

# Summary of Inland Commercial Fisheries in Maine

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**Table of Contents**

1) Table of Contents..... 1  
2) Preface..... 2  
3) Summary..... 2  
4) Introduction..... 3  
5) Commercial Licenses..... 7  
    a) Statewide Trends in License Sales..... 7  
    b) Commercial Smelt Harvest Summary..... 8  
    c) Commercial Baitfish Harvest Summary..... 14  
    d) Bait Retail Location Visitation Program Summary..... 21  
6) Commercial Baitfish Export to New Hampshire Summary..... 25  
7) Commercial Permits..... 28  
8) Conclusion..... 33  
9) References..... 34

*Tables*

1) Species eligible for use as live baitfish in Maine’s Inland waters..... 4  
2) Correlations among inland commercial fisheries and recreational licenses..... 8  
3) Correlations with total reported baitfish harvest..... 21

*Figures*

1) Recreational and commercial inland fisheries license sales..... 7  
2) Smelt Wholesale harvest report compliance..... 9  
3) Smelt Wholesale reported harvest quantities..... 10  
4) Smelt Wholesale reported gear types and harvest by gear type..... 10  
5) Map of waters open to Smelt harvest..... 12  
6) Smelt harvest by Fisheries management region..... 13  
7) Baitfish Wholesale harvest report compliance..... 15  
8) Baitfish Wholesale reported harvest quantities..... 16  
9) Baitfish Wholesale reported gear types and harvest by gear type..... 16  
10) Baitfish Wholesale harvest by species group..... 17  
11) Map of waters closed or restricted to commercial baitfish harvest..... 19  
12) Baitfish harvest by Fisheries management region..... 20  
13) Bait retail location visits summary..... 22  
14) Bait carried by bait retail locations visited..... 23  
15) Bait prices of bait retail locations visited..... 24  
16) Minnow species recorded during bait retail location visits..... 25  
17) Live bait exported from Maine to New Hampshire..... 26  
18) Proportion of Maine’s total Smelt and baitfish harvest exported to New Hampshire ... 27  
19) Commercial inland fisheries permit sales..... 28  
20) Map of waters closed to commercial sucker harvest..... 30  
21) Map of waters open to commercial harvest of Yellow Perch..... 32

## *Preface*

Information provided in this report may differ slightly from past summaries. All previous data was imported into a new database constructed to house all inland commercial fishery data; however, some data were removed through a quality assurance process that included removing duplicates and incomplete records. A record was only considered a duplicate if the subject, dates, and activity were all equal to another record. Records were removed as incomplete if they contained no relevant data (e.g., record only contained the subject but no harvest or inspection data). All partial records containing some relevant data were preserved. Additionally, all licenses and permits sold for each harvest year were requested from their respective point of service databases to provide estimates of the number of licenses and permits sold and failures to report for a given harvest year.

## **Summary**

The following report provides summaries for the inland commercial fisheries managed by the Maine Department of Inland Fisheries and Wildlife (MDIFW). The fisheries summarized include Rainbow Smelt (*Osmerus mordax*; hereafter “Smelt”), baitfish, sucker (*Catostomus spp.*), Sea Lamprey (*Petromyzon marinus*; hereafter “Lamprey”), Yellow Perch (*Perca flavescens*), and American Eel (*Anguilla rostrata*; hereafter “Eel”). Summaries provided in this report include license sales, harvest effort, harvest amounts, how harvests are reported, the species of fish harvested, bait prices, bait availability, bait exports to New Hampshire, and the waters open or closed to each commercial fishery. Some of the key findings within the report include; 1.) yearly sales of commercial licenses and permits have decreased; 2.) there appears to be no relationship between recreational license sales and commercial license sales; 3.) harvest of Smelt and Smelt exports to New Hampshire fluctuates annually with no clear trend; 4.) non-Smelt baitfish harvests have increased, though the number of retailers carrying them may be decreasing; 5.) bait prices fluctuate but appear to be increasing in line with inflation.

## Introduction

Maine's history of regulating inland fisheries with commercial interests dates to at least 1917 when the Department of Inland Fisheries and Game regulated the commercial take of Rainbow Smelt, Cusk (*Lota lota*), suckers, minnows, American Eel, Hornpout (*Ameiurus nebulosus*), and Yellow Perch. The early laws regulating these fishes gave the commissioner authority to grant permits that allowed taking fish for market through the use of Eel pots, traps, spears and nets. Moreover, it established a fine of \$30 (~\$610 in 2020) for unpermitted commercial capture of these fishes. These early laws also prohibited the sale of all fish commonly used as bait outside of the state and excluded specific waters from harvest.

There are currently several inland commercial fisheries managed by MDIFW. These fisheries are managed through three licenses and four permits. There is little regulatory distinction between commercial licenses and permits; however, permits generally require a more thorough approval process due to the permittees specification of specific waters or locations to conduct harvest activity. The three licenses include Baitfish Wholesale, Smelt Wholesale, and Live-Bait Retail. Permits include permits to harvest and sell sucker, Yellow Perch, and Lamprey as an individual or a group (crew permits). The remaining permit allows the commercial harvest of yellow Eel using Eel-pots.

Baitfish, including Smelt, have traditionally been an important inland commercial fishery in Maine. Anglers primarily use live fish for bait during the ice-fishing season and, to a lesser extent, during the spring open water fishing season. Kircheis (1998) found that approximately 90% of baitfish sales occurred during winter and only 20% of bait shops remained open in summer. A large regulatory change occurred to the bait-fishery in 1949 when laws requiring a live-bait dealer license were enacted and the ban that prohibited baitfish sale outside of the state was relaxed. To decrease the probability of non-native species introductions, Maine prohibited baitfish importation in 1959 (Frost & Trial, 1993). In 1969 licensing of the commercial harvest of live-baitfish and Smelt were separated, and an 8-quart Smelt harvest limit was implemented. MDIFW began a bait shop visitation program in 1985 to create awareness and reduce the number of non-bait species being transported by the live-bait market. In 1986 a list restricting the fish species allowed for use as bait was created, limiting legal baitfish to 23 species, and the ban on the importation of live baitfish was tested by the United States Supreme Court in *Maine v. Taylor*. The court found that the ban did not violate interstate commerce clauses. Several species have been removed from the list in recent years due to conservation concerns or non-native status. There are currently 17 legal baitfish species in Maine (Table 1). The majority, 11, of these fish are from the minnow family (Cyprinidae) and the remaining species include two suckers (Catostomidae), two killifish (Fundulidae), the American Eel (Anguillidae), and Rainbow Smelt (Osmeridae).

Table 1 List of the only species eligible to use as live baitfish in Maine’s inland waters.

<b>Common Name</b>	<b>Family</b>	<b>Latin Name</b>
American Eel	Anguillidae	<i>Anguilla rostrata</i>
Longnose Sucker	Catostomidae	<i>Catostomus catostomus</i>
White Sucker	Catostomidae	<i>Catostomus commersonii</i>
Blacknose Dace	Cyprinidae	<i>Rhinichthys atratulus</i>
Common Shiner	Cyprinidae	<i>Luxilus conutus</i>
Creek Chub	Cyprinidae	<i>Semotilus atromaculatus</i>
Eastern Silvery Minnow	Cyprinidae	<i>Hybognathus regius</i>
Fallfish	Cyprinidae	<i>Semotilus corporalis</i>
Fathead Minnow	Cyprinidae	<i>Pimephales promelas</i>
Finescale Dace	Cyprinidae	<i>Chrosomus neogaeus</i>
Golden Shiner	Cyprinidae	<i>Notemigonus crysoleucas</i>
Lake Chub	Cyprinidae	<i>Couesius plumbeus</i>
Northern Redbelly Dace	Cyprinidae	<i>Chrosomus eos</i>
Pearl Dace	Cyprinidae	<i>Margariscus margarita</i>
Banded Killifish	Fundulidae	<i>Fundulus diaphanus</i>
Mummichog	Fundulidae	<i>Fundulus heteroclitus</i>
Rainbow Smelt	Osmeridae	<i>Osmerus mordax</i>

Smelt are the live-bait preferred by many Maine anglers, especially those targeting landlocked Atlantic Salmon (*Salmo salar*) (Halliwell & Boucher, 2012). The landlocked form of Salmon was once rare in Northeast America and commonly known as “Sebago Salmon” (Ward, 1932). They historically only occurred in four Maine drainages; the Saint Croix, Union, Penobscot, and Presumpscot river basins (Boucher & Warner, 2006). It was recognized early on that Smelt abundance was linked to the health of Salmon populations and numerous plantings beginning in the late 1800’s resulted in Salmon and Smelt being present in approximately half of Maine’s freshwater acreage (Halliwell & Boucher, 2012).

Smelt management is complex because they are targeted recreationally as table fare, important in managing native sport fish, support a commercial economy that retails bait for recreational fishing, and their populations fluctuate greatly from year to year (Kircheis & Stanley, 1981). Prior to 1986 Smelt Wholesale license holders were provided with a list of lakes closed to commercial harvest. The list included all lakes closed to ice-fishing and the approximately 130 lakes open to salmonid fishing to prevent wholesalers from disturbing sensitive fisheries closed to anglers, alleviate conflicts with other uses and preserve salmonid forage. This left roughly 1,000 waters open to commercial Smelt harvest. Smelt availability began to greatly increase in popularity as a baitfish. This increased popularity is evidenced in the early bait shop visits which documented the increase in the percentage of bait shops with Smelt from 18% in 1985 to 54% in 1990. In 1986 MDIFW changed from a list of closed waters to a list of open waters due to concerns related to harvest impacts on sport fish forage and conflicts with recreational use, reducing the number of waters eligible for commercial Smelt harvest to 215.

White Sucker (*Catostomus commersonii*) have more recently been regulated as a commercial baitfish; however, in the early 1900s they were likely harvested commercially for human consumption. They are no longer popular as table fare in Maine but are a preferred bait when targeting some larger predatory sport fish species and one of the top five most economically important baitfish within the United States (Margenau, 2006; USDA, 2019). Some of the economic importance of White Sucker is also derived from their more recent use as Lobster (*Homarus americanus*) bait in the Gulf of Maine. The Department of Inland Fisheries and Wildlife began issuing separate permits specifically for the commercial harvest of larger White Sucker in 1991 (Begley, Coghlan Jr, & Zydlewski, 2018). White Sucker harvests have increased in the last decade, as they have become more economically viable as Lobster bait, most likely due to decreased availability of herring for Lobster bait (Ryan, Holland, & Herrera, 2010).

Eel regulation in Maine is complex. Eel are a catadromous species that migrate up rivers to grow to adulthood in freshwater and then migrate back to saltwater to spawn as adults. Historically they were primarily harvested for human consumption using Eel pots, baited cylindrical live traps with conical openings, and weirs, low dams in rivers with narrow openings. Maine's regulation of the Eel fishery appears to have changed little from 1917 to 1954 when an annual 20-pound limit per fishermen was established. A major change to their management occurred in 1996 when the Eel fishery was divided into three separate fisheries; young elvers, adult yellow Eels, and sexually mature silver Eels (Thaler, Shepard, Wippelhauser, & Truebe, 2016). The Maine Department of Marine Resources (DMR) manages the elver fishery that occurs in coastal estuaries. MDIFW manages the weir silver Eel fishery and placed a moratorium on new weir licenses to allow the fishery to vanish as the 24 remaining licensed individuals discontinued fishing. The last commercial Eel weir permit was issued in 2015. MDIFW permits commercial harvest of yellow Eels using baited Eel pots. The use of bait prevents the incidental

take of silver Eels which do not feed (Morrison & Secor, 2003). Yellow Eels are used for human consumption and some export takes place; however, it appears that the majority are used as bait for recreational fishing, especially for Striped Bass (*Morone saxatilis*) (Haro et al., 2000).

There are two additional species eligible for commercial harvest in Maine; Sea Lamprey and Yellow Perch. Commercial Yellow Perch permits have been available since at least 1917, but their intended use was not well documented. Unfortunately, historical records for Yellow Perch are difficult to obtain, but their commercial permitting has continued to be grouped in law with the permitting of Eel and sucker. Sea Lamprey were added to this list of eligible commercially permitted species in 2001. Permits for both of these species are sold infrequently and in low numbers. We are aware that Yellow Perch have been harvested in more recent years as an alternative Lobster bait and Lamprey have been collected for use as specimens for scientific and educational study.

## Commercial Licenses

### Statewide Trends in License Sales

Maine annual recreational fishing license sales reported to the United States Fish and Wildlife Service (USFWS) increased steadily from 1960 to an all-time high of 303,000 in 1989 and have remained fairly consistent since 1990 with a mean of 270,175 (standard error = 2,550; Figure 1a). Licensed recreational fishing may have even increased during this time due the introduction of lifetime licenses in 2000 which are not fully accounted for by USFWS numbers. The consistent annual recreational fishing license sales would imply that demand for Smelt and baitfish also remained consistent. However, there has been a recent decline in commercial fishing licenses with an especially apparent decline in the number Baitfish Wholesale Licenses (Figure 1.b).

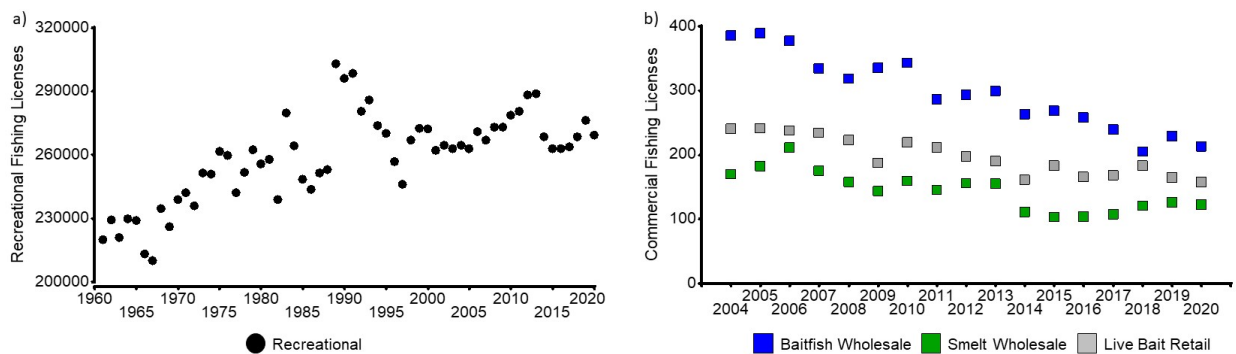


Figure 1 a) Maine certified paid fishing license holders per calendar year reported to United States Fish and Wildlife Service. b) Commercial license sales by harvest year (May 1<sup>st</sup> through April 30<sup>th</sup>).

To better understand if any of the trends in licensing may be related, Pearson’s correlation coefficients (r) among harvest year, and recreational, Smelt Wholesale, Baitfish Wholesale, and Live Bait Retail licenses were calculated (Table 2). Correlations coefficients indicate the direction and strength of a relationship between two variables. Positive correlations mean that both variables tend to increase or decrease simultaneously. Conversely, negative correlations mean that as one increases the other decreases. Correlations are bound between -1 and 1 with 0 indicating no relationship, -1 a one to one negative relationship, and 1 a one to one positive relationship. Probability values (p) are a way to assess whether the relationships are statistically significant. A p-value less than or equal to 0.05 is widely used as the threshold for a statistically significant result. Total annual recreational license sales appear to have no relationship with commercial license sales ( $0.38 \leq p \leq 1.00$ ). Annual recreational license sales relationship with year was not significant ( $p = 0.91$ ), indicating moderate yearly fluctuations are not a sign of a general trend in either direction and supporting the inference of consistent sales. The number of all commercial fishing licenses were strongly positively correlated with one another ( $0.84 \leq r \leq 0.88$ ) and negatively correlated with harvest year ( $-0.92 \leq r \leq -0.83$ ). The positive relationships among the commercial licenses are likely partially driven by instances of individuals purchasing multiple types of commercial licenses within a given year. The significant negative relationships with year confirm the decreasing trends in commercial license sales.

Table 2 Pearson’s correlation coefficient matrix. Numbers in the lower left quadrant represent the strength of the linear relationship among variables (i.e., r). Numbers in the upper right quadrant represent the significance of those relationships (p-value). Bolded values denote significant relationships. \*Yearly recreational licenses do not strictly correspond to harvest year given the difference in reporting dates; calendar year and May to April respectively.

	Recreational Fishing*	Live Bait Retail	Baitfish Wholesale	Smelt Wholesale	Harvest Year
Recreational		1	0.98	0.38	0.91
Live Bait Retail	0.002		$\leq 0.0001$	$\leq 0.0001$	$\leq 0.0001$
Baitfish Wholesale	-0.01	<b>0.88</b>		$\leq 0.0001$	$\leq 0.0001$
Smelt Wholesale	0.23	<b>0.88</b>	<b>0.84</b>		$\leq 0.0001$
Harvest Year	0.03	<b>-0.92</b>	<b>-0.97</b>	<b>-0.83</b>	

### *Commercial Smelt Harvest Summary*

Harvest reports for commercial Smelt Wholesale license holders began as a voluntary program in 2006. Due to its voluntary nature, few reports were received. Beginning in 2010, reports became required even if the license holder did not fish. Failure to report by May 31<sup>st</sup> of each



year resulted in the suspension of the individual’s ability to purchase a license. Thus, the data summarized herein begins in 2010. Since 2010 Smelt Wholesale license sales have fluctuated from a high of 154 to a low of 103. The proportion of individuals complying with the reporting requirement, which includes those reporting they did not fish, has generally increased through time, likely due to relicensing denials of those failing to report (Figure 2).

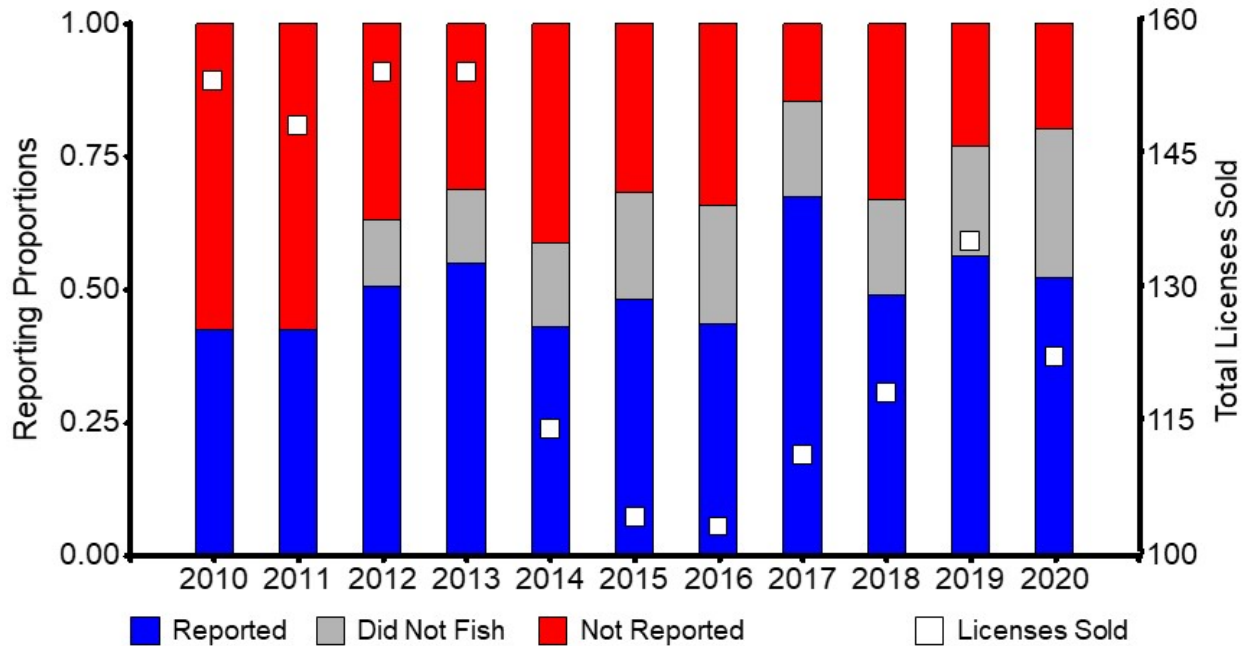


Figure 2 Commercial Smelt wholesale license report summary for 2010 through 2020. “Did not fish” category are licensed individuals that reported they did not fish during a given harvest year.

Smelt wholesaler reporting forms give the licensee the option of reporting their harvests as pounds, quarts, dozens, or individuals. This creates difficulty in summarizing total harvest amounts and is an area where data could be improved through report standardization. Previous data was used to estimate the average number of Smelt per quart (154/qt) to allow conversion to the number of individual Smelt per quart. When summarizing total harvests by harvest year, this conversion was used to estimate total numbers of Smelt harvested per quart and converted dozens to individuals. There is not a method to estimate the number of Smelt per pound. Fortunately, the pound measurement has rarely been used to report harvest amounts. The majority of Smelt wholesalers report their harvests in the quantity used to set bag limits, quarts, though an increasing proportion of harvests are being reported in dozens (Figure 3).

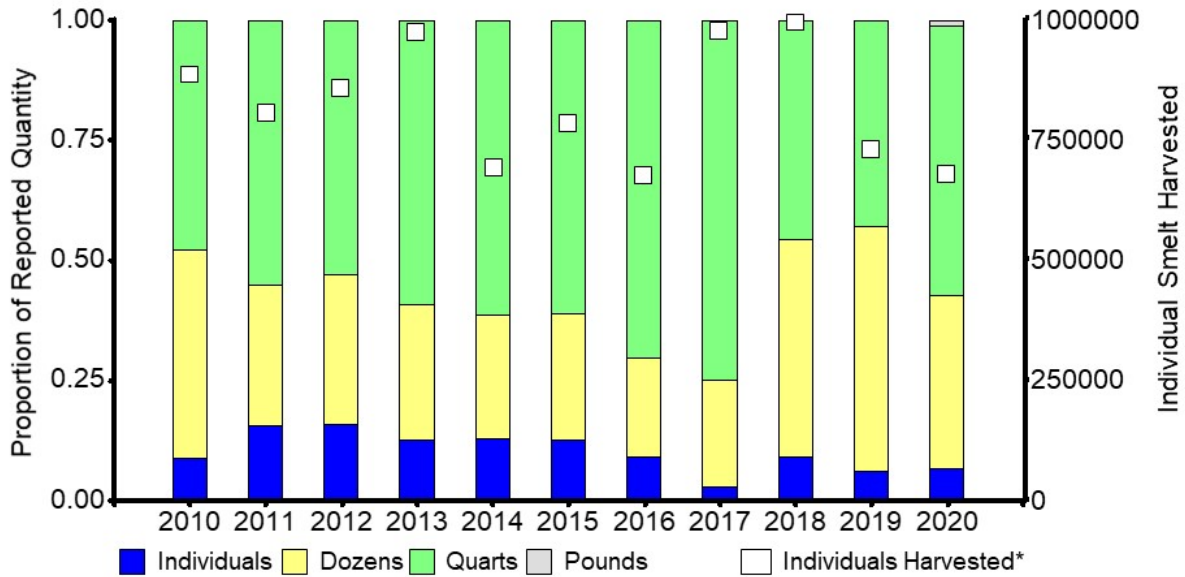


Figure 3 The measurements commercial Smelt wholesalers used to report their total catches with a secondary y-axis used to plot the estimated total number of individual Smelt harvested. \*Quantities reported in pounds were not used to estimate total harvests and a conversion of 154 Smelt/quarter was used to estimate the number of Smelt per quart.

The type of gear that Smelt wholesalers use to capture Smelt is an additional field required in reports. Gear type was not recorded in 2010 but reports from 2011 seldomly leave this field blank. Commercial Smelt harvests predominately use drop-nets, hook and line, or dip-nets (Figure 4a). Other gears are occasionally reported and include lift-nets, bag-nets, and hoop-nets. It is also not uncommon for reports to simply record using a “net”, which does not provide enough information to determine the gear type used. Despite the use of several gear types, drop-nets alone accounted for the vast majority of Smelt harvested (Figure 4b).

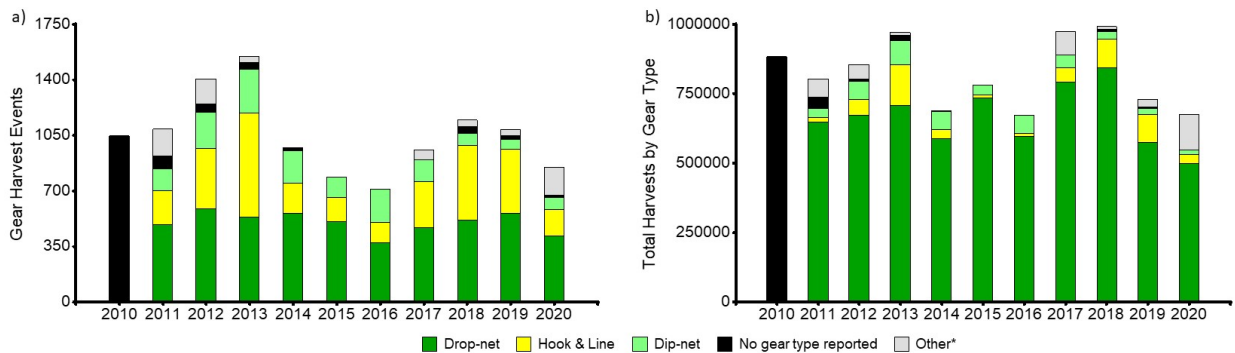


Figure 4 a) The total count of harvest events by gear type. b) The total number of individual Smelt harvested by gear type (does not include harvests reported in pounds). \*Other gear category includes gears rarely or insufficiently reported, and includes bag-net, hoop-net, lift-net, and net.

During the 2020 harvest season there were 304 uniquely named waters totaling 169,672 acres open to the commercial harvest of Smelt (Figure 5). Some of the 304 uniquely named lakes are

contiguous and managed jointly, thus, the 304 lakes are managed as 299 waterbodies. The majority of waters open to the commercial harvest of Smelt are found in the southern third of the state. This area has fewer self-sustaining populations of salmonids than more northern Maine, so Smelt harvest is less likely to negatively impact salmonid populations that depend on Smelt for forage. Forty-eight percent of the open lakes accounting for 59% of the total open acreage were managed by Regions B (Mid-coast and lower portion of the Kennebec River Valley) and C (Downeast).

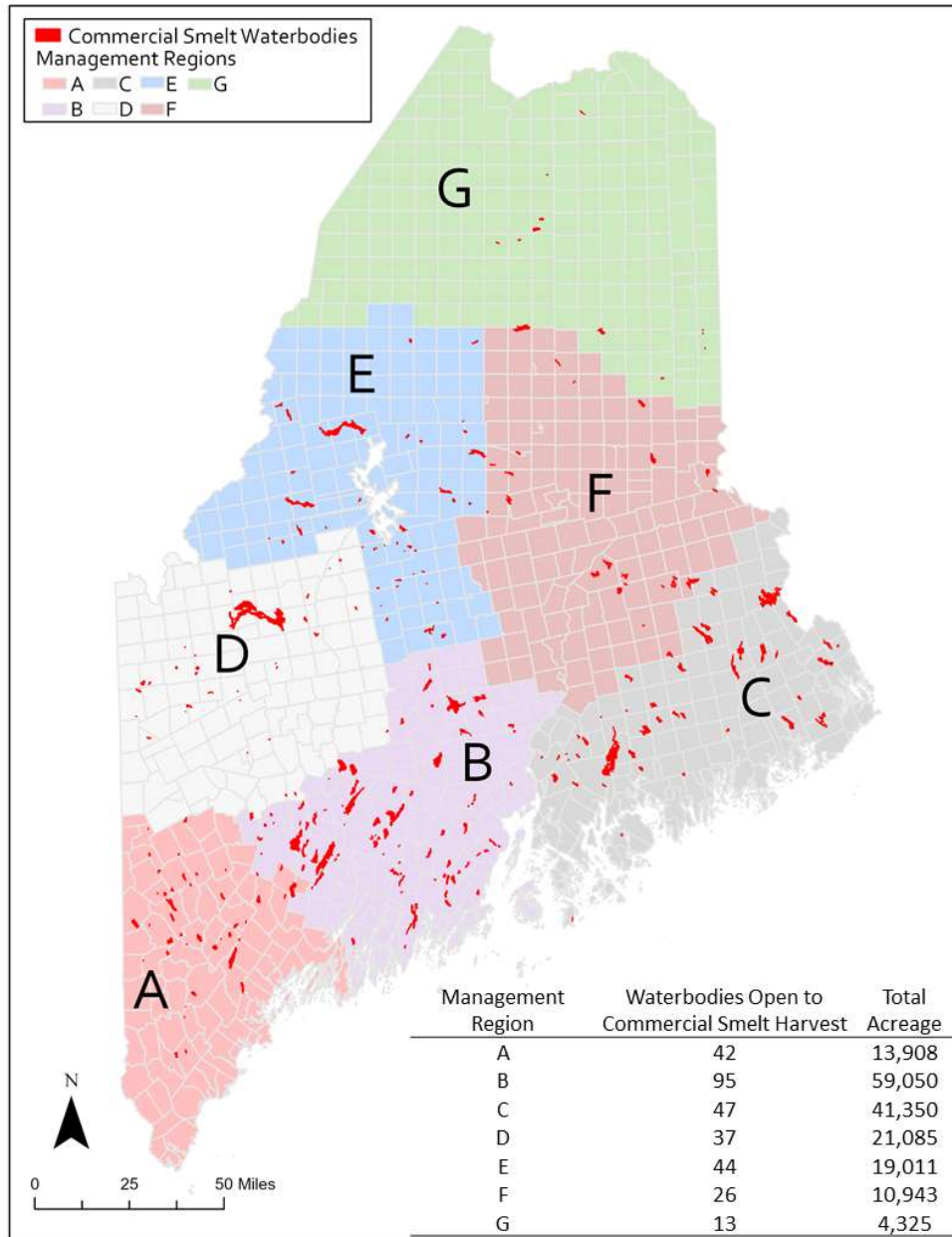


Figure 5 Map displaying the locations of Maine lakes open to the commercial harvest of Smelt with an inset table summarizing the open waters in each management region.

The majority of Smelt harvested were from waters managed by Regions A and B (Figure 6). Though Region A has a smaller proportion of lake acreage open to commercial Smelt harvest, it encompasses the most densely populated portions of Maine. Further, harvest may also be affected by lake accessibility and productivity. Despite Region C containing a large proportion of the lake acreage open to commercial Smelt harvest, few Smelt were harvested from the region. Regions D and E accounted for observable and fairly consistent harvests. Comparably few harvests were reported from Regions F and G.

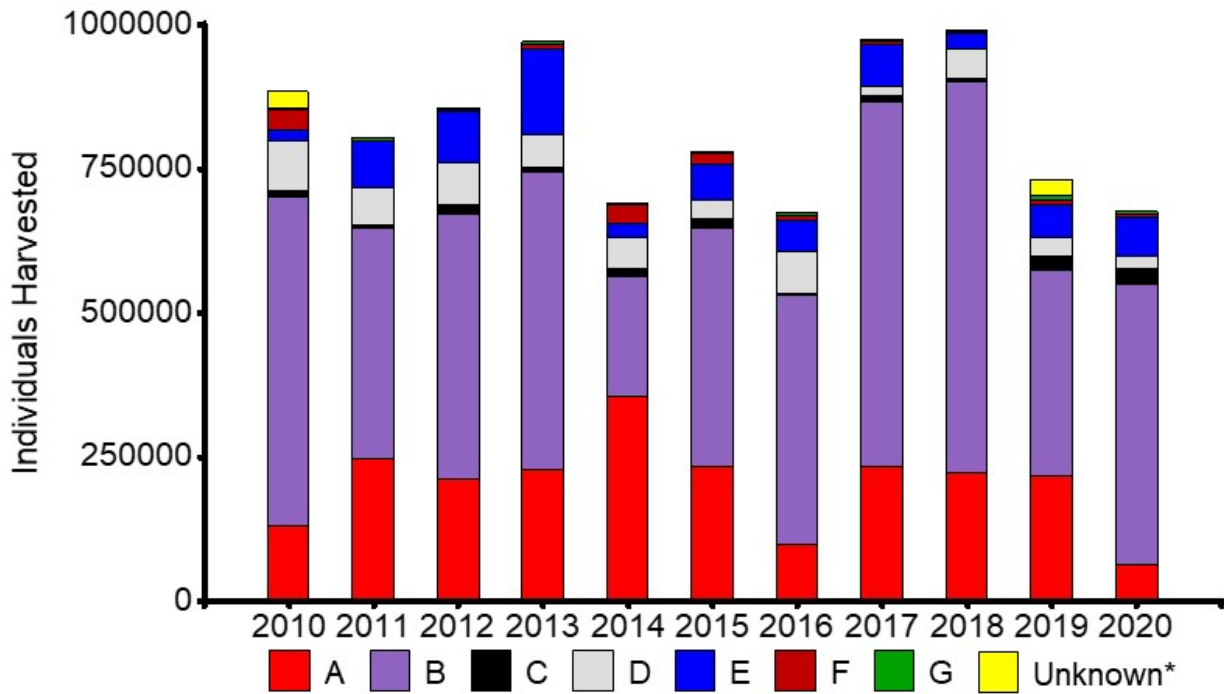


Figure 6 Bar chart showing the total Smelt harvested from each Management Region (refer to Figure 5 for region locations).  
 \*"Unknown" represents reported harvests that were unable to be assigned to a region to due to incomplete reporting

The total number of Smelt Wholesale Licensees is decreasing, but the reduced number of harvesters appeared to have little effect on total harvest. This observation suggests that retail and angler demand for live Smelt as bait can be achieved with reduced wholesaler participation. Linear regression was used to test whether the number of licenses could explain Smelt total harvest variation. In simple terms, regressions use independent variable(s) to explain variation in a dependent variable. The results provide a coefficient of determination ( $r^2$ ) that indicates how much of the dependent variable's variability is explained by the independent variables, and p-values that indicate whether relationships between the model or individual independent variables and the dependent variable are significant. Linear regression using the number of licenses to explain Smelt total harvest variation showed no significant relationship ( $r^2 = 0.08$ ,  $p = 0.40$ ). At the state level, total harvest appears to oscillate on 4 to 5-year intervals that may represent a "boom and bust" population cycle or changing harvest conditions (e.g.,

duration of ice) linked to environmental fluctuations (Figures 3, 4b, and 6). However, without effort corrected water specific data for all years it is impossible to determine if this trend is real or simply an artifact of reporting variability and error associated with self-reporting. More comprehensive data and analyses are necessary to determine if reported harvests are representative of Smelt abundances and the probable factors driving Smelt abundances.

### Commercial Baitfish Harvest Summary

Harvest reports for Baitfish Wholesale license holders have been required since 2017. Baitfish Wholesalers are required to submit a report of their harvest by May 31<sup>st</sup>. Failure to submit a report results in the suspension of the individual’s ability to purchase a license. The proportion of individuals reporting has improved greatly since beginning in 2017 (Figure 7). Much like Smelt, the increase in reporting compliance is probably attributable to relicensing denials. The proportion of individuals reporting they did not fish has remained relatively constant. Total license sales have also remained relatively consistent with a high of 239 in 2017 and a low of 205 in 2018 (mean = 222).

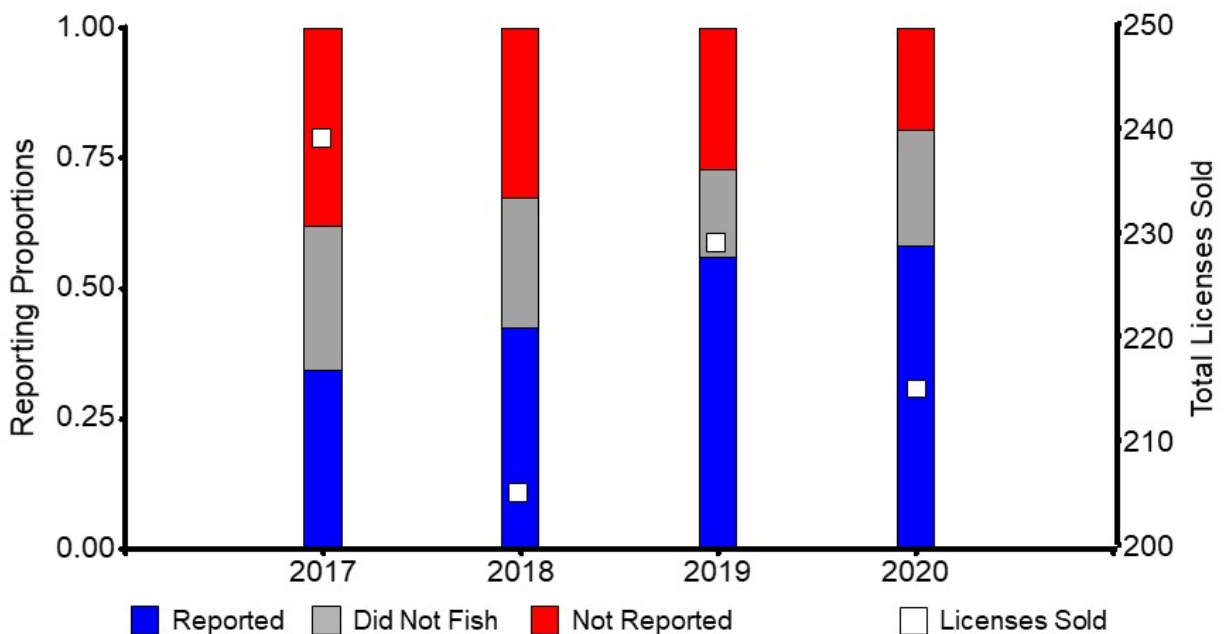


Figure 7 Commercial Baitfish wholesale license report summary 2017 through 2020. “Did not fish” category are licensed individuals that reported they did not fish during a given harvest year.

Baitfish Wholesalers are allowed to report their harvests in pounds, quarts, dozens, or individuals. The majority of Baitfish Wholesalers reported their catches in individuals or dozens (Figure 8). Unlike Smelt reports, an average number of baitfish per quart has not been estimated, so only harvests provided in individuals or dozens are used when estimating total

harvest quantities. Fortunately, few harvests were reported in quarts or pounds. However, like Smelt reporting, this is an area where report standardization could greatly improve data quality. The mean total number of baitfish harvested each year was 1,965,890 with a low of 1.7 million in 2017 and 2018, and a high of 2.4 million in 2019. Given the lower reporting compliance, the reported total harvests in 2017 and 2018 may not reflect actual lower total harvests.

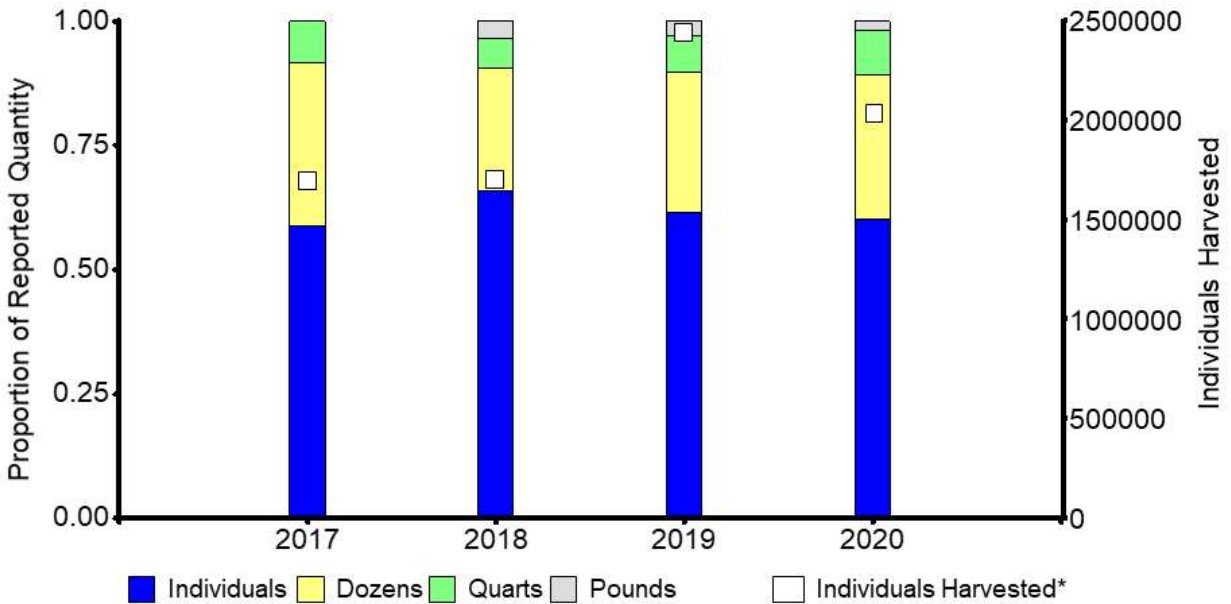


Figure 8 Measurements commercial Baitfish Wholesalers used to report their total catches with a secondary y-axis used to plot the estimated total number of individual baitfish harvested. \*Quantities reported in pounds and quarts were not used to estimate total harvests.

Baitfish reporting requires recording the gear-type used to harvest fish and most wholesalers complied. The most used gear were baitfish traps (Figure 9a), which also accounted for the majority of harvests (Figure 9b). Seine nets were used far less frequently but accounted for a relatively large proportion of the fish harvested (Figure 9b). Other gears accounted for few harvest events and harvested fish.

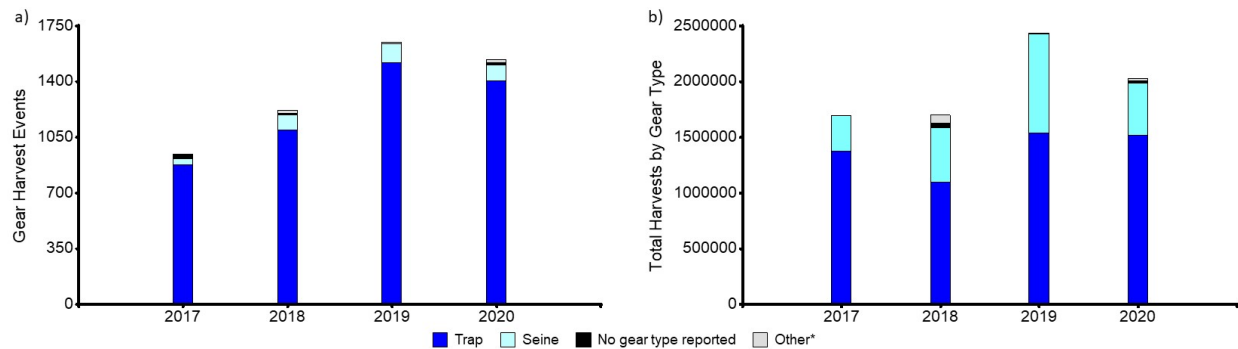


Figure 9 a) The number of baitfish harvest events by gear type. b) The total number of individual baitfish harvested by gear type (does not include harvests reported in pounds or quarts). \*Other gear category includes gears rarely reported or reported insufficiently to determine exact gear and includes dip-net, drop-net, hook and line, lift-net, and net.

Baitfish reports allow harvesters to record multiple species harvested during a single harvest event, so determining the total number of a given species harvested in a given year is not possible. This is an area to explore opportunities to obtain more detail from harvesters, so that harvest of individual species or species groups could be better assessed. Species are also often reported using common names that are used for several allowed baitfish species in Maine (e.g., “shiner”, “minnow”, “sucker”). A few common names for species were recorded in the database differently than reported to account for the uncertainty (e.g., “redfin shiner” were recorded as “shiner”). Species reported were grouped into coarse taxonomic groups to allow more accurate comparisons of their relative harvest contributions (Figure 10). The groups include shiners (fish that were reported as shiner, Golden Shiner, or Common Shiner), minnows (minnows, Eastern Silvery Minnow, Fathead Minnow), dace (dace, Blacknose Dace, Finescale Dace, Northern Redbelly Dace, and Pearl Dace), chubs (chub, Creek Chub, Lake Chub, and Fallfish), killifish (Banded Killifish and Mummichog) and suckers (sucker and White Sucker). Of note is that the only allowable baitfish species without a reported harvest is Longnose Sucker.

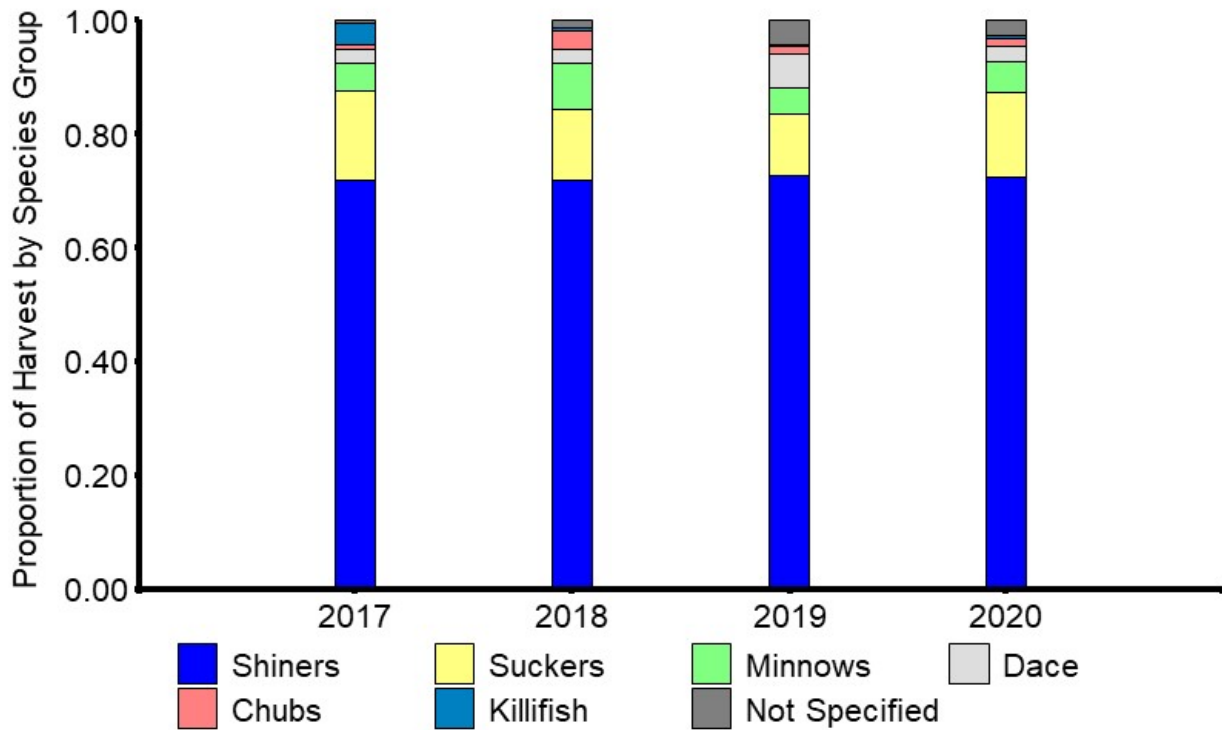


Figure 10 Proportion of each taxonomic group reported as harvested among harvest events. \*Refer to preceding text for information on the species included in each taxonomic group.

Unlike Smelt where waters are considered closed unless expressly opened, all waters are considered open to commercial baitfish harvest unless expressly closed. This difference has to do with the much higher prevalence of baitfish than Smelt throughout the state, fewer associated user groups and management conflicts, and the greater difficulty in depleting a number of baitfish species simultaneously when compared with more targetable Smelt. Waters are closed to baitfish due to concerns regarding ecological value, unauthorized introductions, and movement of invasive species. Some waters are gear restricted to the use of minnow-traps, while other waters are completely closed to harvest (Figure 11). Closed and restricted baitfish waters also include flowing waters which makes summarizing the acreage and number of waters open to commercial baitfish harvest difficult. However, the table within Figure 11 summarizes the number of lakes restricted or closed to commercial baitfish harvesters. Maine has over one million acres of lakes and ponds and approximately 90% of that total acreage remains open to baitfish harvest.



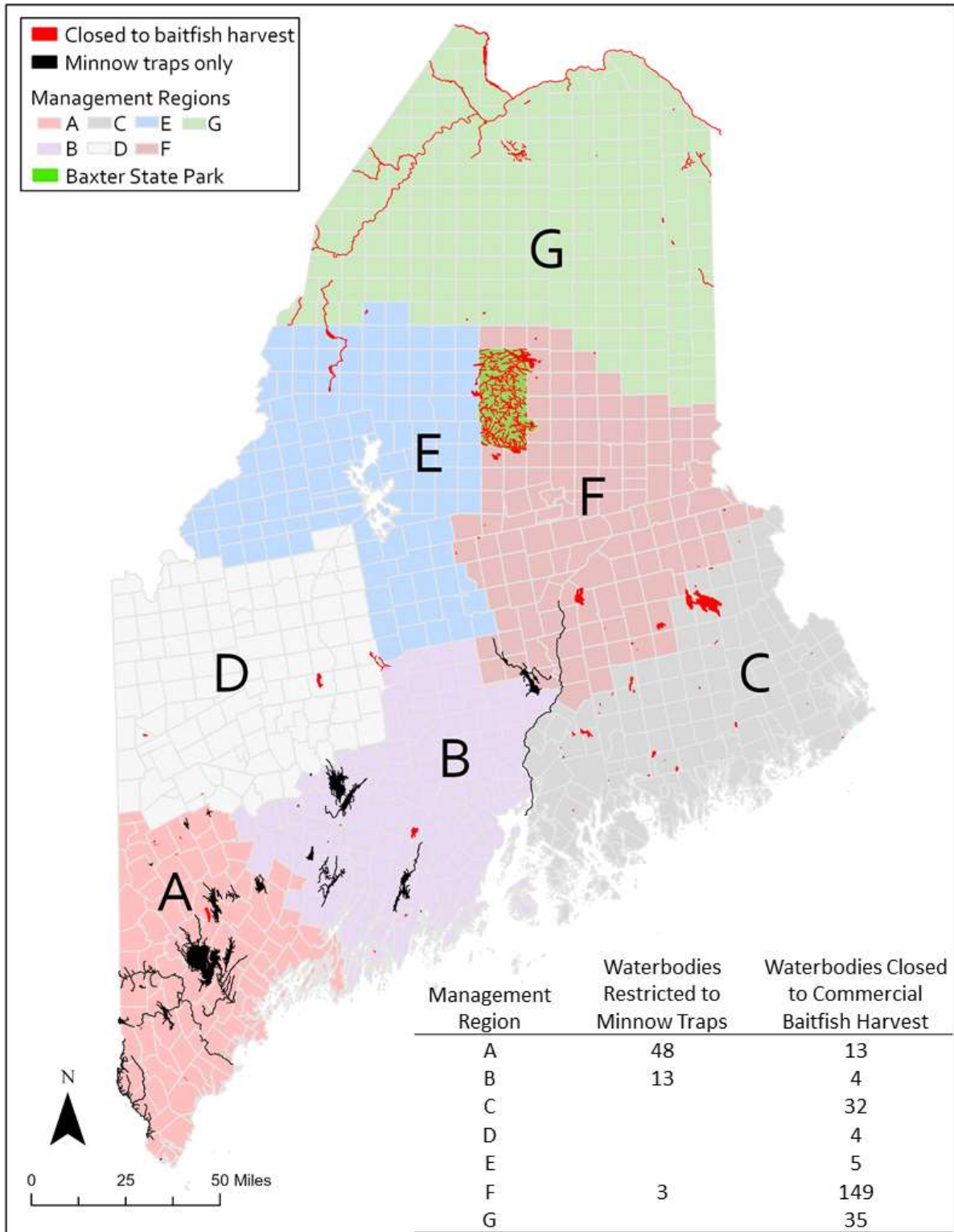


Figure 11 Map showing the waters restricted or closed commercial baitfish harvests with an inset table summarizing the number of uniquely named lakes restricted or closed by management region. \*Note: Region F has many more closed waters due to the closure of waters within Baxter State Park.

Estimates of the total number of baitfish harvested from each management region are depicted in Figure 12. Reported harvests in Region A appear to have declined while harvests in Regions C and E have increased. Much like Smelt, Region B accounts for a large proportion of baitfish harvests. Harvests in Regions D and F appear fairly constant. Relative to other regions, few baitfish were reported harvested from Region G.

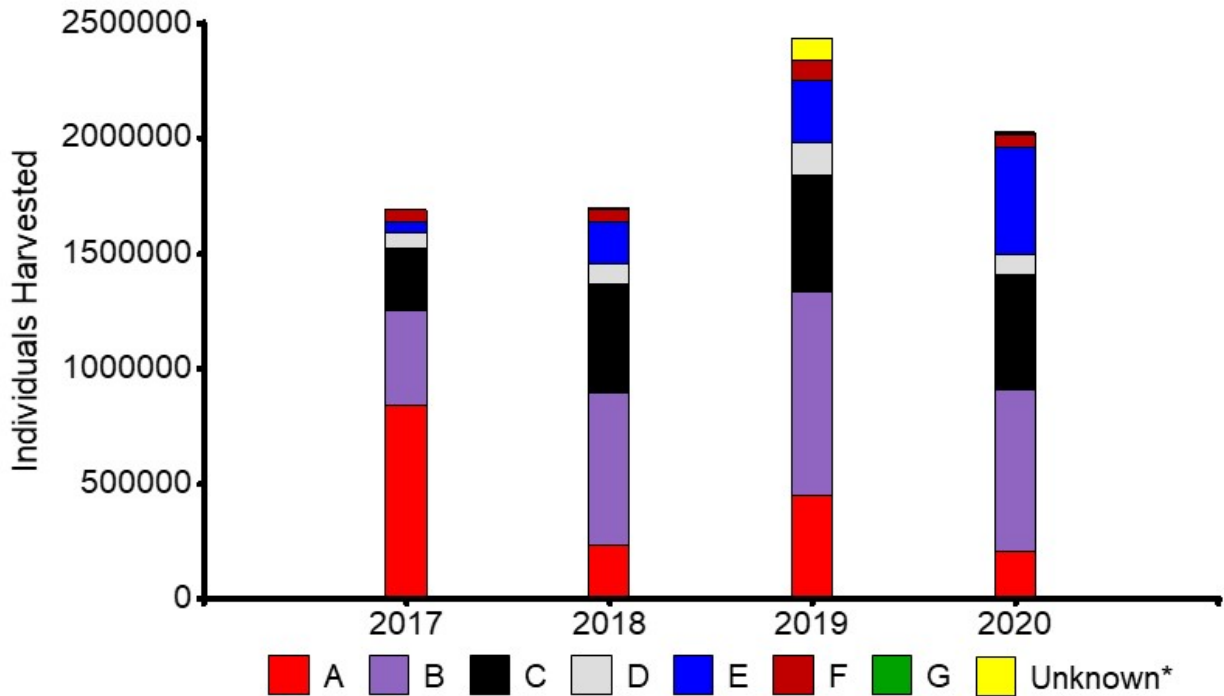


Figure 12 The total baitfish harvested from each Management Region (refer to Figure 5 for region locations). \*"Unknown" represents reported harvests that I was unable to assign a region to due to incomplete reporting

Though there are only four years of commercial baitfish harvest data available, Pearson's correlation coefficients were used to determine if there were relationships between total harvest and recreational license sales, Baitfish Wholesaler licenses, and year (Table 3). Given the lack of data, these results are very preliminary and contain a high level of uncertainty. None of variables had a significant relationship with total baitfish harvests at the 0.05 threshold; however, there was a strong positive relationship ( $r = 0.92$ ) between the number of recreational fishing licenses and the total reported baitfish harvested significant at the 0.10 threshold ( $p = 0.08$ ). The significance of the relationship despite the small number of observations indicates the relationship is real; however, there is not enough data at this time for confirmation. Though the relationship between recreational licenses and harvested baitfish is logical given supply and demand economics, it is complicated by the fact that not all baitfish are sold and the potential inaccuracies of harvest reporting.

Table 3 Pearson's r and significance (p) of the relationships between total baitfish harvests and given variables.

Variable	r	p
Bait Wholesaler Licenses	0.18	0.82
Recreational Fishing Licenses	0.92	0.08
Harvest Year	0.64	0.36

*Bait Retail Location Visitation Program Summary*

The bait retail visitation program began in 1985, as an educational tool to reduce the spread of fish in Maine waters. Unfortunately, electronic records of the visits did not begin until 2001, thus our summaries are limited to the years 2001 through 2020. All three commercial MDIFW licenses (Baitfish Wholesale, Smelt Wholesale, and Live-Bait Retail) allow the licensee to designate a retail location to market baitfish to the public. The primary differences among the licenses involve the types of bait the holders are able to retail. Smelt and Baitfish wholesalers may only retail the species they are licensed to harvest (i.e., a Baitfish Wholesaler cannot sell Smelt and a Smelt Wholesaler cannot sell baitfish). A Live-Bait Retail licensee cannot harvest fish but may sell Smelt and baitfish purchased from a licensed wholesaler. From 2001 to 2020 1,114 retail location visits were conducted. The most common license possessed by a visited retailer was Live-Bait Retail (66%) followed by Baitfish Wholesale (48%) and Smelt Wholesale (18%). Possessing multiple license types was not uncommon with 24% of visited retailers possessing two of the licenses and 4% possessing all three licenses. A mean of 15% of individuals licensed to retail were visited each year for years in which visits were conducted and licensing data was available (Figure 13).

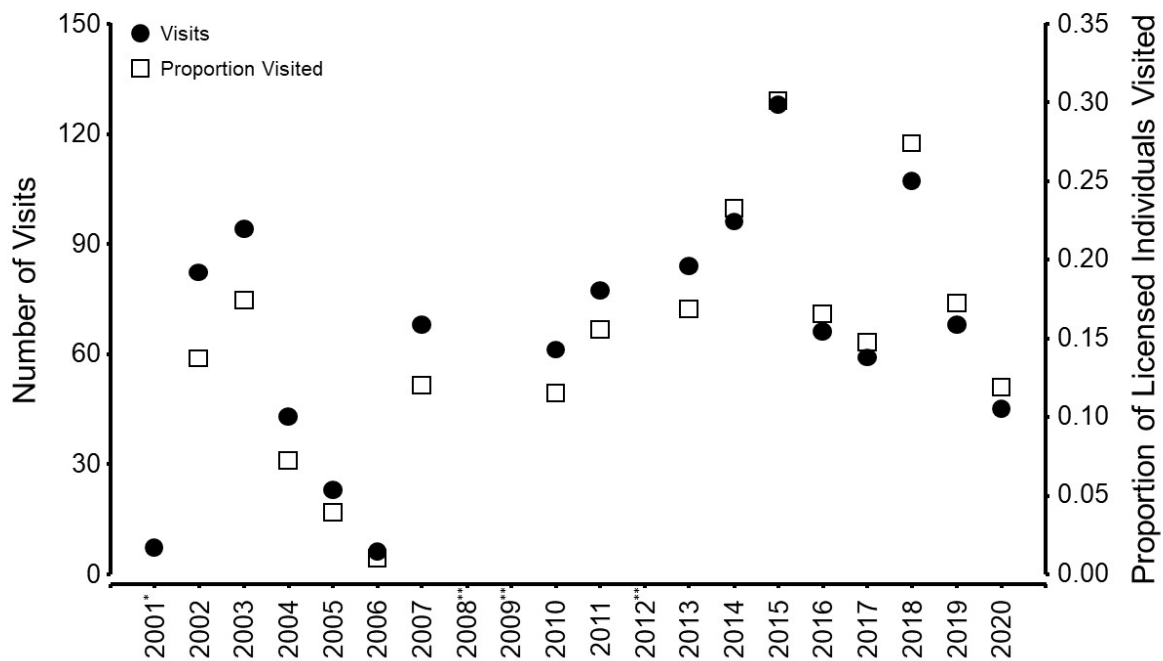


Figure 13 Summary of bait dealer visits 2001-2020. The total count of the number of dealers for each year used to estimate the proportion visited counts unique individuals, as many dealers purchase multiple licenses that allow them to deal bait. \* An accurate record of the total number of licensed dealers is not available for 2001. \*\* No visits were conducted in 2008, 2009, or 2012.

The site visits also allow MDIFW to monitor the availability and prices of baitfish. We considered a retailer to have a type of bait available if they had a given type of bait priced. This is imperfect, as some retailers may have prices posted for bait that were sold out at the time of the visit, but this is the most consistent way to track availability through the visitation record. Smelt were available at a mean of 45% of retailer visits, minnows at 90%, and suckers at 36%. To test whether the availability of a bait type changed over time, Pearson’s correlation coefficient between the percentage of retailers that had prices for the various bait types (Smelt, minnows, and suckers) and year were calculated. Based on these analyses, only the availability of one type of bait had changed significantly ( $p \leq 0.05$ ) through time. The number of retailers carrying minnows appears to have decreased between 2001 and 2020; however, they were still widely available during all years with 74% of retailers having prices for minnows in the lowest available year, 2019 (Figure 14).

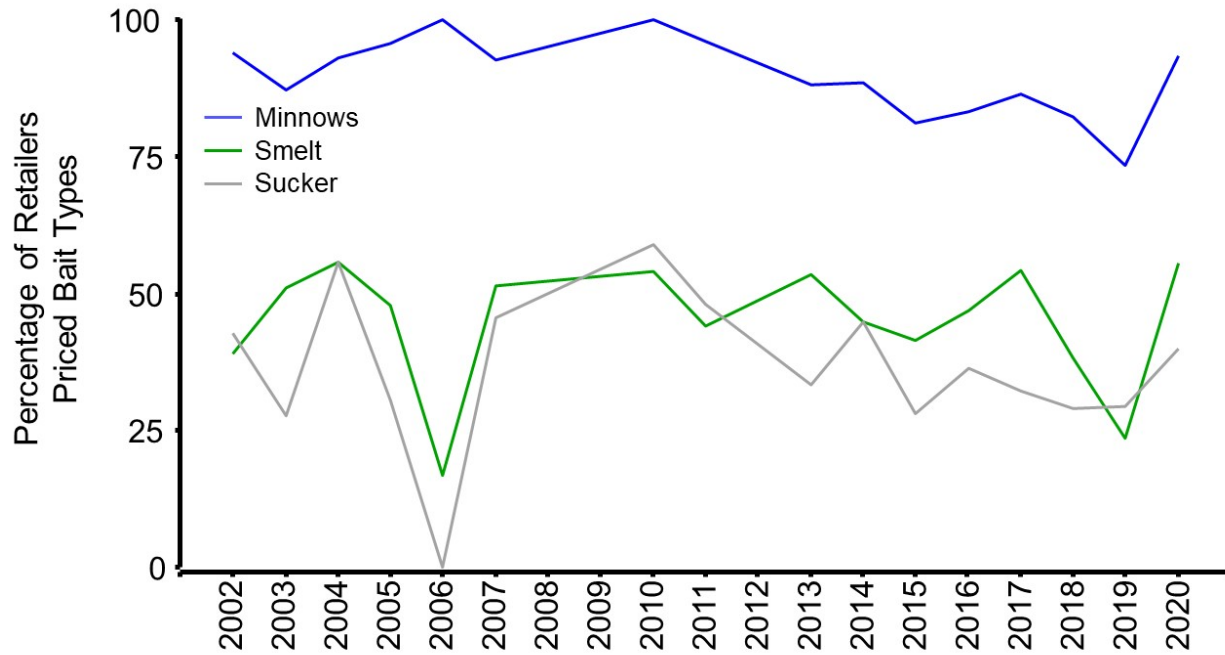


Figure 14 The percentage of bait retailers visited that listed prices for different types of bait from 2002-2020.

The prices of all bait subcategories have increased since 2001 (Figure 15). Though there was some annual variability, cursory comparisons of the price increases with inflation implied that they increased at a rate similar to all consumer goods over the time period analyzed. However, the higher degree of variability in Large Sucker and Jumbo Minnow prices may indicate greater fluctuations in the availability of those bait subcategories.

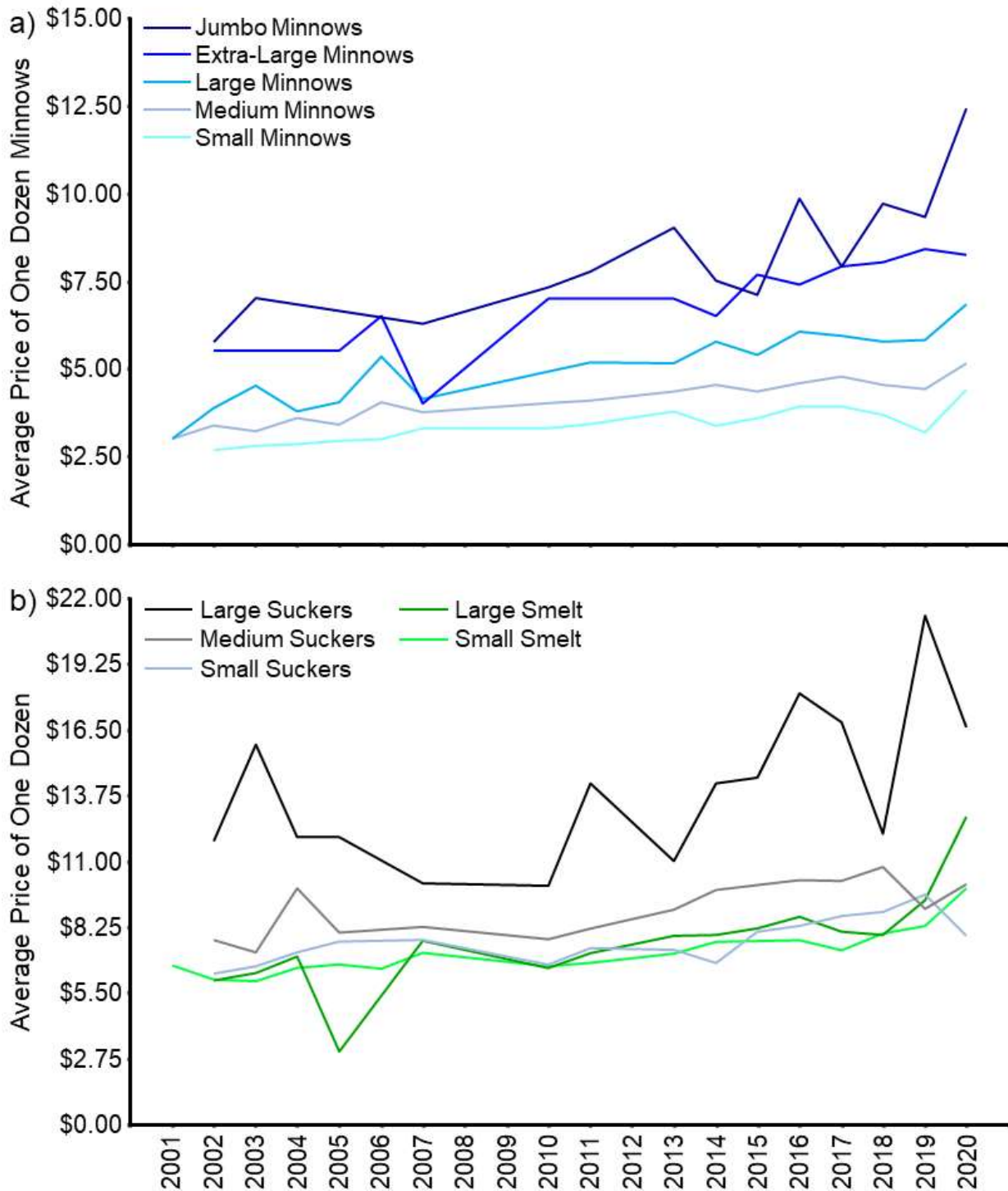


Figure 15 Changes in the prices of various subcategories of bait observed from 2001-2020 through retail site visits.

The species of “minnows” for sale are also recorded during retailer visits. These species are often grouped together and sold by size classes (e.g., large minnows and small minnows) that vary by retailer. The species included in this minnow category are from the Cyprinidae and

Fundulidae families (Table 1). Though it isn't feasible to count every individual of each species during retailer visits, we can obtain a good indication of the relative prevalence of each species by comparing the number of times a given species was recorded as present during visits each year. The most available minnow species in order of prevalence are Golden Shiner, Common Shiner, Eastern Silvery Minnow, and Fathead Minnow (Figure 16). These four species accounted for a yearly mean of 80% of the the observed species since 2001. The other species were generally less prevalent, but not uncommon.

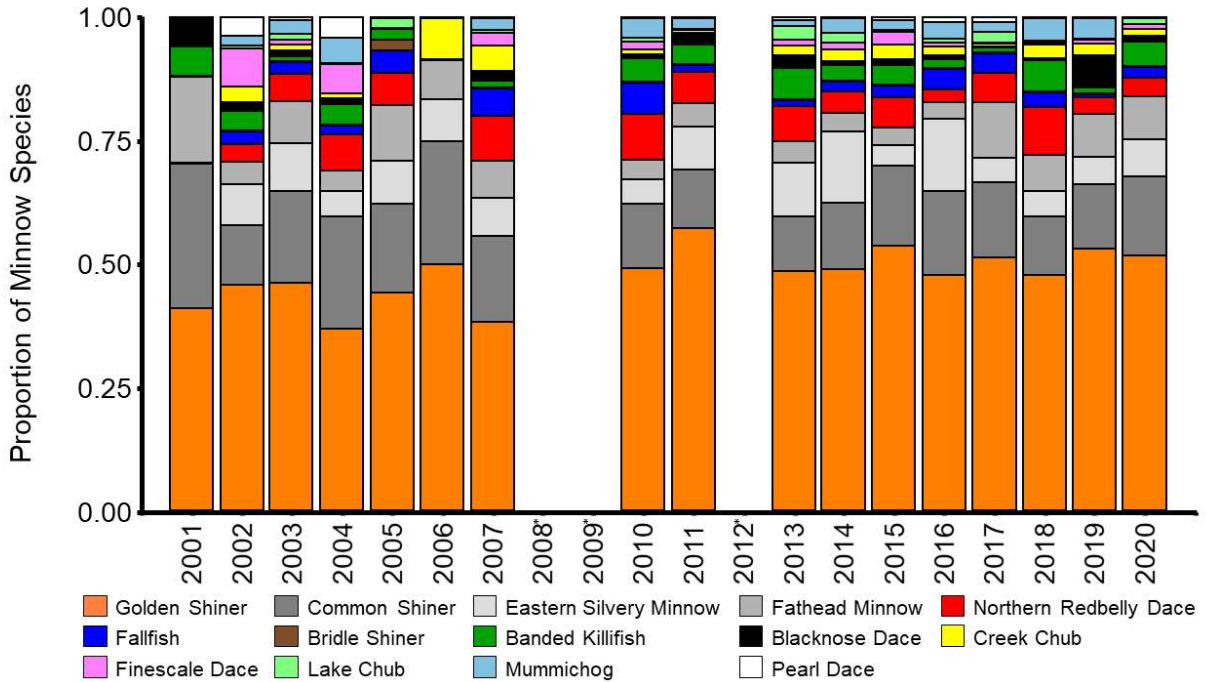


Figure 16 “Minnow” species observed during retailer visits by proportion of observations. \* No inspections were conducted in 2008, 2009, or 2012.

### Commercial Baitfish Export to New Hampshire Summary

The state of New Hampshire records baitfish importation information which includes the fish species, quantity, seller, home city and state of seller, and the buyer. They generously supplied their data pertaining to Maine sourced baitfish imported into New Hampshire to MDIFW (Figure 17). The data begins in 2001 and only records Smelt until 2007. From 2007 through 2019 all baitfish species were recorded. When baitfish were purchased in quarts or pounds, the average number per quart or pound of that purchase was used to estimate the total number of fish imported by New Hampshire Fish and Game. New Hampshire bait retailers imported an mean of 120,000 Smelt per year from Maine from 2001 through 2019, and a mean of 45,000 minnows and 9,300 White Sucker from Maine per year from 2007 through 2019.

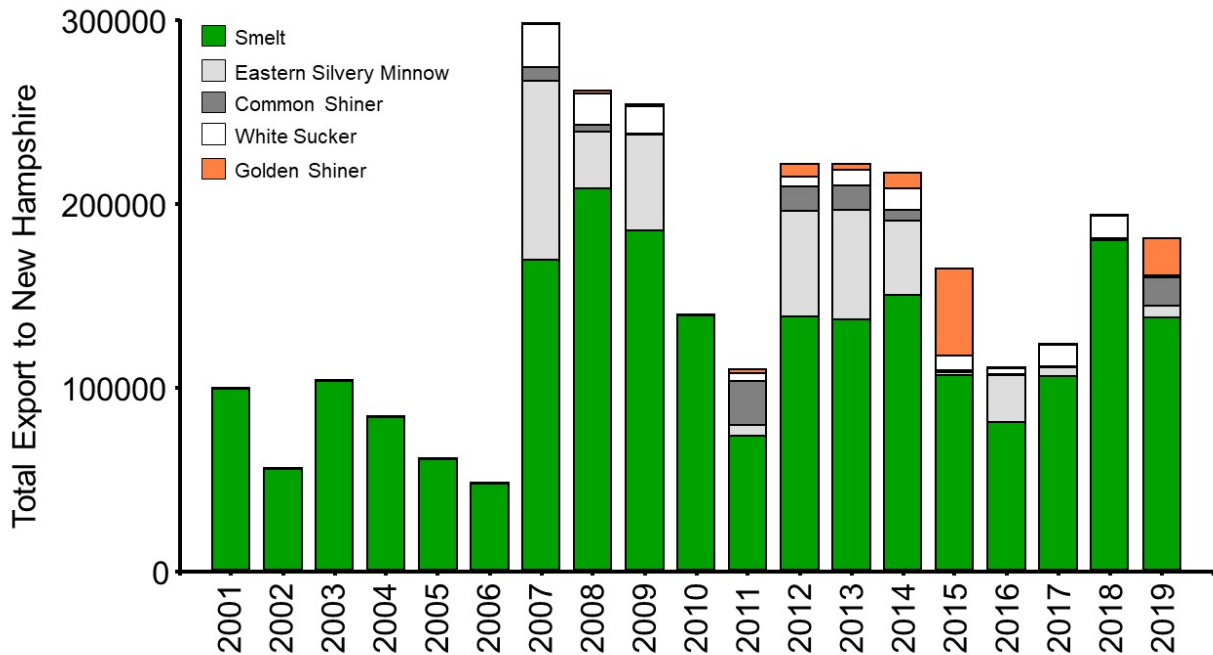


Figure 17 The number of individual fish by species reported as exported from Maine to New Hampshire. Some species are not represented in this figure due to their low numbers including Mummichog and Fallfish.

When compared with the total harvests reported by Maine wholesalers (Figure 18), Smelt exports to New Hampshire accounted for a mean of 15% of Maine’s total annual Smelt harvest from 2010 to 2019 with a low of 9% in 2011 and a high of 22% in 2014. Minnows and White Sucker were grouped to compare New Hampshire export with Maine’s total reported Baitfish Wholesaler harvests, which indicated a mean of 1.5% of live baitfish annually harvested in Maine where exported to New Hampshire from 2017 to 2019 with less than 1% exported in 2017 and 2018, and 2.7% exported in 2019.



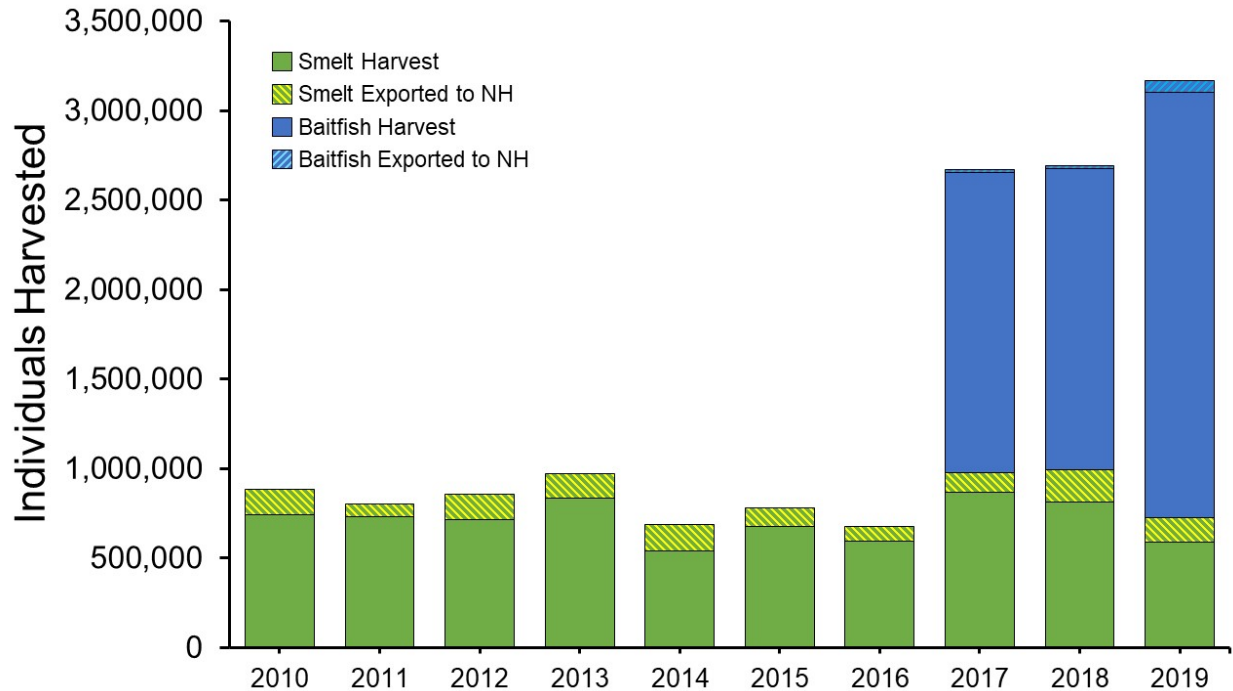


Figure 18 The total estimated number of individuals reported harvested by wholesalers with the number reported imported into New Hampshire.

Testing was conducted using the ten years of data from Maine and New Hampshire, 2010 through 2019, to determine if Smelt exports could be explained with licensing and harvest data. Linear regression was used to test whether the average price of a dozen small Smelt (supply and demand), Maine recreational license sales (demand), New Hampshire recreational license sales (demand), and total reported Smelt harvest (supply) could explain the yearly variation in Smelt exports to New Hampshire. All possible model combinations were compared using Akaike’s information criterion (AICc) which penalizes models with more variables (Bedrick & Tsai, 1994). The best model ( $\Delta AICc = 0$ ) explained 20% ( $adjR^2 = 0.20$ ) of the yearly variation in Smelt exports and included the average price of a dozen small Smelt, New Hampshire recreational license sales, and total reported Smelt harvest. Spearman rank correlation coefficients ( $\rho$ ) were then used to assess the relationship (i.e. positive = both increase together, or negative = one increases while the other decreases) between Smelt exports and each of the variables. There was no significant relationship among any of the individual variables and Smelt export, though all relationships were positive. The relatively weak linear model and the lack of significant relationships among the variables could indicate that supply does not influence export, harvest reports are not adequately capturing the year to year variation in harvest, New Hampshire import records don’t adequately capture Maine exports, or some other unaccounted for factors are affecting export.

## Commercial Permits

There are much less data available for Inland Commercial Permits than for licenses. Complete electronic sales data for Eel permits began in 2002, and for sucker, Yellow Perch, and Lamprey in 2011 (Figure 19). Permitting of commercial Eel Weirs ceased in 2015, and sales of Yellow Perch and Lamprey permits have been minimal since the electronic sales records began. Only a mean of one permit was sold each year for Yellow Perch and Lamprey with a maximum of 2 Yellow Perch permits (2013) and 3 Lamprey permits (2011 and 2020) sold each year. Though there were many more Sucker and Eel Pot permits sold each year, sales of both appear to be declining.

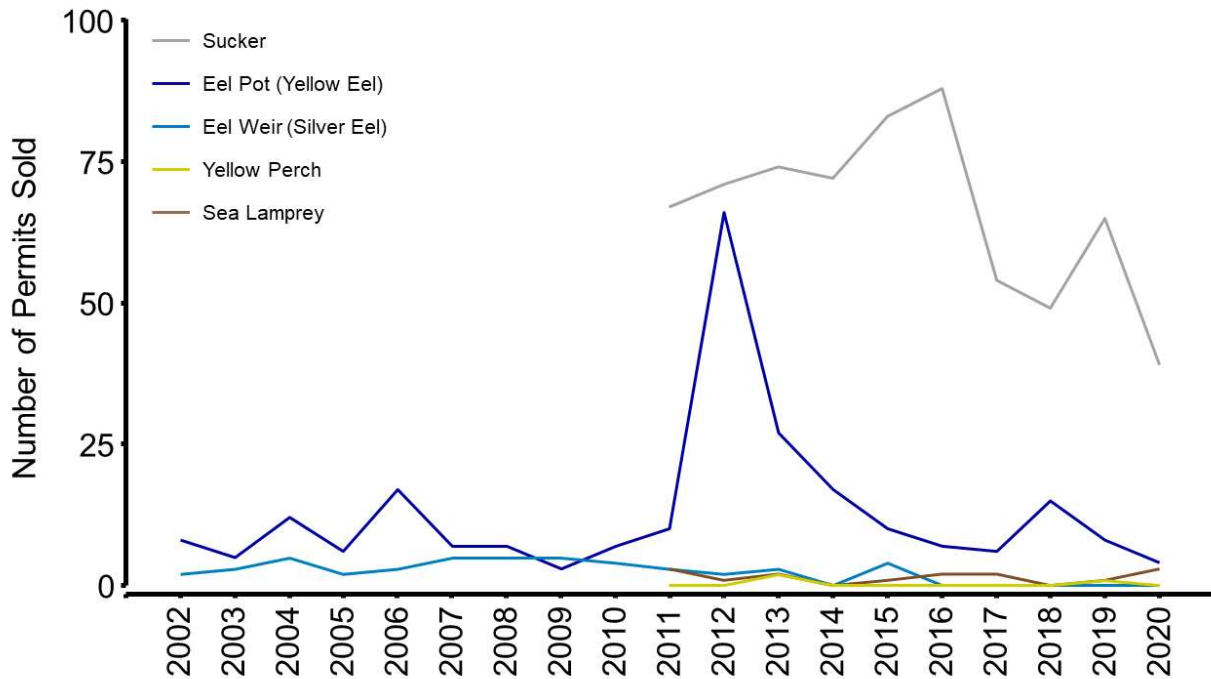


Figure 19 Permit license sales by year. Sales data for individual and crew permits were combined for fisheries with that option (sucker, Yellow Perch, Lamprey).

Sucker specific permits have been issued by MDIFW since 1991. Though the permits allow harvest of both sucker species found in Maine, White Sucker and Longnose Sucker (*Catostomus catostomus*), available information suggests Longnose Sucker are not regularly harvested. Longnose Sucker primarily occur in interior Maine farther away from demand for Lobster bait and grow to smaller sizes than White Sucker. A sucker permit allows harvest of sucker using traps at permittee selected and MDIFW approved locations from April 1<sup>st</sup> through the Friday preceding Memorial Day weekend. Some waters are closed to the commercial harvest of sucker due to concerns over spawning Smelt bycatch, the importance of suckers as forage for sport fish, the movement of invasive aquatic plants in traps, or bycatch of sport fish (Figure 20).

Sucker permittees have been required to report their harvests since 2018. A mean of 14 US tons of sucker per year have been reported harvested since 2018 with 11 US tons in 2018, 16 in 2019, and 14 in 2020.

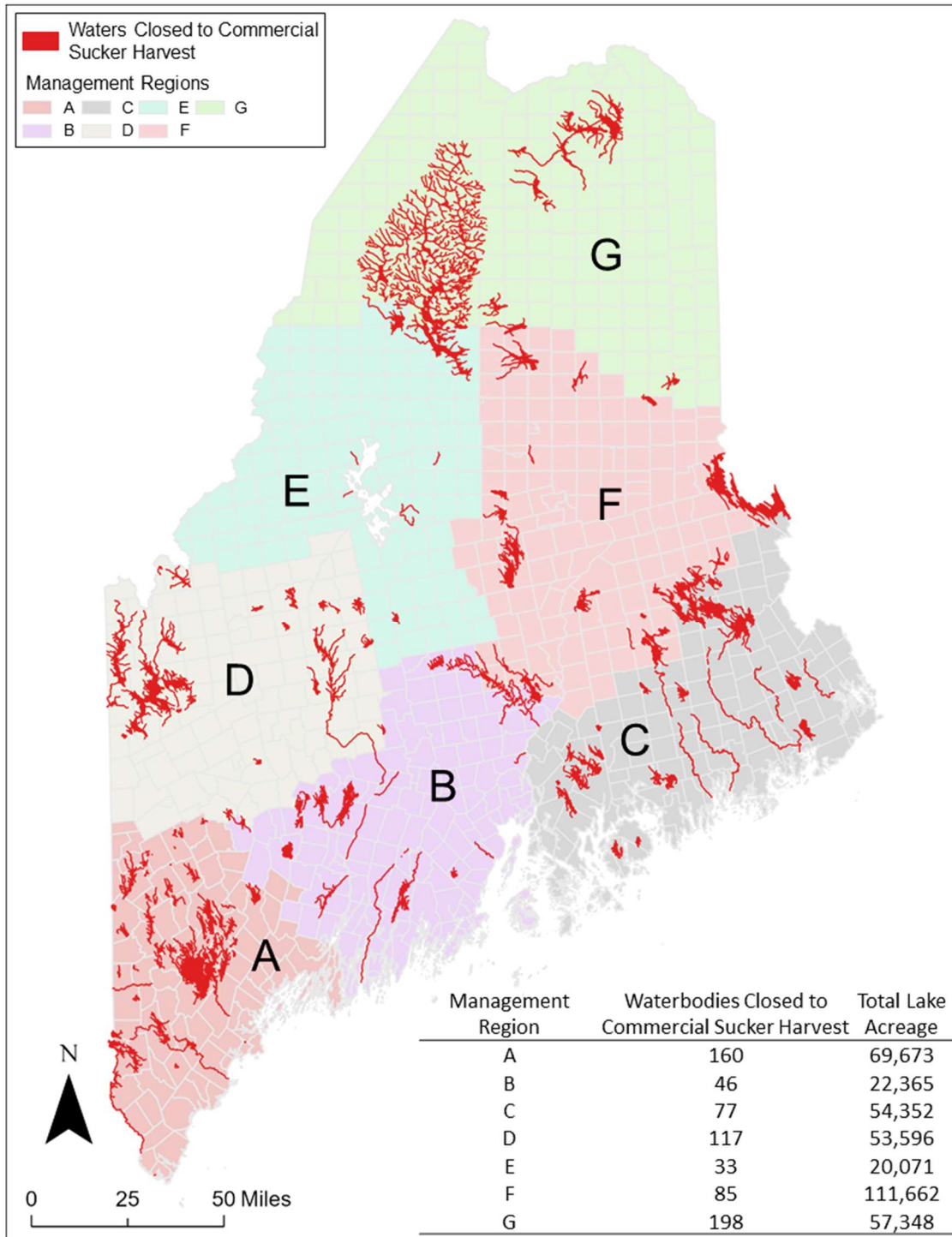


Figure 20 Map displaying waters closed to the commercial harvest of sucker. The number of uniquely named waters in the inset table includes lakes and flowing waters (i.e., brooks, streams, and rivers) while the total acreage only includes lakes.

Commercial permits specifically for the harvest of Yellow Eels through the use of baited Eel pots began in 1996 when the three Eel life stages began to be permitted separately. Eel pots cannot be baited with live-bait and may be placed in all waters within Maine if they do not obstruct other activities (e.g., boat launching, channels, swimming areas), with the exception of two ponds in Boothbay Harbor that are the subject of an ongoing Eel study. Eel Pot permittees are required to report their harvests on a monthly basis due to a requirement of the Atlantic States Fisheries Commission that compiles information across states to assess the status and health of their populations. Records of these reports have been entered electronically since 2019. In 2019 142 pounds of Eel were reported harvested using Eel pots and no Eels were reported harvested in 2020.

As far back as state law is digitally available, 1917, commercial Yellow Perch harvest permits have been available in Maine. Like Smelt Wholesaler licenses, Yellow Perch permittees are provided a list of waters where harvest is allowed (Figure 21). Waters open to Yellow Perch harvest were selected to minimize salmonid and Smelt bycatch. Unlike other commercial licenses and permits administered through MDIFW, Yellow Perch permittees are expressly required to kill Yellow Perch when harvested to prevent their spread to waters where they may have a detrimental impact. Yellow Perch permittees have also been required to submit an annual harvest report since 2018; however, there is no harvest data available given the lack of permit sales.

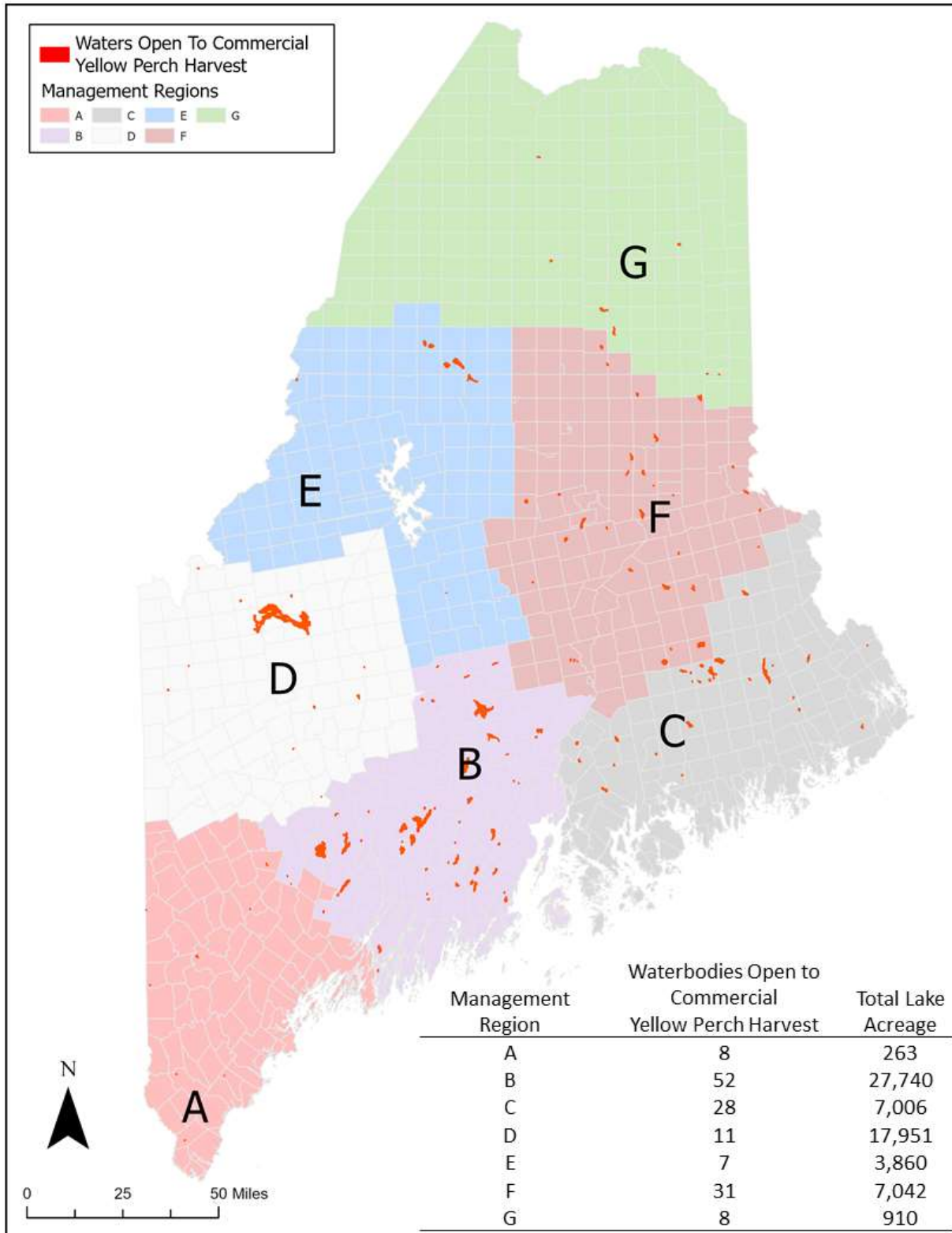


Figure 21 Map displaying the waters open to the commercial harvest of Yellow Perch. Only lakes are open to commercial harvest and the inset table summarizes the number and total acreage of the lakes by region.

The last commercial fishery permitted by MDIFW is the Sea Lamprey fishery. Commercial Sea Lamprey harvest permits have been available since 2001, as “Lamprey Eel” permits. Lamprey are harvested by dip-net or hand, though some have received scientific collectors permits that allow them to employ backpack electrofishers, so the risk of sport fish bycatch and transporting invasive aquatic plants is negligible. Thus the fishery has not required water specific regulations. Like Yellow Perch, permittees have been required to annually report their harvest activities since 2018, but the harvest data was not available at the time of this report.

## **Conclusion**

The commercial inland fisheries administered by MDIFW support commonly practiced traditional recreational fishing methods while contributing directly and indirectly to Maine’s economy. Wholesalers harvest bait to sell to retailers who sell to recreational anglers. Sucker harvesters sell suckers to Lobster fishermen. These fisheries are an important component of Maine’s economy. As such, these resources are actively managed to provide public use and economic opportunities while remaining considerate of the potential negative ecological consequences. There are numerous challenges to managing commercial inland fisheries including addressing concerns of overharvest, understanding ecological impacts, the potential spread of invasive species, and conflicts with other resource users (e.g., boaters, swimmers, fly-anglers, property owners). Despite their importance to Maine, these fisheries have not always received the same level of attention as other fishery resources due in part to the complexity of the ecological and social management issues associated with them. The data collected by MDIFW supports more informed decision making to fulfill the agency’s stewardship responsibility and ensure current and future generations can enjoy bountiful freshwater natural resources.

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# COOPERATIVE

STATE



FEDERAL

# PROJECT

This report has been funded in part by the Federal Aid in Sport Fish Restoration Program. This is a cooperative effort involving federal and state government agencies. The program is designed to increase sport fishing and boating opportunities through the wise investment of angler's and boater's tax dollars in state sport fishery projects. This program which was founded in 1950 was named the Dingell-Johnson Act in recognition of the congressmen who spearheaded this effort. In 1984 this act was amended through the Wallop Breaux Amendment (also named for the congressional sponsors) and provided a threefold increase in Federal monies for sportfish restoration, aquatic education and motorboat access.

The program is an outstanding example of a "user pays-user benefits" or "user fee" program. In this case, anglers and boaters are the users. Briefly, anglers and boaters are responsible for payment of fishing tackle, excise taxes, motorboat fuel taxes, and import duties on tackle and boats. These monies are collected by the sport fishing industry, deposited in the Department of Treasury, and are allocated the year following collection to state fishery agencies for sport fisheries and boating access projects. Generally, each project must be evaluated and approved by the U.S. Fish and Wildlife Service (USFWS). The benefits provided by these projects to users complete the cycle between "user pays – user benefits."



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