between sampling periods (F-test, $p < 0.05$), differences in total length between June and October 2024 were evaluated using a nonparametric Wilcoxon rank-sum test. The magnitude of change in median total length was estimated using the Hodges–Lehmann estimator with 95% confidence intervals. Statistical significance was predetermined at $p < 0.05$. Eighty percent confidence intervals for CPUE were calculated using the following formula: CI = mean ± 1.282 (SE). Ninety percent confidence intervals for PSD were calculated similarly with CI = mean ± 1.645 (SE).

3. Results

No walleye were captured during the July 2023 trap net survey. However, walleye were detected in both trap net and night electrofishing surveys conducted in 2024 (**Table 1**). Trap nets in June captured 72 walleye (14.4 fish/net-night), whereas night electrofishing conducted in October captured 37 walleye (55.5 fish/h). A total of 109 walleye were captured in post-stocking surveys, which is nearly 0.8% of the 14,000 walleye stocked in 2023. Stock-length walleye (>254 mm) were present during both 2024 sampling periods, and quality-length walleye were present in the electrofishing survey.

Table 1. Catch per unit effort (CPUE, 80% confidence interval), catch per unit effort of stock length fish (CPUE-S, 80% confidence interval), proportional size distribution of quality-length fish (PSD, 90% confidence interval), and relative weight (W_r, 90% confidence interval) of walleye captured from Belvidere Dam in 2024. CPUE for trap nets is fish per trap night and CPUE for electrofishing is fish per hour effort.

	Walleye Captured
Trap Net	
N	72

Continued

CPUE	14.4 (7.6)
CPUE-S	8.0 (4.6)
PSD	0
W_r	102.2 (1.7)
Electrofishing	
N	37
CPUE	55.5 (22.5)
CPUE-S	55.5 (22.5)
PSD	3 (4)
W_r	96.9 (0.4)

Length-frequency distributions differed between June and October (Figure 2). Trap-net samples collected in June had total lengths mostly from 225 to 275 mm, whereas electrofishing samples in October consisted primarily of fish ranging from approximately 300 to 375 mm.

Walleye total length increased significantly from June to October (W = 2663, p $< 2.2 \times 10^{-16}$; Figure 2). Median total length increased from 251 mm (19.25 IQR) to 344 mm (17.00 IQR; 95% CI = 87-100 mm Hodges-Lehmann Estimator).

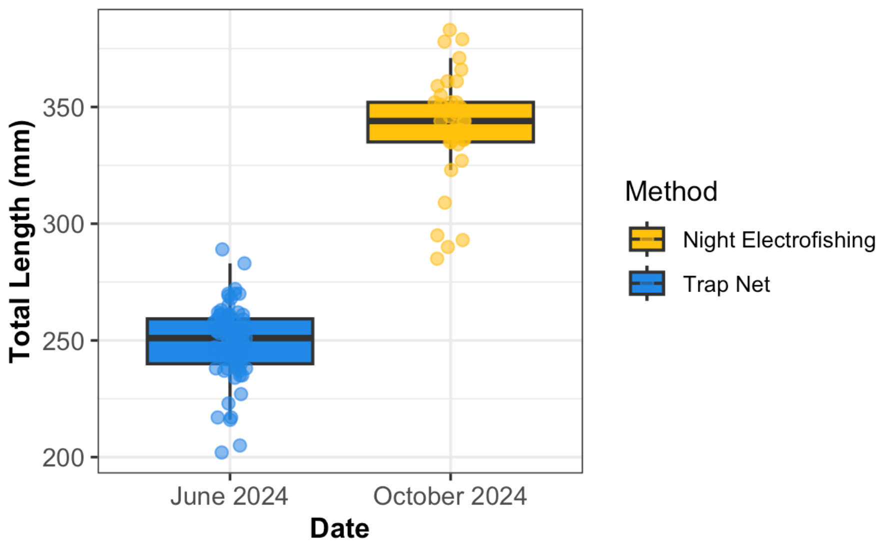

Figure 2. Boxplot of total length (mm) of RAS-reared walleye sampled at Belvidere Dam during 2024 surveys. The horizontal line within each box represents the median length of walleye sampled for the given survey year, and the box bounds indicate the interquartile range (25th - 75th percentiles). Points represent individual fish lengths, colored by sampling method.

4. Discussion

The results from this study indicate that walleye reared in a recirculating aquaculture system survived and grew after release into Belvidere Dam. The absence of juvenile walleye in the 2023 trap netting is because of gear-specific sampling bias. Trap nets are known to be relatively ineffective at capturing smaller, juvenile individuals [33] [34]. In addition, sampling for age-0 fish, like the walleyes in this study, is typically recommended to occur in the fall when the fish are of adequate size to be effectively sampled [35] [36]. Boat electrofishing in the fall is a much more established method to sample juvenile walleyes than trap nets [33] [37]-[40].

Walleye were present at stock length (254 mm) approximately 12 months post-stocking and reached quality length (381 mm) within 16 months post-stocking. Mean relative weights of the recaptured walleye were in the upper 90s to low 100s. These findings compare favorably with previous studies documenting post-stocking survival and growth of intensively-reared walleyes in RAS [20] [27].

Because trap netting and electrofishing were done at different times of the year growth estimates could only be done at a cohort, rather than individual fish, level. That being said, the growth observed in Belvidere Dam walleye exceeded 340 mm median total length by approximately 16 months post-stocking, surpassing reported age-2 averages from other walleye fisheries in relatively close geographic proximity [27] [41] [42]. The Iowa Department of Natural Resources [42] reported mean back-calculated lengths of 234 mm at age-1 and 328 mm at age-2 for walleye. Similarly, age-2 walleye in a western South Dakota reservoir average approximately 300 mm total length [41]. Walleye growth in Belvidere also exceeded that observed in Owen Dam, South Dakota, where median total length at approximately 16 months post-stocking was 275 mm and no individuals exceeded 300 mm [27]. Relative weight values near or exceeding 100 indicate excellent body condition [31], indicating that the stocked walleye were able to find and capture food [43].

Stocking density and fish size at stocking are important factors influencing post-stocking survival of walleye [20] [44]-[46]. In this study, walleye were stocked at an extremely high density (824 walleye/ha). Fayram *et al.* [44] suggested an appropriate stocking rate of 75 walleye/ha. The relatively high stocking rates used in this study could be problematic, potentially leading to density-dependent growth reductions [47] [48], cannibalism [49], and decreased cost-efficiencies [44]. Despite stocking densities exceeding this recommendation, RAS-reared walleye at Belvidere Dam still survived and grew substantially over 16 months. The RAS-reared walleyes stocked in this study were also smaller than those reported by Johnson *et al.* [20], where walleye were stocked at nearly 1 g.

Fish community interactions may have influenced walleye survival and growth at Belvidere Dam. Black bullheads, which survived the previous winter winterkill event, will eat small fish like the juvenile walleyes stocked in this study [50]. However, the primary negative effect of bullheads on juvenile walleyes may be competition for food [51] [52]. A negative correlation between bullhead abundance and walleye recruitment has been observed [51]. Juvenile largemouth bass were stocked concurrently with walleye in 2023. Largemouth bass are piscivorous and will eat juvenile walleye [53]-[56], although predation is likely not as big of an impact as dietary overlap [54] [57]. The 75 adult northern pike stocked prior to walleye stocking could have also consumed stocked walleye [58] [59], but their predatory impact is generally considered less than that of largemouth bass [53]. Even though Belvidere experienced a recent winterkill prior to the stocking of RAS-reared walleye in this study, it was not a reservoir devoid of fish. Thus, the survival and growth of RAS-reared walleyes observed in this study indicates that at least some of the stocked walleyes were able to avoid predation and could compete against other fish species potentially consuming similar prey items.

This study used RAS-reared walleyes originating from South Dakota broodstock. A similar study documenting the survival and growth of RAS-reared walleyes in a small reservoir used fish originating from Nebraska broodstock [27]. While genetic differences between broodstock sources can influence walleye survival and growth [60]-[62], it appears that using either of the genetically-different brood sources in this and the Marchant *et al.* [27] study can be reared in RAS, stocked, and successfully recruit into a fishery.

As with most field-based evaluations of stocked fish, this study has several limitations. Approximately 0.8% of the 2023 cohort was detected in post-stocking surveys; however, this value should not be interpreted as a true survival estimate. Post-stocking survival was inferred from catch per unit effort (CPUE), which provides an index of relative abundance and may be influenced by gear sampling efficiency [33] [34] [63], environmental conditions, and seasonal timing [33] [63] [64]. Trap nets and electrofishing are known to exhibit gear-specific biases when sampling juvenile and subadult walleye [33] [34]. Additionally, sampling was not conducted in 2025 due to low water levels, limiting the evaluation of longer-term survival. Finally, RAS walleye rearing techniques continue to be refined, which may also affect growth and survival outcomes.

5. Conclusion

This study is one of only three documenting the post-stocking survival of RAS-reared juvenile walleye. Rapid growth to quality length within 16 months post-stocking was observed, and walleye persisted at detectable levels across sampling periods. These findings support the potential use of recirculating aquaculture systems as a viable hatchery production strategy for walleye stocked into recreational fisheries. However, further evaluations of other winterkilled and non-winterkilled reservoirs stocked with both RAS-reared and pond-reared walleye should be completed.

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Author Contributions

Conceptualization, G. Galinat, C. Treft, M. E. Barnes.; methodology, G. Galinat,

B. H. Miller, C. Treft.; formal analysis, B. H. Miller, G. Galinat, A. S. Marchant; investigation, B.. H. Miller, G. Galinat, C. Treft; resources, G. Galinat, M. E. Barnes.; data curation, B. H. Miller, G. Galinat, C. Treft; writing—original draft preparation, A. S. Marchant, M. E. Barnes.; writing—review and editing, A. S. Marchant, J. M. Voorhees, M. E. Barnes.; visualization, G. Galinat, M. E. Barnes; supervision, G. Galinat, M. E. Barnes.; project administration, G. Gallnat, M. E. Barnes. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Summerfelt, R.C. (1996) Introduction. In: Summerfelt, R.C., *Walleye Culture Manual. NCRAC Culture Series* 101, North Central Regional Aquaculture Center Publications Office, 1-10. https://www.ncrac.org/files/inline-files/Chapter1.pdf

[2] Johnston, T.A., Lysack, W. and Leggett, W.C. (2012) Abundance, Growth, and Life History Characteristics of Sympatric Walleye (*Sander vitreus*) and Sauger (*Sander canadensis*) in Lake Winnipeg, Manitoba. *Journal of Great Lakes Research*, **38**, 35-46. https://doi.org/10.1016/j.jglr.2010.06.009

[3] Feiner, Z.S. and Höök, T.O. (2015) Environmental Biology of Percid Fishes. In: Kestemont, P., Dabrowski, K. and Summerfelt, R.C., *Biology and Culture of Percid Fishes: Principles and Practices*, Springer, 61-100. https://doi.org/10.1007/978-94-017-7227-3_2

[4] Johnson, F.H. (1961) Walleye Egg Survival during Incubation on Several Types of Bottom in Lake Winnibigoshish, Minnesota, and Connecting Waters. *Transactions of the American Fisheries Society*, **90**, 312-322. https://doi.org/10.1577/1548-8659(1961)90[312:wesdio]2.0.co;2

[5] Sullivan, M.G. (2003) Active Management of Walleye Fisheries in Alberta: Dilemmas of Managing Recovering Fisheries. *North American Journal of Fisheries Management*, **23**, 1343-1358. https://doi.org/10.1577/m01-232am

[6] Hansen, G.J.A., Gaeta, J.W., Hansen, J.F. and Carpenter, S.R. (2015) Learning to Manage and Managing to Learn: Sustaining Freshwater Recreational Fisheries in a Changing Environment. *Fisheries*, **40**, 56-64. https://doi.org/10.1080/03632415.2014.996804

[7] Shaw, S.L., Sass, G.G. and VanDeHey, J.A. (2018) Maternal Effects Better Predict Walleye Recruitment in Escanaba Lake, Wisconsin, 1957-2015: Implications for Regulations. *Canadian Journal of Fisheries and Aquatic Sciences*, **75**, 2320-2331. https://doi.org/10.1139/cjfas-2017-0318

[8] Raabe, J.K., VanDeHey, J.A., Zentner, D.L., Cross, T.K. and Sass, G.G. (2020) Walleye Inland Lake Habitat: Considerations for Successful Natural Recruitment and Stocking in North Central North America. *Lake and Reservoir Management*, **36**, 335-359. https://doi.org/10.1080/10402381.2019.1697771

[9] Fenton, R., Mathias, J.A. and Moodie, G.E.E. (1996) Recent and Future Demand for Walleye in North America. *Fisheries*, **21**, 6-12. https://doi.org/10.1577/1548-8446(1996)021<0006:rafdfw>2.0.co;2

[10] Kerr, S. (2008) A Survey of Walleye Stocking Activities in North America. Ministry of Natural Resources.

[11] Kerr, S.J. (2011) Stocking and Marking: Lessons Learned over the Past Century. In: Barton, B.A., *Biology, Management, and Culture of Walleye and Sauger*, American Fisheries Society, 423-449.

[12] Halverson, M.A. (2008) Stocking Trends: A Quantitative Review of Governmental Fish Stocking in the United States, 1931 to 2004. *Fisheries*, **33**, 69-75. https://doi.org/10.1577/1548-8446-33.2.69

[13] Harding, L.M. and Summerfelt, R.C. (1994) Effects of Fertilization and of Fry Stocking Density on Pond Production of Fingerling Walleye, *Stizostedion vitreum*. *Journal of Applied Aquaculture*, **2**, 59-80. https://doi.org/10.1300/j028v02n03_04

[14] Summerfelt, R.C., Clouse, C.P. and Harding, L.M. (1994) Pond Production of Fingerling Walleye, *Stizostedion vitreum*, in the Northern Great Plains. *Journal of Applied Aquaculture*, **2**, 33-58. https://doi.org/10.1300/j028v02n03_03

[15] Rogge, M.L., Moore, A.A. and Morris, J.E. (2003) Organic and Mixed Organic-Inorganic Fertilization of Plastic-Lined Ponds for Fingerling Walleye Culture. *North American Journal of Aquaculture*, **65**, 179-190. https://doi.org/10.1577/c02-022

[16] Czesny, S., Rinchard, J. and Dabrowski, K. (2005) Intrapopulation Variation in Egg Lipid and Fatty Acid Composition and Embryo Viability in a Naturally Spawning Walleye Population from an Inland Reservoir. *North American Journal of Fisheries Management*, **25**, 122-129. https://doi.org/10.1577/m03-202.1

[17] Kaatz, S.E., Morris, J.E., Rudacille, J.B., Johnson, J.A. and Clayton, R.D. (2011) Role of Organic Fertilizers in Walleye (*Sander vitreus*) Production in Plastic-Lined Culture Ponds. *Aquaculture Research*, **42**, 490-498. https://doi.org/10.1111/j.1365-2109.2010.02644.x

[18] Ward, M.J. (2018) Comparison of Two Alfalfa Fertilizers Used for Walleye Fingerling Production in Lined Ponds. *Proceedings of the South Dakota Academy of Science*, **97**, 51-60.

[19] Zebro, L.R., Sass, G.G., Wuellner, M.R. and Koupal, K.D. (2025) Evaluating the Contributions and Economic Costs for Walleye Fry and Fingerling Stocking in a Large Midwestern Reservoir. *Fisheries Research*, **281**, Article 107207. https://doi.org/10.1016/j.fishres.2024.107207

[20] Johnson, J.A., Kelsey, K. and Summerfelt, R.C. (2021) Walleye Larviculture in Water Reuse Aquaculture Systems. In: Bruner, J.C. and DeBruyne, R.L., *Yellow Perch, Walleye, and Sauger*: *Aspects of Ecology, Management, and Culture*, Springer, 141-190. https://doi.org/10.1007/978-3-030-80678-1_6

[21] Ebeling, J.M. and Timmons, M.B. (2012) Recirculating Aquaculture Systems. In: Tidwell, J.H., *Aquaculture Production Systems*, World Aquaculture Society, 245-277.

[22] Balami, S. (2021) Recirculation Aquaculture Systems: Components, Advantages, and Drawbacks. *Tropical Agroecosystems*, **2**, 104-109. https://doi.org/10.26480/taec.02.2021.104.109

[23] Aneshansley, E.D., Timmons, M.B. and Colesante, R.I. (2001) Survival and Growth of Walleye *Stizostedion vitreum* Fry as Affected by Water Recirculation, Feed Transition Age, and Stocking Density. *Journal of the World Aquaculture Society*, **32**, 89-95. https://doi.org/10.1111/j.1749-7345.2001.tb00926.x

[24] Zarnoch, C.B., Schreibman, M.P., Colesante, R.T. and Timmons, M.B. (2010) Growth Performance of Walleye, *Sander vitreus*, in Recirculating Aquaculture Systems. *Journal of Applied Aquaculture*, **22**, 285-296.

https://doi.org/10.1080/10454431003736532

[25] Johnson, J.A. and Summerfelt, R.C. (2015) Intensive Culture Methods of Walleye during Ongrowing. In: Kestemont, P., Dabrowski, K. and Summerfelt, R.C., *Biology and Culture of Percid Fishes*, Springer, 437-468. https://doi.org/10.1007/978-94-017-7227-3_17

[26] Davidson, J., Summerfelt, R., Barrows, F., Gottsacker, B., Good, C., Fischer, G., *et al.* (2016) Walleye *Sander vitreus* Performance, Water Quality, and Waste Production in Replicated Recirculation Aquaculture Systems When Feeding a Low Phosphorus Diet without Fishmeal versus a Traditional Fishmeal-Based Diet. *Aquacultural Engineering*, **75**, 1-13. https://doi.org/10.1016/j.aquaeng.2016.09.005

[27] Marchant, A.S., Miller, B.H., Gallinat, G., Treft, C., Voorhees, J.M. and Barnes, M.E. (2026) Recirculating Aquaculture System-Reared Juvenile Walleye Survived and Grew after Stocking in Owen Dam, South Dakota, USA. *Global Journal of Fisheries Science*, **8**, 46-53. https://doi.org/10.31248/gjfs2026.104

[28] South Dakota Department of Game, Fish and Parks (2023) Belvidere Lake Fisheries Survey Report, 2023 (Report No. 43151).

[29] Maunder, M.N., Sibert, J.R., Fonteneau, A., Hampton, J., Kleiber, P. and Harley, S.J. (2006) Interpreting Catch per Unit Effort Data to Assess the Status of Individual Stocks and Communities. *ICES Journal of Marine Science*, **63**, 1373-1385. https://doi.org/10.1016/j.icesjms.2006.05.008

[30] Gabelhouse Jr, D.W. (1984) A Length-Categorization System to Assess Fish Stocks. *North American Journal of Fisheries Management*, **4**, 273-285. https://doi.org/10.1577/1548-8659(1984)4<273:alstaf>2.0.co;2

[31] Blackwell, B.G., Brown, M.L. and Willis, D.W. (2000) Relative Weight (Wr) Status and Current Use in Fisheries Assessment and Management. *Reviews in Fisheries Science*, **8**, 1-44. https://doi.org/10.1080/10641260091129161

[32] R Core Team (2013) R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. https://www.r-project.org/

[33] Fischer, J.R. and Quist, M.C. (2014) Gear and Seasonal Bias Associated with Abundance and Size Structure Estimates for Lentic Freshwater Fishes. *Journal of Fish and Wildlife Management*, **5**, 394-412. https://doi.org/10.3996/082013-jfwm-054

[34] Miller, B.T., Schoenebeck, C.W. and Koupal, K.D. (2018) Gear- and Season-Specific Catch Rates of Age-0 Walleyes and White Bass: Standard Sampling Recommendations for Great Plains Reservoirs. *North American Journal of Fisheries Management*, **38**, 903-910. https://doi.org/10.1002/nafm.10189

[35] Newcomb, B.A. (2016) Harlan Reservoir 2016 Fish Population Survey Summary. Nebraska Game and Parks Commission, Lincoln.

[36] Minnesota Department of Natural Resources (2017) Manual of Instructions for Lake Survey. Minnesota Department of Natural Resources Special Publication No. 180.

[37] Ward, M.C., Willis, D.W., Herwig, B.R., Chipps, S.R., Parsons, B.G., Reed, J.R., *et al.* (2008) Consumption Estimates of Walleye Stocked as Fry to Suppress Fathead Minnow Populations in West-Central Minnesota Wetlands. *Ecology of Freshwater Fish*, **17**, 59-70. https://doi.org/10.1111/j.1600-0633.2007.00257.x

[38] Isermann, D.A. and Parsons, B.G. (2011) Harvest Regulations and Sampling. In: Barton, B.A., *Biology, Management, and Culture of Walleye and Sauger*, American Fisheries Society, 403-422.

[39] Uphoff, C.S., Schoenebeck, C.W., Hoback, W.W., Koupal, K.D. and Pope, K.L. (2013) Degree-Day Accumulation Influences Annual Variability in Growth of Age-0 Wall-

eye. *Fisheries Research*, **147**, 394-398. https://doi.org/10.1016/j.fishres.2013.05.010

[40] DeBoer, J.A. and Pope, K.L. (2015) Factors Influencing Recruitment of Walleye and White Bass to Three Distinct Early Ontogenetic Stages. *Ecology of Freshwater Fish*, **25**, 504-517. https://doi.org/10.1111/eff.12229

[41] Ward, M.J., Willis, D.W., Miller, B.H. and Chipps, S.R. (2007) Walleye Consumption and Long-Term Population Trends Following Gizzard Shad Introduction into a Western South Dakota Reservoir. *Journal of Freshwater Ecology*, **22**, 339-345. https://doi.org/10.1080/02705060.2007.9665056

[42] Gelwicks, G., Flammang, M., Meerbeek, J. and Bowler, M. (2019) Iowa Department of Natural Resources Walleye Management Plan. Iowa Department of Natural Resources.

[43] Porath, M.T. and Peters, E.J. (1997) Use of Walleye Relative Weights (Wr) to Assess Prey Availability. *North American Journal of Fisheries Management*, **17**, 628-637. https://doi.org/10.1577/1548-8675(1997)017<0628:uowrww>2.3.co;2

[44] Fayram, A.H., Hansen, M.J. and Nate, N.A. (2005) Determining Optimal Stocking Rates Using a Stock-Recruitment Model: An Example Using Walleye in Northern Wisconsin. *North American Journal of Fisheries Management*, **25**, 1215-1225. https://doi.org/10.1577/m04-184.1

[45] Kampa, J.M. and Hatzenbeler, G.R. (2009) Survival and Growth of Walleye Fingerlings Stocked at Two Sizes in 24 Wisconsin Lakes. *North American Journal of Fisheries Management*, **29**, 996-1000. https://doi.org/10.1577/m08-163.1

[46] Lawson, Z.J., Latzka, A.W. and Eslinger, L. (2022) Stocking Practices and Lake Characteristics Influence Probability of Stocked Walleye Survival in Wisconsin's Ceded Territory Lakes. *North American Journal of Fisheries Management*, **42**, 523-534. https://doi.org/10.1002/nafm.10721

[47] Fox, M.G. and Flowers, D.D. (1990) Effect of Fish Density on Growth, Survival, and Food Consumption by Juvenile Walleyes in Rearing Ponds. *Transactions of the American Fisheries Society*, **119**, 112-121. https://doi.org/10.1577/1548-8659(1990)119<0112:eofdog>2.3.co;2

[48] Bohlin, T., Sundström, L.F., Johnsson, J.I., Höjesjö, J. and Pettersson, J. (2002) Density-Dependent Growth in Brown Trout: Effects of Introducing Wild and Hatchery Fish. *Journal of Animal Ecology*, **71**, 683-692. https://doi.org/10.1046/j.1365-2656.2002.00631.x

[49] Hansen, M.J., Bozek, M.A., Newby, J.R., Newman, S.P. and Staggs, M.D. (1998) Factors Affecting Recruitment of Walleyes in Escanaba Lake, Wisconsin, 1958-1996. *North American Journal of Fisheries Management*, **18**, 764-774. https://doi.org/10.1577/1548-8675(1998)018<0764:farowi>2.0.co;2

[50] Welker, B.D. (1962) Summer Food Habits of Yellow Bass and Black Bullheads in Clear Lake. *Proceedings of the Iowa Academy of Science*, **69**, 286-295.

[51] Brown, M.L., Willis, D.W. and Blackwell, B.G. (1999) Physicochemical and Biological Influences on Black Bullhead Populations in Eastern South Dakota Glacial Lakes. *Journal of Freshwater Ecology*, **14**, 47-60. https://doi.org/10.1080/02705060.1999.9663654

[52] Sikora, L.W., VanDeHey, J.A., Sass, G.G., Matzke, G. and Preul, M. (2021) Fish Community Changes Associated with Bullhead Removals in Four Northern Wisconsin Lakes. *North American Journal of Fisheries Management*, **41**, S71-S81. https://doi.org/10.1002/nafm.10594

[53] Fayram, A.H., Hansen, M.J. and Ehlinger, T.J. (2005) Interactions between Walleyes

and Four Fish Species with Implications for Walleye Stocking. *North American Journal of Fisheries Management*, **25**, 1321-1330. https://doi.org/10.1577/m04-203.1

[54] Freedman, J.A., Hoxmeier, R.J.H., Einfalt, L.M., Brooks, R.C. and Wahl, D.H. (2012) Largemouth Bass Predation Effect on Stocked Walleye Survival in Illinois Impoundments. *North American Journal of Fisheries Management*, **32**, 1039-1045. https://doi.org/10.1080/02755947.2012.716014

[55] Einfalt, L.M., Parkos III, J.J. and Wahl, D.H. (2015) Effect of Predator Size and Prey Characteristics on Piscivory of Juvenile Largemouth Bass. *Transactions of the American Fisheries Society*, **144**, 682-692. https://doi.org/10.1080/00028487.2015.1027002

[56] Davis, R.P. and Isermann, D.A. (2024) Assessing Factors Related to Walleye Stocking Success in the Midwestern United States. *North American Journal of Fisheries Management*, **44**, 1008-1024. https://doi.org/10.1002/nafm.11030

[57] Kelling, C.J. (2014) Largemouth Bass in Wisconsin: Dietary Interactions with Walleyes and Factors Regulating First-Year Growth and Diet. PhD Dissertation, University of Wisconsin-Stevens Point.

[58] Lawler, G.H. (1965) The Food of the Pike, *Esox lucius*, in Heming Lake, Manitoba. *Journal of the Fisheries Research Board of Canada*, **22**, 1357-1377. https://doi.org/10.1139/f65-120

[59] Margenau, T.L., Rasmussen, P.W. and Kampa, J.M. (1998) Factors Affecting Growth of Northern Pike in Small Northern Wisconsin Lakes. *North American Journal of Fisheries Management*, **18**, 625-639. https://doi.org/10.1577/1548-8675(1998)018<0625:fagonp>2.0.co;2

[60] Galarowicz, T.L. and Wahl, D.H. (2003) Differences in Growth, Consumption, and Metabolism among Walleyes from Different Latitudes. *Transactions of the American Fisheries Society*, **132**, 425-437. https://doi.org/10.1577/1548-8659(2003)132<0425:digcam>2.0.co;2

[61] Quist, M.C., Guy, C.S., Schultz, R.D. and Stephen, J.L. (2003) Latitudinal Comparisons of Walleye Growth in North America and Factors Influencing Growth of Walleyes in Kansas Reservoirs. *North American Journal of Fisheries Management*, **23**, 677-692. https://doi.org/10.1577/m02-050

[62] Waterhouse, M.D., Sloss, B.L. and Isermann, D.A. (2014) Relationships among Walleye Population Characteristics and Genetic Diversity in Northern Wisconsin Lakes. *Transactions of the American Fisheries Society*, **143**, 744-756. https://doi.org/10.1080/00028487.2014.880742

[63] Rogers, M.W., Hansen, M.J. and Beard Jr, T.D. (2005) Relationships between Recapture Rates from Different Gears for Estimating Walleye Abundance in Northern Wisconsin Lakes. *North American Journal of Fisheries Management*, **25**, 195-202. https://doi.org/10.1577/m03-171.1

[64] Wang, H.Y., Cook, H.A., Einhouse, D.W., Fielder, D.G., Kayle, K.A., Rudstam, L.G., *et al*. (2009) Maturation Schedules of Walleye Populations in the Great Lakes Region: Comparison of Maturation Indices and Evaluation of Sampling-Induced Biases. *North American Journal of Fisheries Management*, **29**, 1540-1554. https://doi.org/10.1577/m08-156.1