RADFORD, K. W., R. T. ORR, AND C. L. HUBBS.
1965. Reestablishment of the northern elephant seal (*Mirounga angustirostris*) off Central California. Proc. Calif. Acad. Sci. 31:601-612.
REITER, J., N. L. STINSON, AND B. J. LE BOEUF.
1978. Northern elephant seal development: The transition from weaning to nutritional dependance. Behav. Ecol. Sociobiol. 3:337-367.
RETT, E. Z.
1952. The northern elephant seal on San Miguel Island, California. J. Mammal. 33:109.
RICE, D. W., K. W. KENYON, AND L. B. LLUCH.
1965. Pinniped populations at Islas Guadalupe, San Benitos, and Cedros, Baja California, in 1965. Trans. San Diego Soc. Nat. Hist. 14:73-84.

GEORGE A. ANTONELIS, JR.

National Marine Mammal Laboratory
National Marine Fisheries Service, NOAA
7600 Sand Point Way NE.
Seattle, WA 98115

STEPHEN LEATHERWOOD

Hubbs-Sea World Research Institute
1700 South Shores Road
San Diego, CA 92109

DANIEL K. ODELL

University of Miami Rosenstiel School of
Marine and Atmospheric Science
4600 Rickenbacker Causeway
Miami, FL 33149

GROWTH CHARACTERISTICS OF YOUNG-OF-THE-YEAR WALLEYE, *STIZOSTEDION VITREUM VITREUM*, IN JOHN DAY RESERVOIR ON THE COLUMBIA RIVER, 1979

The walleye, *Stizostedion vitreum vitreum*, is becoming increasingly abundant in many of the large reservoirs of the Columbia River (Durbin[1]). Although the origin of this species in the Columbia River system is not entirely clear, Durbin (footnote 1) reported that walleye was introduced into the upper Clark Fork River, Idaho (a tributary of the Columbia River drainage), in the late 1940's (Figure 1). The large impoundments of the Columbia River, with turbid water conditions occurring through most of the spring and early summer, are providing walleye with suitable habitat. Scott and Crossman (1973) reported that walleye, throughout its range, reaches its greatest abundance in large turbid lakes and slow moving rivers.

[1]Durbin, K. 1977. News column. Oreg. Dep. Fish Wildl., Portland.

The increase in walleye population has generated considerable interest among sport fishermen throughout the Columbia River area (Harbour 1980). Because of its value as a game fish, some envision a significant new fishery similar to the historic fisheries of the Great Lakes region. Fisheries managers responsible for the survival of juvenile salmon, *Oncorhynchus* spp., and steelhead, *Salmo gairdneri*, are viewing the increase in walleye population with alarm, fearing that because of its highly piscivorous habits, it may become a significant salmonid predator.

Turbine intake gatewells at major dams in the Columbia River system are sampled each year to monitor the juvenile salmonid migrations (Raymond 1979). John Day Dam, a large hydroelectric project on the Columbia River, was completed in 1968 and created a reservoir (Lake Umatilla) 122 km long (Figure 1). Juvenile walleye was first observed in the gatewells at John Day Dam in 1973, and small numbers continued to be taken through 1978. In 1979, a large increase in the number of young-of-the-year walleye in the gatewells at John Day Dam was observed.

Information yielded by monitoring these young-of-the-year walleye in John Day Reservoir is presented in this paper. A comparison between growth of walleye in this reservoir and walleye populations from other areas is also given.

Methods

A large dip net, similar to that described by Bentley and Raymond (1968), was used to collect juvenile walleye from the turbine intake gatewells at John Day Dam. Young walleye were captured incidentally to the juvenile salmonid monitoring operation at the dam. A sample consisted of a 24-h composite catch removed daily from the gatewell via the dip net. Sampling extended from 1 March through 18 December 1979. All fish taken were measured for total length (TL) to the nearest millimeter and weighed to the nearest 0.1 g. Age was determined from scale samples taken in the manner described by Eschmeyer (1950). Scales were removed and examined from all specimens ≥100 mm TL to confirm that they were in fact young-of-the-year fish.

Results and Discussion

In 1979, the number of walleye entering the turbine intake gatewells at John Day Dam in-

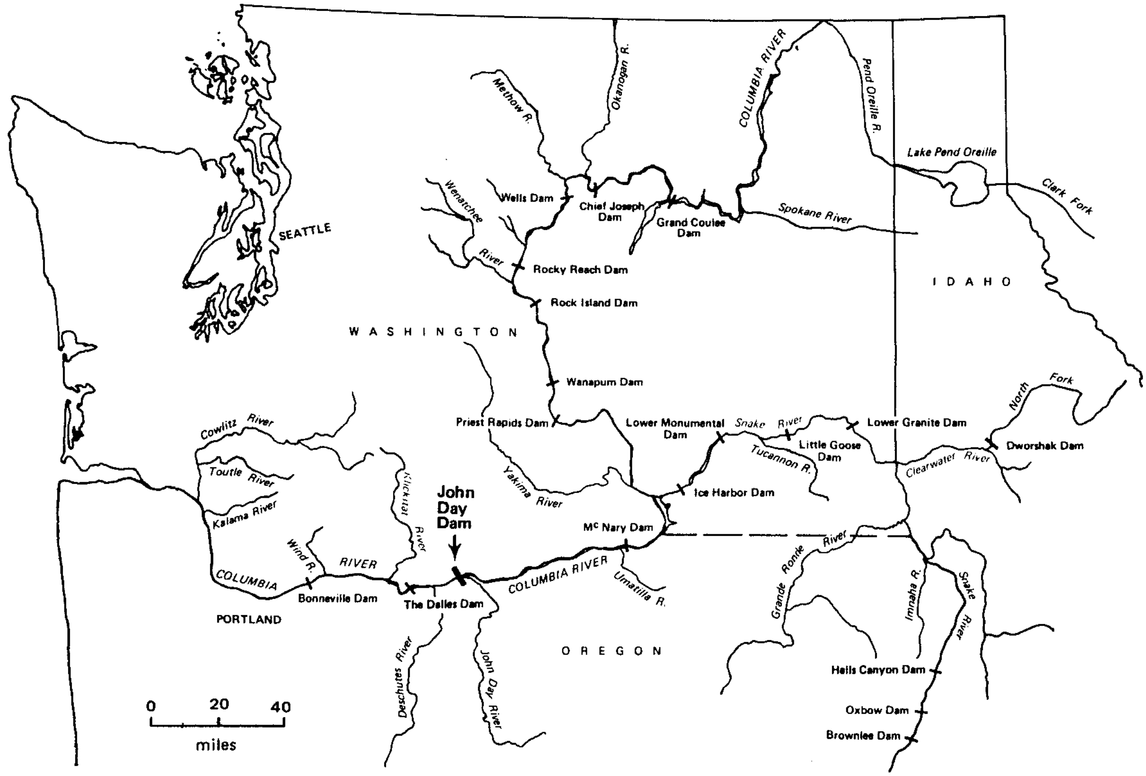

FIGURE 1.—Columbia River drainage.

creased significantly. From 1973 through 1978 fewer than 15 juvenile walleye were taken per year, whereas in 1979, several hundred were taken with similar fishing effort. Early in the season, an exact count was not possible because many of the small fish (<40 mm TL) fell through the mesh of the net [12.7 mm (½ in) stretched measure]. In 1979, young-of-the-year walleye was first taken in the gatewells in July and continued to be taken until sampling was suspended in mid-December.

Walleye normally spawns at water temperatures between 5.6° and 11.1° C (Scott and Crossman 1973). Hatching occurs in 21 d at water temperatures of 10°-12.8° C (Niemuth et al. 1972). Water temperatures at John Day Dam rose from 6.2° to 13.8° C during April and May 1979. At these temperatures one would expect hatching to extend through May, producing fry in the 40 mm class by early July.

Water temperatures in John Day Reservoir during the summer were near optimum for excellent growth of juvenile walleye. Huh et al. (1976) reported the growth of young-of-the-year walleye to be temperature dependent, with optimum growth occurring at 22° C. Water temperatures in John Day Reservoir fluctuated between 19° and 21° C for a 10-wk period extending from early July through September.

Total length of juvenile walleye increased an average of 11 mm/wk from July to October (Figure 2). This compares very favorably to the 13 mm/wk reported by Wolfert (1977) for walleye in Lake Erie. Mean length of young-of-the-year walleye in John Day Reservoir at the end of the 1979 growing season was 226 mm. Average weight by this time was 87.4 g (0.19 lb). Total length at the end of the growing season was only slightly less than reported for walleye in Lake Erie (Wolfert 1977) and considerably greater than lengths reported in Lake Gogebic, Mich. (Eschmeyer 1950); Red Lake, Minn. (Smith and Pycha 1960); and Oneida Lake, N.Y. (Forney 1966). Growth of young-of-the-year walleye in John Day Reservoir slowed steadily in November with declining water temperatures.

The presence of a larger number of walleye in the gatewell samples during 1979 indicates that the abundance of juvenile walleye appears to be increasing. The potential impact on salmonid

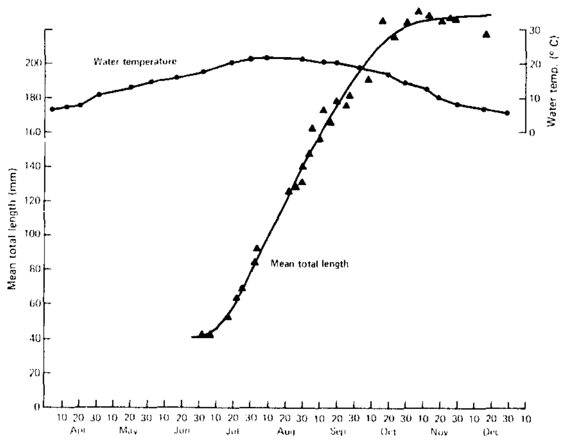

FIGURE 2.—First year growth of walleye and water temperature at John Day Dam on the Columbia river, 1979. Growth curve fitted by inspection (171 fish represented). Each point on the growth curve is the arithmetic mean of 3 to 12 specimens.

populations by the increasing abundance of walleye indicates a continuing need for monitoring walleye in this section of the Columbia River system.

Acknowledgments

My thanks to Dale A. Brege, G. R. Priegel, and J. Congdon for verifying aging; M. E. Urness for technical assistance; D. A. Faurot for reference assistance; C. W. Sims and R. C. Johnsen for manuscript review.

Literature Cited

BENTLEY, W. W., AND H. L. RAYMOND.
1968. Collection of juvenile salmonids from turbine intake gatewells of major dams in the Columbia River system. Trans. Am. Fish. Soc. 97:124-126.

ESCHMEYER, P. H.
1950. The life history of walleye, *Stizostedion vitreum vitreum* (Mitchill) in Michigan. Bull. Inst. Fish. Res., Mich. Dep. Conserv. 3, 99 p.

FORNEY, J. L.
1966. Factors affecting first-year growth of walleyes in Oneida Lake, New York. N.Y. Fish Game J. 13:146-167.

HARBOUR, D.
1980. Western walleye invasion. Sports Afield 183(3): 124-130.

HUH, H. T., H. E. CALBERT, AND D. A. STUIBER.
1976. Effect of temperature and light on growth of yellow perch and walleye using formulated food. Trans. Am. Fish. Soc. 105:254-258.

NIEMUTH, W., W. CHURCHILL, AND T. WIRTH.
1972. Walleye, its life history, ecology, and management. Wis. Dep. Nat. Resour. Publ. 227, 20 p.

RAYMOND, H. L.
1979. Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. Trans. Am. Fish. Soc. 108:505-529.

SCOTT, W. B., AND E. J. CROSSMAN.
1973. Freshwater fishes of Canada. Fish. Res. Board Can., Bull. 966 p.

SMITH, L. L., JR., AND R. L. PYCHA.
1960. First-year growth of the walleye, *Stizostedion vitreum vitreum* (Mitchill), and associated factors in the Red Lakes, Minnesota. Limnol. Oceanogr. 5:281-290.

WOLFERT, D. R.
1977. Age and growth of the walleye in Lake Erie, 1963-1968. Trans. Am. Fish. Soc. 106:569-577.

DEAN A. BREGE

Northwest and Alaska Fisheries Center Coastal Zone and Estuarine Studies Division
National Marine Fisheries Service, NOAA
2725 Montlake Boulevard East
Seattle, WA 98112

EFFECTS OF TEMPERATURE AND SALINITY ON EGG HATCHING AND LARVAL SURVIVAL OF RED DRUM, *SCIAENOPS OCELLATA*[1]

The red drum, *Sciaenops ocellata*, is a sciaenid fish distributed along the eastern coast of North America from Massachusetts to southern Florida and along the gulf coast at least as far south as Tampico, Mexico (Hildebrand and Schroeder 1928; Simmons and Breuer 1962). Spawning occurs in late summer through fall outside estuaries in nearshore coastal waters, and the young red drum is carried into the estuaries by tides and currents (Pearson 1929; Mansueti 1960). Late larvae and early juveniles have been collected in the shallow water of tidal flats and sea grass beds. The early planktonic stages, the eggs and yolk-sac larvae, have not been identified from field collections but have recently been described, based on specimens from laboratory-spawned red drum (Holt et al. 1981).

Temporal fluctuations in abundance of red drum result in annual variation in sport and commercial catches (Matlock and Weaver 1979). Variations in environmental factors such as temperature and salinity could affect egg incubation and larval survival, and ultimately year-class strength. Juveniles and adults are euryhaline and are found naturally in freshwater, in brackish

[1]University of Texas Marine Science Institute Contribution No. 466.