# North Central Region 1990

## Salmonid Egg and Fingerling Purchases, Production, and Sales

by

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# Introduction

The North Central Region (NCR) of the U.S. aquaculture industry is growing and changing. Salmonids (salmon and trout) are among the principal fishes currently cultured in the NCR — the rainbow trout being the number one species produced commercially (NCA-23 1987). Though it is relatively small when compared to the Idaho trout industry, trout farming in the NCR adds significantly to agriculture diversity in the region and to the total national production of trout (NCA-23 1987; WASC 1988).

To better assist the salmon and trout producers within the NCR, the North Central Regional Aquaculture Center (NCRAC) has established a Salmonid Research Work Group to initiate new research that will benefit the aquaculture industry. The first Work Group meeting decided that a survey of the trout and salmon producers in the 12-state NCR be initiated to document the volume of production of trout and salmon eggs and fingerlings.

This study was designed to: (1) determine existing salmonid production by species and strains, and in what states they are being produced; (2) provide a description of salmonid egg purchase, source, and type; (3) summarize salmonid egg production, point of sale, and type; (4) determine salmonid fingerling purchase and source; and (5) describe salmonid fingerling production and point of sale.

There is growing concern about the importation of eggs and fish into the NCR from other regions because of the potential for bringing new pathogens into the area. Thus, it is important to determine if the NCR could become self-sufficient in salmonid egg and fingerling production in the event that importation from other regions becomes more strongly regulated.

It also is important to document the number of aquaculture producers who are utilizing monosex and/or polyploid salmonids in their production facilities. The NCRAC Salmonid Research Work Group has initiated research in the development of such stocks for use in the region. Production by aquaculture producers in Europe of hybrids, sterile fish, or monosex populations through chromosome set manipulation has been shown to be highly profitable (Bye and Lincoln 1986). Such applications could also prove to be profitable in the NCR.

# Methods

Aquaculture producers who were licensed to grow or produce salmonids (trout and/or salmon) in the NCR of the United States were identified by NCRAC, state fisheries management agencies, state aquaculture extension specialists, and aquaculture associations. It was determined that there were 258 aquaculture producers who were licensed to grow or produce salmonids in the twelve states of Michigan, Ohio, Indiana, Wisconsin, Illinois, Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Kansas, and Missouri.

In early January 1991 these 258 aquaculture producers were each mailed a 1990 Salmonid Egg and Fingerling Production Survey and a

cover letter that asked them to complete the survey and return it. To assure that they would not receive future mailings requesting participation in the survey, a stamped return postcard also was provided so they could indicate they had completed the survey and whether or not they wanted a copy of the results when completed.

Two weeks after mailing the survey a reminder letter was mailed to the aquaculture producers who had not yet returned their postcards. At four weeks after the original mailing, a final reminder notice was sent to those who had not returned the survey. This letter also included another survey and a stamped return envelope.

The survey collected information on: (1) fish production by state, species, strains, and years in business; (2) egg purchase by species, strains, number, states where purchased, fish health inspection, and egg type; (3) egg production by species, strains, number, use, point of sale, fish health inspection, and egg type; (4) fingerling purchase by species, strains, number, states where purchased, and fish health inspection; and (5) fingerling production by species, strains, number, use, states where sold, and fish health inspection.

Fifty-nine percent of the 258 surveys that were distributed were returned. Of these aquaculture producers 53 percent grew or produced salmonids in 1990.

The salmonid strains were found to be either registered or unregistered and determination was made by using the Trout Strain Registry (Kincaid 1981).

To maintain anonymity, only the locations of purchase and sale of salmonid eggs and fingerlings were disclosed. Location of individuals making purchase or individuals making sales was not disclosed.

# Results

### States Where Salmonids Are Produced and Years in Production

Wisconsin and Michigan accounted for over half of the aquaculture producers who produced salmonids in the NCR in 1990 (Table 1). Another one-third of the producers were found in Minnesota, Nebraska, and Ohio. The number of years that salmonid aquaculture producers have been in business ranged from one to fifty years, with the average being 15.6 years.

**Table 1. States in NCR where salmonids are produced.**

| State | Percent of Producers |
|---|---|
| WI | 28.6 |
| MI | 27.3 |
| MN | 11.7 |
| NE | 10.4 |
| OH | 9.1 |
| MO | 6.5 |
| SD | 3.9 |
| IA | 1.3 |
| CO | 1.3 |

### Salmonid Species and Strains Produced

The Kamloop strain of rainbow trout was used by over half of the producers using registered strains followed by the Donaldson strain (Table 2). A variety of unregistered strains were used by others, with over half of unknown origin.

One producer each used the Temiscamie and Assinica strains of brook trout with the majority using unregistered strains or of unknown origin (Table 3).

**Table 2. Rainbow trout strains produced.**

| Strains | Number of Producers |
|---|---|
| *(Registered)* | |
| Kamloop | 28 |
| Donaldson* | 10 |
| Shasta | 4 |
| Golden | 2 |
| Steelhead | 2 |
| Native | 1 |
| Wigwam | 1 |
| **Total** | **48** |
| *(Unregistered)* | |
| Unknown | 17 |
| Kamloop x Seven Pines | 2 |
| Kamloop (mixed) | 1 |
| Kamloop (lake) | 1 |
| Kamloop x Black Canyon | 1 |
| Kamloop x Steelhead x Crystal Lake | 1 |
| Kamloop x Steelhead | 1 |
| Missouri | 1 |
| Muskegon River | 1 |
| Rocky Mountain | 1 |
| Wyoming | 1 |
| Snake River | 1 |
| Domestic | 1 |
| Natural | 1 |
| Own Stock | 1 |
| **Total** | **32** |
| **GRAND TOTAL** | **80** |

*Includes one Finnish and one Swedish source

**Table 3. Brook trout strains produced.**

| Strains | Number of Producers |
|---|---|
| *(Registered)* | |
| Temiscamie | 1 |
| Assinica | 1 |
| **Total** | **2** |
| *(Unregistered)* | |
| Unknown | 14 |
| Eastern | 4 |
| Eastern Hybrid | 3 |
| Jocko | 2 |
| Jocko x Assinica | 1 |
| Eastern x Assinica | 1 |
| Madison (Straight Run) | 1 |
| Canadian x Domestic | 1 |
| Domestic | 1 |
| Own Stock | 1 |
| Brook | 1 |
| Speckled Eastern | 1 |
| **Total** | **31** |
| **GRAND TOTAL** | **33** |

**Table 4. Brown trout strains produced.**

| Strains | Number of Producers |
|---|---|
| *(Registered)* | |
| Brown | 2 |
| Bitterroot | 2 |
| **Total** | **4** |
| *(Unregistered)* | |
| Unknown | 10 |
| German | 5 |
| Hiberve | 1 |
| Domestic | 1 |
| Own Stock | 1 |
| Seven Pines x Rock Creek | 1 |
| **Total** | **19** |
| **GRAND TOTAL** | **23** |

Two producers each used the Brown and Bitterroot registered strains of brown trout with the majority using unregistered strains or of unknown origin (Table 4). Other salmonid species produced in the NCR are shown in Table 5.

## Salmonid Egg Purchase

Of those producing salmonids in the NCR, 41 percent indicated that they purchased salmonid eggs in 1990. Sixty-seven percent of those purchasing salmonid eggs indicated that they needed a fish health inspection report to import them.

Sixty-four percent of the salmonid producers who purchased eggs indicated that they were familiar with eggs that have undergone chromosome set manipulation but never

**Table 5. Other salmonid species and strains produced. (Unregistered)**

| Species | Strains | Number of Producers |
|---|---|---|
| Tiger (Brown Trout x Brook Trout) | Unknown | 3 |
| Coho Salmon | Unknown | 3 |
| Coho Salmon | Wild | 2 |
| Chinook Salmon | Fall | 1 |
| Chinook Salmon | Great Lakes | 1 |
| Grayling | Unknown | 1 |
| Lake Trout | Unknown | 1 |
| **Total** | | **12** |

attempted to purchase any. Another 9 percent indicated that they were not familiar with this type of egg. Eighteen percent indicated that they attempted to purchase all female rainbow trout eggs and, of these, 83 percent found them available. Six percent of those purchasing salmonid eggs tried to purchase all female triploid rainbow trout eggs and none was successful finding them. Twelve percent attempted to purchase mixed sex triploid rainbow trout with half of these finding them available.

The majority of rainbow trout eggs purchased by aquaculture producers in the NCR were from registered strains, with slightly over half of all the eggs purchased being of the Kamloop strain purchased from Washington (Table 6). In fact, 92 percent of the rainbow trout eggs are coming from outside the NCR, and the majority of these are coming from the western United States.

Only one aquaculture producer within the region purchased a registered brook trout egg strain, the others purchasing unregistered strains (Table 7). Sixty-five percent of the brook trout eggs were purchased from Michigan with the others coming from Massachusetts.

All the brown trout eggs purchased were unregistered strains with 85 percent coming from Wyoming (Table 8) . The remainder of the brown trout eggs were purchased from Michigan.
Salmon eggs pur-

**Table 6. Rainbow trout egg strains purchased.**

| Strains | Number of Producers | Number of Eggs | States/Countries Where Purchased |
|---|---|---|---|
| *(Registered)* | | | |
| Kamloop | 15 | 2,583,000 | WA |
| Kamloop | 1 | 30,000 | WI |
| Kamloop | 1 | 30,000 | MN |
| Donaldson | 3 | 120,000 | MI |
| Donaldson | 1 | 475,000 | CA |
| Donaldson (Finnish) | 1 | 200,000 | WA |
| Donaldson (Swedish) | 1 | 200,000 | Sweden |
| Steelhead | 1 | 200,000 | MI |
| Shasta | 1 | 250,000 | WA |
| Shasta | 1 | 50,000 | CA |
| **Total** | **26** | **4,138,000** | |
| *(Unregistered)* | | | |
| Unknown | 2 | 75,000 | WA |
| Unknown | 1 | 300,000 | Unreported |
| Unknown | 1 | 75,000 | ID |
| Unknown | 1 | 60,000 | CA |
| Black Canyon | 1 | 90,000 | UT |
| Rocky Mountain | 1 | 75,000 | WA |
| Wyoming | 1 | 50,000 | WY |
| Domestic | 1 | 50,000 | WA |
| **Total** | **9** | **775,000** | |
| **GRAND TOTAL** | **35** | **4,913,000** | |

**Table 7. Brook trout egg strains purchased.**

| Strains | Number of Producers | Number of Eggs | States Where Purchased |
|---|---|---|---|
| *(Registered)* | | | |
| Assinica | 1 | 20,000 | MI |
| *(Unregistered)* | | | |
| Natural | 1 | 20,000 | MA |
| Domestic | 1 | 10,000 | MI |
| Jocko | 1 | 7,000 | MI |
| **Total** | **3** | **37,000** | |
| **GRAND TOTAL** | **4** | **57,000** | |

**Table 8. Brown trout egg strains purchased. (Unregistered)**

| Strains | Number of Producers | Number of Eggs | States Where Purchased |
|---|---|---|---|
| German | 2 | 25,000 | MI |
| Unknown | 1 | 200,000 | WY |
| Domestic | 1 | 10,000 | MI |
| **Total** | **4** | **235,000** | |

chased by aquaculture producers within the region were unregistered strains. Sixty-six percent of them were chinook salmon eggs from Michigan and Minnesota (Table 9). The other eggs purchased were coho and chinook salmon from outside the NCR.

A summary (by species) of salmonid eggs purchased by producers in the region is given in Table 10. Rainbow trout accounted for 67 percent of all salmonid eggs purchased. Of these rainbow trout egg purchases 92 percent were from outside the NCR. The next largest was salmon, which accounted for 29 percent of the total egg purchases. Only 34 percent of the salmon eggs came from outside the region.

### Salmonid Egg Production

Forty percent of those producing salmonids in the NCR in 1990 produced their own eggs. Of those producing their own salmonid eggs 66 percent indicated that they produced them for their own use while 34 percent used some of the eggs themselves and sold the rest.

**Table 9. Salmon egg species and strains purchased. (Unregistered)**

| Species | Strains | Number of Producers | Number of Eggs | States/Country Where Purchased |
|---|---|---|---|---|
| Coho | Unknown | 2 | 518,750 | WA |
| Chinook | Unknown | 1 | 1,400,000 | MI, MN |
| Chinook | Chile | 1 | 200,000 | Chile |
| **Total** | | **4** | **2,118,750** | |

Fifty percent of the salmonid producers in the region who produced eggs indicated they were familiar with chromosome set manipulation of eggs, but never attempted to produce them. Another 19 percent said they were not familiar with these types of eggs. Twelve percent of those producing eggs in the region stated they have produced either all female or mixed sex triploid rainbow trout eggs. One salmonid producer in the region declared that he had produced tetraploid eggs but did not say which species of salmonid.

**Table 10. Salmonid eggs purchased in and out of the NCR.**

| Species | Number Purchased In Region | Number Purchased Out of Region | Total Number Purchased |
|---|---|---|---|
| Rainbow Trout | 380,000 | 4,533,000 | 4,913,000 |
| Brook Trout | 37,000 | 20,000 | 57,000 |
| Brown Trout | 35,000 | 200,000 | 235,000 |
| Salmon | 1,400,000 | 718,750 | 2,118,750 |
| **Total** | **1,852,000** | **5,471,750** | **7,323,750** |

Sixty-eight percent of the rainbow trout eggs produced in the NCR were registered strains, mainly Kamloop and Donaldson (Table 11). The other rainbow trout eggs produced in the region were a variety of unregistered strains.

The majority (91 percent) of the brook

**Table 11. Rainbow trout egg strains produced.**

| Strains | Producers | Number of Eggs |
|---|---|---|
| *(Registered)* | | |
| Kamloop | 8 | 3,271,000 |
| Donaldson | 2 | 1,230,000 |
| Shasta | 1 | 100,000 |
| **Total** | **11** | **4,601,000** |
| *(Unregistered)* | | |
| Unknown | 4 | 158,400 |
| Kamloop x Seven Pines | 2 | 1,050,000 |
| Kamloop x Crystal Lake | 1 | 150,000 |
| Missouri | 1 | 400,000 |
| Native | 1 | 120,000 |
| Muskegon River | 1 | 100,000 |
| Rocky Mountain | 1 | 85,000 |
| Straight Run | 1 | 60,000 |
| **Total** | **12** | **2,123,400** |
| **GRAND TOTAL** | **23** | **6,724,400** |

**Table 12. Brook trout egg strains produced.**

| Strains | Producers | Number of Eggs |
|---|---|---|
| *(Registered)* | | |
| Assinica | 2 | 130,000 |
| Temiscamie | 1 | 60,000 |
| **Total** | **3** | **190,000** |
| *(Unregistered)* | | |
| Unknown | 8 | 592,600 |
| Eastern | 3 | 270,000 |
| Eastern Hybrid | 2 | 250,000 |
| Jocko | 2 | 335,000 |
| Own | 1 | 400,000 |
| Runyan | 1 | 65,000 |
| Canadian x Domestic | 1 | 50,000 |
| **Total** | **18** | **1,962,600** |
| **GRAND TOTAL** | **21** | **2,152,600** |

trout eggs produced in the region were unregistered strains (Table 12). The remainder consisted of the Assinica and Temiscamie registered strains.

Seventy percent of the brown trout eggs produced in the NCR were unregistered strains (Table 13). The remainder consisted of the Bitterroot registered strain. A small number of tiger trout (brown x brook) eggs were produced in the region (Table 14).

A summary of salmonid egg

**Table 13. Brown trout egg strains produced.**

| Strains | Producers | Number of Eggs |
|---|---|---|
| *(Registered)* | | |
| Bitterroot | 1 | 300,000 |
| *(Unregistered)* | | |
| Unknown | 7 | 169,200 |
| Own | 1 | 350,000 |
| German | 1 | 185,000 |
| **Total** | **9** | **704,200** |
| **GRAND TOTAL** | **10** | **1,004,200** |

**Table 14. Tiger trout (brown x brook) eggs produced (Unregistered)**

| Strains | Number of Producers | Eggs |
|---|---|---|
| Unknown | 2 | 25,000 |
| Hiberve x Eastern | 1 | 13,000 |
| **Total** | **3** | **38,000** |

production by producers in the region is given in Table 15. Rainbow trout egg production accounted for 68 percent of all salmonid egg production by producers in the region. Brook and brown trout accounted for 32 percent of egg production.

**Table 15. Salmonid egg production in the North Central Region.**

| Species | Number | Percent |
|---|---|---|
| Rainbow Trout | 6,724,400 | 68 |
| Brook Trout | 2,152,600 | 22 |
| Brown Trout | 1,004,200 | 10 |
| Tiger Trout | 38,000 | <1 |
| **Total** | **9,919,200** | **100** |

### Salmonid Egg Sales

Thirty-four percent of those producing salmonid eggs in the NCR used the eggs both for sale and their own use. Of those exporting eggs for sale 54 percent said they needed a fish health inspection report.

Rainbow trout eggs sold by producers from the region were mainly registered strains (91 percent) with the majority being the Donaldson strain. Most of the rainbow trout eggs sold went either to Michigan or to the three eastern states of New York, Pennsylvania, and North Carolina (Table 16).

The brook trout eggs sold by producers from the NCR were all unregistered strains. Most of the brook trout egg sales went to Michigan, with the remainder going to three eastern states (Table 17).

The majority of brown trout eggs sold by producers from the region were the Bitterroot registered strain. Sale of brown trout eggs were to Michigan and Wisconsin and to two eastern states outside the region (Table 18). A small number of tiger trout (brown x brook) eggs were sold in the region (Table 19).

**Table 16. Rainbow trout egg strains sold.**

| Strains | Number of Producers | Number of Eggs | States Where Sold |
|---|---|---|---|
| *(Registered)* | | | |
| Kamloop | 2 | 60,055 | MI |
| Donaldson | 1 | 600,000 | NY,PA,NC,MI |
| Donaldson | 1 | 50,000 | MI |
| **Total** | **4** | **710,055** | |
| *(Unregistered)* | | | |
| Rocky Mountain | 1 | 40,000 | MI |
| Kamloop x Crystal Lake | 1 | 30,000 | WI |
| **Total** | **2** | **70,000** | |
| **GRAND TOTAL** | **6** | **780,055** | |

A summary of salmonid egg sales by producers in the region is given in Table 20. Rainbow trout accounted for 63 percent of all salmonid egg sales and more than half of these sales were made to areas outside the NCR. Brook trout accounted for 29 percent of salmonid egg sales with only 21 percent of these sold outside the region.

### Salmonid Fingerling Purchase

Thirty-five percent of the salmonid producers in the NCR indicated they purchased salmonid fingerlings in 1990. Fifteen percent of those purchasing salmonid fingerlings said they needed a fish health inspection report to import them.

Half of the rainbow trout fingerlings purchased

**Table 17. Brook trout egg strains sold. (Unregistered)**

| Strains | Number of Producers | Number of Eggs | States Where Sold |
|---|---|---|---|
| Eastern Mix x Temiscamie | 1 | 160,000 | MI |
| Eastern | 1 | 100,000 | MI |
| Jocko | 1 | 100,000 | PA,NY,NH,MI |
| **Total** | **3** | **360,000** | |

**Table 18. Brown trout egg strains sold.**

| Strains | Number of Producers | Number of Eggs | States Where Sold |
|---|---|---|---|
| *(Registered)* | | | |
| Bitterroot | 1 | 100,000 | WI,PA,NC,MI |
| *(Unregistered)* | | | |
| German | 1 | 60 | MI |
| **GRAND TOTAL** | **2** | **100,060** | |

**Table 19. Tiger trout (brown x brook) eggs sold. (Unregistered)**

| Strains | Number of Producers | Number of Eggs | States Where Sold |
|---|---|---|---|
| Cross | 1 | 5,000 | WI |

**Table 20. Salmonid egg sales in and out of the North Central Region.**

| Species | Number Sold in Region | Number Sold Out of Region | Total Number Sold |
|---|---|---|---|
| Rainbow Trout | 330,055 | 450,000 | 780,055 |
| Brook Trout | 285,000 | 75,000 | 360,000 |
| Brown Trout | 50,060 | 50,000 | 100,060 |
| Tiger Trout | 5,000 | 0 | 5,000 |
| **Total** | **670,115** | **575,000** | **1,245,115** |

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by producers in the region were registered strains, mainly Kamloop (Table 21). Over half of the rainbow trout fingerlings were purchased from Michigan and Wisconsin. Less than 10 percent of the rainbow trout fingerlings were purchased from outside the region — Pennsylvania, Tennessee, and Wyoming.

Brook and brown trout fingerlings were purchased from within the region from Minnesota, Wisconsin, and Michigan (Tables 22 and 23). Some coho salmon fingerlings were also purchased from Nebraska (Table 24).

A summary of salmonid fingerlings purchased by producers in the region is given in Table 25. Rainbow trout fingerling purchases accounted for 77 percent of all salmonid fingerlings purchased by producers in the region. Of these rainbow trout fingerlings 93 percent were purchased from within the NCR. Brook trout, brown trout, and

**Table 21. Rainbow trout fingerling strains purchased.**

| Strains | Number of Producers | Number of Fingerlings | States Where Purchased |
|---|---|---|---|
| *(Registered)* | | | |
| Kamloop | 5 | 145,000 | MI |
| Kamloop | 1 | 30,000 | MI,TN |
| Kamloop | 1 | 10,000 | NE,SD |
| Kamloop | 1 | 8,000 | WI |
| Kamloop | 1 | 100 | MN |
| Wigwam | 1 | 15,000 | WY |
| Shasta | 1 | 12,000 | WI |
| Donaldson | 2 | 6,000 | MI |
| Donaldson | 1 | 5,000 | NE |
| **Total** | **14** | **231,100** | |
| *(Unregistered)* | | | |
| Unknown | 5 | 116,200 | WI |
| Unknown | 1 | 2,000 | PA |
| Unknown | 1 | 300 | SD |
| Trout Lodge (Washington) | 1 | 60,000 | NE |
| Emerson | 1 | 56,000 | MO |
| **Total** | **9** | **234,500** | |
| **GRAND TOTAL** | **23** | **465,600** | |

**Table 22. Brook trout fingerling strains purchased. (Unregistered)**

| Strains | Number of Producers | Number of Fingerlings | States Where Purchased |
|---|---|---|---|
| Eastern | 1 | 30,000 | MN |
| Jocko | 1 | 5,000 | MI |
| Unknown | 1 | 1,000 | WI |
| **Total** | **3** | **36,000** | |

**Table 23. Brown trout fingerling strains purchased. (Unregistered)**

| Strains | Number of Producers | Number of Fingerlings | States Where Purchased |
|---|---|---|---|
| Unknown | 1 | 40,000 | WI |
| Unknown | 1 | 30,000 | MN |
| German | 1 | 5,000 | MI |
| **Total** | **3** | **75,000** | |

salmon fingerlings accounted for the remaining 23 percent of fingerlings purchased, and all were acquired within the region.

### Salmonid Fingerling Production

Sixty-five percent of those producing salmonids in the NCR in 1990 produced their own fingerlings. Of these, 25 percent said they produced them for their own use, 17 percent produced fingerlings for the sole purpose of selling them, and 58 percent produced them for both their own use and to sell them.

**Table 24. Coho salmon fingerling strains purchased. (Unregistered)**

| Strains | Number of Producers | Number of Fingerlings | States Where Purchased |
|---|---|---|---|
| Unknown | 1 | 20,000 | NE |
| Wild | 1 | 5,000 | NE |
| **Total** | **2** | **25,000** | |

**Table 25. Salmonid fingerlings purchased in and out of the North Central Region.**

| Species | Number Purchased in Region | Number Purchased Out of Region | Total Number Purchased |
|---|---|---|---|
| Rainbow Trout | 433,600 | 32,000 | 465,600 |
| Brook Trout | 36,000 | 0 | 36,000 |
| Brown Trout | 75,000 | 0 | 75,000 |
| Salmon | 25,000 | 0 | 25,000 |
| **Total** | **569,600** | **32,000** | **601,600** |

Sixty-five percent of the rainbow trout fingerlings produced in the NCR were registered strains, mainly Kamloop and Donaldson (Table 26). The other 35 percent of the rainbow trout fingerlings produced were unregistered strains.

The majority (91 percent) of the brook trout fingerlings produced in the region were unregistered strains (Table 27). The remainder consisted of the registered strain Assinica.

Eighty-six percent of the brown trout fingerlings produced in the NCR were unregistered strains (Table 28). The remainder consisted of the Bitterroot registered strain. A small number

**Table 26. Rainbow trout fingerling strains produced.**

| Strains | Number of Producers | Number of Fingerlings |
|---|---|---|
| (Registered) | | |
| Kamloop | 20 | 2,409,500 |
| Donaldson | 6 | 707,500 |
| Donaldson (Finnish) | 1 | 125,000 |
| Donaldson (Swedish) | 1 | 150,000 |
| Shasta | 3 | 250,000 |
| Steelhead | 1 | 20,000 |
| Wigwam | 1 | 15,000 |
| **Total** | **33** | **3,677,000** |
| (Unregistered) | | |
| Unknown | 11 | 504,500 |
| Kamloop x Own | 2 | 650,000 |
| Native | 1 | 400,000 |
| Missouri | 1 | 215,000 |
| Rocky Mountain | 1 | 65,000 |
| Muskegon River | 1 | 60,000 |
| Straight Run | 1 | 60,000 |
| Domestic | 1 | 40,000 |
| Wyoming | 1 | 22,000 |
| **Total** | **20** | **2,016,500** |
| **GRAND TOTAL** | **53** | **5,693,500** |

**Table 27. Brook trout fingerling strains produced.**

| Strains | Number of Producers | Number of Fingerlings |
|---|---|---|
| (Registered) | | |
| Assinica | 2 | 95,000 |
| (Unregistered) | | |
| Unknown | 7 | 349,500 |
| Eastern | 5 | 348,000 |
| Jocko | 3 | 152,000 |
| Runyan x Eastern | 1 | 90,000 |
| Domestic | 1 | 10,000 |
| **Total** | **17** | **949,500** |
| **GRAND TOTAL** | **19** | **1,044,500** |

**Table 28. Brown trout fingerling strains produced.**

| Strains | Number of Producers | Number of Fingerlings |
|---|---|---|
| *(Registered*) | | |
| Bitterroot | 1 | 140,000 |
| *(Unregistered)* | | |
| Unknown | 9 | 292,600 |
| German | 3 | 50,000 |
| Own | 2 | 525,000 |
| Domestic | 1 | 10,000 |
| **Total** | **15** | **877,600** |
| **GRAND TOTAL** | **16** | **1,017,600** |

of tiger trout (brown x brook) fingerlings were produced in the region (Table 29).

**Table 29. Tiger trout (brown X brook) fingerlings produced (Unregistered)**

| Strains | Number of Producers | Number of Fingerlings |
|---|---|---|
| Unknown | 1 | 15,000 |
| Cross | 1 | 2,000 |
| **Total** | **2** | **17,000** |

Salmon fingerling production in the region included both coho and chinook salmon (Table 30). Most of the salmon fingerlings produced were chinook.

A summary of salmonid fingerling production by producers in the region is given in Table 31. Rainbow trout fingerling production accounted for 54 percent of all salmonid fingerling pro-duction, followed by salmon (26 percent), brook trout (10 percent), and brown trout (10 percent).

### Salmonid Fingerling Sales

Fifty-eight percent of those producing salmonid fingerlings in the NCR used the fingerlings both for sale and their own use, while

**Table 30. Salmon fingerling species and strains produced. (Unregistered)**

| Species | Strains | Number of Producers | Number of Fingerlings |
|---|---|---|---|
| Coho | Unknown | 1 | 400,000 |
| Chinook | Unknown | 2 | 2,300,000 |
| Chinook | Chile | 1 | 80,000 |
| **Total** | | **4** | **2,780,000** |

**Table 31. Salmonid fingerling production within the North Central Region.**

| Species | Number | Percent |
|---|---|---|
| Rainbow Trout | 5,693,500 | 54 |
| Brook Trout | 1,044,500 | 10 |
| Brown Trout | 1,017,600 | 10 |
| Tiger Trout | 17,000 | <1 |
| Salmon | 2,780,000 | 26 |
| **Total** | **10,552,600** | **100** |

**Table 32. Rainbow trout fingerling strains sold.**

| Strains | Number of Producers | Number of Fingerlings | States/Province Where Sold |
|---|---|---|---|
| *(Registered)* | | | |
| Donaldson | 3 | 90,000 | MI |
| Donaldson | 1 | 180,000 | MI,IN |
| Donaldson | 1 | 15,000 | MO |
| Donaldson | 1 | 3,000 | NE |
| Donaldson (Finnish) | 1 | 150,000 | NE |
| Donaldson (Swedish) | 1 | 150,000 | NE |
| Kamloop | 4 | 63,500 | MI |
| Kamloop | 3 | 365,000 | WI |
| Kamloop | 3 | 350,000 | OH |
| Kamloop | 1 | 325,000 | MI,OH |
| Kamloop | 1 | 35,000 | WI,IA |
| Kamloop | 1 | 10,000 | IL |
| Shasta | 1 | 75,000 | OH |
| Shasta | 1 | 40,000 | MI |
| Shasta | 1 | 19,200 | WI |
| Wigwam | 1 | 4,000 | NE |
| Wigwam | 1 | 2,000 | WY |
| **Total** | **26** | **1,876,700** | |
| *(Unregistered)* | | | |
| Unknown | 3 | 16,011 | WI |
| Kamloop x Own | 2 | 300,000 | WI |
| Missouri | 1 | 215,000 | MO |
| Black Canyon | 1 | 80,000 | SD,WY,MT, Saskatchewan |
| Rocky Mountain | 1 | 50,000 | MI |
| Wyoming | 1 | 22,000 | NE |
| Domestic | 1 | 5,000 | WI,MN |
| Straight Run | 1 | 700 | WI |
| **Total** | **11** | **688,711** | |
| **GRAND TOTAL** | **37** | **2,565,411** | |

17 percent produced fingerlings for the sole purpose of selling them. Of those exporting fingerlings for sale, 32 percent indicated that they needed a fish health inspection report.

Rainbow trout fingerlings sold by producers from the region were mostly registered strains (73 percent) with the majority being the Kamloop and Donaldson strains (Table 32). Most of the rainbow trout fingerlings were sold to states within the region. Less than 3 percent was sold to Wyoming, Montana, and the province of Saskatchewan.

**Table 33. Brook trout fingerling strains sold.**

| Strains | Number of Producers | Number of Fingerlings | States Where Sold |
|---|---|---|---|
| *(Registered)* | | | |
| Assinica | 1 | 40,000 | PA |
| Assinica | 1 | 10,000 | MI |
| **Total** | **2** | **50,000** | |
| *(Unregistered)* | | | |
| Unknown | 4 | 16,529 | WI |
| Unknown | 1 | 5,000 | WI,MN |
| Jocko | 3 | 32,000 | MI |
| Eastern | 2 | 80,000 | MI |
| Runyan x Eastern | 1 | 55,000 | MI,OH |
| Domestic | 1 | 10,000 | MI |
| **Total** | **12** | **198,529** | |
| **GRAND TOTAL** | **14** | **248,529** | |

**Table 34. Brown trout fingerling strains sold.**

| Strains | Number of Producers | Number of Fingerlings | States Where Sold |
|---|---|---|---|
| *(Registered)* | | | |
| Bitterroot | 1 | 30,000 | WI,PA |
| *(Unregistered)* | | | |
| Unknown | 3 | 8,000 | WI |
| German | 3 | 30,000 | MI |
| Own | 2 | 150,000 | WI |
| **Total** | **8** | **188,000** | |
| **GRAND TOTAL** | **9** | **218,000** | |

**Table 35. Tiger trout (brown X brook) fingerlings sold. (Unregistered)**

| Strains | Number of Producers | Number of Fingerlings | States Where Sold |
|---|---|---|---|
| Cross | 1 | 500 | WI |

Eighty percent of the brook trout sold by producers from the NCR were unregistered strains, with the remainder being the Assinica registered strain (Table 33). Only 16 percent of the brook trout fingerlings were exported out of the region to Pennsylvania.

The majority of brown trout fingerlings sold by producers from the region were unregistered strains (86 percent), with the remainder being the registered Bitterroot strain (Table 34). Only a small fraction of brown trout fingerlings were exported out of the region to Pennsylvania. The others were sold in Wisconsin and Michigan. A small number of tiger trout (brown x brook) fingerlings were sold in the region (Table 35).

Salmon fingerlings sold by producers from the region included coho and chinook (Table 36). All the salmon fingerlings were sold within the region to Nebraska and Minnesota.

A summary of salmonid fingerling sales by producers in the region is given in Table 37. Rainbow trout accounted for 79 percent of all salmonid fingerling sales, and of these 98 percent were sold within the region. Brook trout, brown trout, and salmon fingerlings accounted for 21 percent of the sales with most being sold within the NCR.

# Discussion

The salmonid producers in the NCR who responded to the survey indicated they purchased 7.3 million salmonid eggs, produced 9.9 million eggs, and sold 1.2 million eggs during the 1990 production year. Rainbow trout accounted for 67 percent of all the egg purchases, 68 percent of egg production, and 63 percent of egg sales, clearly demonstrating the importance of this species in the region.

Seventy-five percent of all purchased salmonid eggs were obtained from outside the region. In fact, 92 percent of all purchased rainbow trout eggs came from outside the NCR — the majority from the western United States. These figures indicate that some opportunities for additional egg production in the NCR may exist, especially in light of the growing concern about bringing new pathogens into the region.

Salmonid producers in the region responding to the survey sold 1.2 million salmonid eggs in 1990 — rainbow trout accounting for 63 percent of these sales. Fifty-four percent of all salmonid egg sales occurred within the region. About 6.1 million more salmonid eggs were purchased than were sold by salmonid producers in the NCR suggesting a demand for eggs, especially rainbow trout. Salmonid egg producers in the region should further explore the possibility of increasing production to meet regional needs.

To increase market potential in egg sales, additional producers should be encouraged to

**Table 36. Salmon fingerling species and strains sold. (Unregistered)**

| Species | Strains | Number of Producers | Number of Fingerlings | States Where Sold |
|---|---|---|---|---|
| Coho | Unknown | 1 | 130,000 | NE |
| Chinook | Chile | 1 | 80,000 | MN |
| **Total** | | **2** | **210,000** | |

About 9.9 million salmonid eggs were produced in 1990 by those salmonid producers in the region who responded to the survey. Rainbow trout accounted for 68 percent of these eggs. About 2.6 million more salmonid eggs were produced within the region than were purchased. Salmonid producers in the NCR demonstrate the ability to produce a large share of their own eggs.

**Table 37. Salmonid fingerling sales in and out of the North Central Region.**

| Species | Number Sold In Region | Number Sold Out of Region | Total Number Sold |
|---|---|---|---|
| Rainbow Trout | 2,503,411 | 62,000 | 2,565,411 |
| Brook Trout | 208,529 | 40,000 | 248,529 |
| Brown Trout | 203,000 | 15,000 | 218,000 |
| Tiger Trout | 500 | 0 | 500 |
| Salmon | 210,000 | 0 | 210,000 |
| **Total** | **3,125,440** | **117,000** | **3,242,440** |

explore the feasibility of producing chromosome set manipulation of eggs. Production of hybrids, sterile fish, or monosex populations has been shown to be highly profitable in other areas. Currently only 12 percent of those producing salmonid eggs in the region said they produced either all female or mixed sex triploid rainbow trout eggs. A ready market for chromosome set manipulated salmonid eggs exists; sixty-four percent of salmonid producers from the region who purchased eggs indicated their familiarity with them, while another 27 percent mentioned attempts to purchase such eggs.

The majority of rainbow trout eggs purchased, produced, and sold by salmonid producers in the North Central region consisted of registered strains. Other species of salmonid eggs purchased, produced, and sold had a high percentage of unregistered strains. It is important that salmonid producers in the region keep good records of the salmonid species strains that they are using so that production comparisons can be made between strains and desired performance characteristics noted.

Salmonid producers in the NCR who responded to the survey indicated that they purchased 0.6 million, produced 10.5 million, and sold 3.2 million salmonid fingerlings during the 1990 production year. Rainbow trout accounted for 77 percent of all fingerling purchases, 54 percent of fingerling production, and 79 percent of fingerling sales, again demonstrating the importance of this species in the region.

Ninety-five percent of all salmonid fingerlings were purchased from within the region. About 10.5 million salmonid fingerlings were produced in 1990 by salmonid producers in the region who responded to the survey. Rainbow trout accounted for just over half of this fingerling production followed by salmon at 26 percent. About 9.9 million more salmonid fingerlings were produced within the region than were purchased outside. Salmonid producers in the NCR demonstrate the ability to produce the bulk of their own fingerlings.

Salmonid producers in the region responding to the survey sold 3.2 million salmonid fingerlings in 1990 with rainbow trout accounting for 79 percent of these sales. Ninety-six percent of all salmonid fingerling sales occurred within the region.

Over half of the rainbow trout fingerlings purchased, produced, and sold by salmonid producers in the NCR consisted of registered strains. Other species of salmonid fingerlings purchased, produced, and sold had a high percentage of unregistered strains.

## References

Bye, V.J. and R.F. Lincoln. 1986. Commercial methods for the control of sexual maturation in rainbow trout (*Salmo gairdneri R.* ). Aquaculture 57:299-310.

Kincaid, H.L. 1981. Trout Strain Registry. U.S. Dept. Int., Fish Wildl. Serv., FWS/NFC-L/81-1.

NCA-23 (Aquaculture Subgroup of the NCA-23 Fish and Wildlife Committee). 1987. North Central Regional Aquaculture Center. A report to the North Central Regional Research Committee and North Central Regional Agriculture Experiment Station Directors.

WASC (Wisconsin Aquaculture Study Committee). 1988. Wisconsin aquaculture: a state plan. Wisconsin Department of Agriculture, Trade and Consumer Protection, Madison, Wisconsin.

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