

**ASSESSMENT OF POTENTIAL FOR DISPERSAL OF AQUATIC
NUISANCE SPECIES BY RECREATIONAL BOATERS
INTO THE WESTERN UNITED STATES**

Technical Report

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ABSTRACT

The 100th Meridian Initiative is a multi-state, multi-agency program whose purpose is to prevent or slow the westward expansion of aquatic nuisance species (ANS), especially the zebra mussel, *Dreissena polymorpha*. It was implemented under the National Invasive Species Act of 1996 (P.L. 104-332). A major component of the Initiative is a large-scale recreational boater survey and inspection project conducted by agencies in states located along the 100th Meridian (i.e., North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas) under administration of the U.S. Fish and Wildlife Service. A preliminary survey was conducted in 1998. The results of the 1998 survey were used to design a much more extensive and intensive 1999 survey. The 1999 survey was carried out from April 1999 to April 2000. Survey components included boater interviews and inspections of accompanying watercraft; timed counts of trailered watercraft entering 100th Meridian Initiative states from the east; and counts and inspections of trailers at public launching areas of major lakes and reservoirs in 100th Meridian States. Survey results for 1999 revealed that, in Texas, Oklahoma, Kansas, and South Dakota, high percentages of out-of-state boaters were from home states harboring zebra mussels (mean = 84%). These states also reported that high percentages of boaters who had previously launched out-of-state last launched in states with zebra mussel infestations (mean = 86%), with 8% of these boaters last launching in bodies of water currently harboring zebra mussels. Nebraska reported low percentages of out-of-state boaters from zebra mussel-infested states (3%), but high percentages of out-of-state boaters from states west of the 100th Meridian (93%), indicating that it could serve as an important staging area for westward ANS dispersal. Seven hundred and twenty-four vessel inspections revealed only one instance of ANS transport (i.e., zebra mussels in Nebraska), but confirmed

sightings of zebra mussels on recreational boats independent of the 100th Meridian Initiative Survey were reported in Texas, Arizona, and Colorado during the 1999-2000 survey period. Survey results suggested that the transport of zebra mussels by recreational boaters may occur unpredictably and at low levels, and that programs relying heavily on inspections and removal to control ANS dispersal into western states may prove ineffective. Recommendations for future surveys include collection of more specific data relating to boater movements, concentrations, and home lake usage, and using data to effectively target expanded ANS education and awareness activities.

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INTRODUCTION

Nonindigenous aquatic nuisance species (ANS), including zebra mussels, have had major negative ecological impacts in environments where they have been introduced. These impacts include the displacement (and sometimes extinction) of native species and alterations in ecosystem nutrient and energy flows, which often produce cascading trophic effects. Zebra mussels have been implicated in the decline and extinction of native clams and mussels, and may ultimately cause the extinction of 50% of native unionid mussel species during the next ten years (Stein and Flack 1996). Filter feeding by dense populations of zebra mussels have greatly reduced phytoplankton concentrations and altered phytoplankton species compositions in some aquatic habitats, disrupting existing trophic structures (OTA 1993). Eurasian watermilfoil dominates and often excludes native plants where it becomes established (Boylen *et al.* 1999). Surface mats of this species cover aquatic habitats, inducing hypoxic conditions and increasing eutrophication as the plants decompose. The loss of native plant cover also reduces the macroinvertebrate and juvenile fish populations associated with native plant communities, adversely impacting the trophic levels dependent on these food sources (Benedict and Hepp 1999). Overall, it is estimated that impacts from terrestrial and aquatic nonindigenous species (NIS) are involved in the decline of 50% of all endemic North American species considered endangered or threatened, with NIS being the main factor in the decline of 18% of these threatened or endangered species (OTA 1993).

Environmental damage resulting from the introduction of NIS is frequently accompanied by negative economic impacts (Wiley 1997). Economic losses associated with ANS are usually incurred through expenditures for removal and/or control of the organisms and for environmental restoration. Macrofouling by zebra mussels has resulted in water outages (LePage 1993) and power disruption (O'Neill 1996) for entire municipalities, and costs associated with removing and controlling them in man-made raw water facilities will eventually run into the billions of dollars (OTA 1993). By the mid-1990s population levels of water hyacinth (a macrophytic ANS)

in Louisiana exceeded 1.2 million acres (Morton 1997), with water hyacinth and hydrilla control in Louisiana and Florida costing tens of millions of dollars annually (OTA 1993).

The federal government acknowledged the need for a comprehensive national ANS policy when it passed the National Aquatic Nuisance Prevention and Control Act (NANPCA) in 1990 (P.L. 101-646), and again in 1996 when it passed the National Invasive Species Act (NISA) (P.L. 104-332), which reauthorized and further strengthened NANPCA. One of the accomplishments of NANPCA was the creation of the Aquatic Nuisance Species Task Force co-chaired by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service (USFWS). The ANS Task Force includes members from six state, one Canadian provincial, and ten non-federal agencies. One of the products of the ANS Task Force was the formation of the Western Regional Panel on Aquatic Nuisance Species (WRP), whose main objective is to facilitate development of coordinated programs designed to prevent the introduction and spread of zebra mussels and other ANS into non-infested North American freshwaters west of the 100th Meridian.

The 100th Meridian Initiative—a major multi-agency partnership effort among the states and provinces located along the 100th Meridian—was implemented in late 1997 by the USFWS to achieve the goals set forth by the WRP. A major focus of the 100th Meridian Initiative is monitoring and controlling the westward dispersal of zebra mussels and other ANS. One of the main components of the 100th Meridian Initiative is a large-scale boater interview and inspection project coordinated by the USFWS and conducted by agencies and institutions in states along the 100th Meridian (i.e., Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota). The Center for Biological Macrofouling Research at The University of Texas at Arlington was chosen by the USFWS to conduct the Texas component of the 100th Meridian Initiative Survey and to compile and analyze overall survey data collected during the preliminary 1998 survey and the full twelve-month 1999 survey. This report describes the outcomes of the 1998 and 1999 100th Meridian Initiative Surveys. It presents an analysis of survey results, draws conclusions

regarding the potential of trailered watercraft to act as a vector for spread of ANS into western states, and makes recommendations for modifying future surveys to better achieve the objectives of the 100th Meridian Initiative.

MATERIALS AND METHODS

Data collection for the 100th Meridian Initiative Survey began in the summer of 1998. It involved conducting boater interviews and recreational watercraft inspections at various launch areas and highway rest stops in five states, including Texas, Oklahoma, Kansas, Nebraska, and South Dakota. These interviews were conducted from June 5, 1998 to December 19, 1998, with exact interview dates varying from state to state. Data were collected using an early version of the Trailered Boat Survey Interview Form (Appendix 1).

Based on the 1998 field season experience, an effort was made to increase the amount and quality of the data collected during the 1999 season. Thus, the 100th Meridian Initiative Survey for 1999 was expanded to include different data collection methods. Several standardized forms, each with a specific set of instructions, were developed for field personnel in order to promote consistent data collection among survey participants (Appendices 2, 3, 4, and 5). Data collection for the 1999 season consisted of four major components and involved direct reporting from the same five states involved in the 1998 survey. Reports of 100th Meridian Initiative survey data for North Dakota were independently submitted to the USFWS in both 1998 and 1999; pertinent data from these North Dakota reports were included in this report. Overall, the 1999 survey encompassed the period from April 10, 1999 to April 8, 2000, although the dates and combination of survey components used varied from state to state. Survey data for 1998 and 1999 were compiled in a Microsoft Access database that was queried to provide values for survey variables of interest.

Survey Components

Data collection for the 1999 survey consisted of four main components: (1) boater interviews and inspection of the accompanying trailers and watercraft at launch areas and highway rest stops, (2) self-interview forms left on unattended out-of-state vehicles with trailers at public launch areas, (3) counts and inspections of unattended trailers (with and without watercraft) at public launch areas, and (4) timed counts of trailered westbound watercraft passing highway rest areas at entry points on the eastern borders of 100th Meridian states.

The Trailered Boat Survey Interview Form (Appendices 1 and 2) was initially the main focus of the 100th Meridian Initiative survey, since it was felt that this was the most efficacious way to determine the extent of transport of ANS (particularly *Dreissena polymorpha*, the zebra mussel, and aquatic macrophytes) by recreational boaters between drainages, and to remove, collect, and identify any ANS discovered. These interviews also provided the opportunity for conducting outreach and public awareness activities. Interviews and inspections were conducted by trained personnel from various state agencies and educational institutions at both highway rest stops and public launch areas at major water bodies. The rest stop sites surveyed were on major highways where interviewers were likely to intercept the greatest number of boaters moving west into 100th Meridian states from waters in eastern states harboring zebra mussels. The Trailered Boat Survey Interview Form had fields for recording information provided by the interviewed boater, including the home state of the boater as well as general information on the type and usage of the watercraft. Information was also collected on the locations and dates of the boater's previous launchings and on the locations and dates of planned future launchings. The actual sites of last launch recorded on the Trailered Boat Survey Interview Form were compared with data on the current distribution of zebra mussels in order to determine the extent of previous launches by interviewed boaters in zebra mussel-infested waters. Information on zebra mussel distribution was obtained from the ANS Clearinghouse Database maintained by the U.S. Geological Survey. The final section of the form recorded the results of the watercraft and trailer inspection by the

interviewer and included specific data on the identification and handling of any ANS discovered. The information recorded allowed determination of a number of variables related to the movement patterns of boaters and the possible dispersal of ANS. The Trailered Boat Survey Interview Form used in 1999 was virtually identical to the 1998 form, with slight changes made to the interview location and ANS inspection fields in order to streamline data entry and analysis (Appendices 1 and 2).

While conducting interviews at public launch areas during 1998, it was noted that there were often numbers of unattended vehicles with trailers parked at these sites, many from out-of-state. Thus, for the 1999 field season, a Boater Survey For Nonnative Aquatic Species form (Appendix 3) was developed to collect data from boaters when they returned to their trailers at the launch site. This form was designed to be self-completed by the boater, and was placed (along with ANS outreach materials) in a postage-paid return envelope on the windshield of all out-of-state tow vehicles in the boat launch parking lot. The Boater Survey For Nonnative Aquatic Species form contained the same fields as the Trailered Boat Survey Interview Form, excluding inspection results (since the operator and watercraft were not present to be interviewed and inspected). Information from all returned forms was compiled in the Trailered Boat Survey Interview Form database.

At the launch sites visited, the total number of unattended trailers and their states of origin were also counted in order to estimate visitation by out-of-state boaters at the water bodies surveyed. Parked trailers were visually inspected for ANS. Data were recorded on the Trailer Counts for Launch Areas and Related Facilities form (Appendix 4). A report form was completed for each visit to a launch site. Data recorded included the total number of trailers and the state of origin of each trailer present, as well as the presence and type of any ANS found on a trailer. Trailer count data was compiled in a separate database and analyzed for variables that included numbers of out-of-state trailers, numbers of trailers from states harboring zebra mussels, and numbers of trailers from states west of the 100th Meridian.

Timed counts of trailered westbound watercraft were recorded during boater interview sessions at highway rest stops. This data was recorded on the Trailered Boat Traffic Summary Report form (Appendix 5). Data were collected on the number, type, and state of origin of trailered westbound watercraft passing the stop during one-hour intervals. The data were entered into a separate database and analyzed for information relating to a number of variables that included rate of entry, home state, and the relative percentages of out-of-state boaters.

Survey logistics and movement patterns of recreational boaters varied among participating states. Thus, researchers in different states placed different emphasis on the types of data collected during the 1999 survey. The specific types of data recorded by each state in 1999 are described in the following section. Survey data for Texas were supplied by Kevin L. Buch and Robert. F. McMahon of the Department of Biology, The University of Texas at Arlington; for Oklahoma by Jim Schooley at Northeastern State University; for Kansas by Gene Young at Southwestern College; for Nebraska by Steven Schainost with the Nebraska Game and Parks Commission; for South Dakota by Clifton Stone with the South Dakota Department of Game, Fish and Parks; and for North Dakota by Terry Steinwand at the North Dakota Game and Fish Department.

Data Collection by State

Texas

In 1998, boater interviews and inspections were conducted from September 7, 1998 to December 19, 1998 at five separate locations within eastern Texas (Table 1). Texas survey data for 1999 were collected using all four forms (Table 2). Boater interviews and inspections were conducted from April 10, 1999 until April 8, 2000 at five different locations. Trailer counts and self-survey form distributions were conducted over the same period at launch sites on four different lakes. Highway rest stop traffic counts were conducted at two sites from April 10, 1999 until July 5, 1999.

Oklahoma

In 1998, boater interviews and inspections were conducted at two sites during the period of July 2, 1998 and July 22, 1988 (Table 1). For 1999, Oklahoma researchers conducted rest stop traffic counts only from May 15, 1999 until October 3, 1999 at two sites (Table 2).

Kansas

In 1998, boater interviews and inspections were conducted from June 5, 1998 until September 27, 1998 at a single site (Table 1). For 1999, Kansas researchers conducted boater interviews and inspections, launch area trailer counts, and rest stop traffic counts (Table 2). Interviews and inspections were conducted at fourteen sites between May 28, 1999 and August 22, 1999. Launch area trailer counts were made at launch sites on eleven different lakes from May 22, 1999 until September 9, 1999. Traffic counts were conducted from May 28, 1999 until June 30, 1999 at a single site (Table 2).

Table 1. Data collection by state—1998

State	Interviews and Inspections	Launch Area Trailer Counts	Highway Trailered Boat Counts
TX	9/7/1998 – 12/19/1998 I-30 Rest Stop, New Boston Lake Fork Lake Texoma Wright-Patman Lake Lake 'O' The Pines	NA	NA
OK	7/2/1998 – 8/20/1998 Newt Graham L&D #18 Chouteau L&D #17	NA	NA
KS	6/5/1998 – 9/27/1998 Belle Plaine Visitor Center	NA	NA
NE	7/23/1998 – 9/13/1998 Lake MacConaughy Cabela's (Sydney)	NA	NA
SD	7/3/1998 – 9/28/1998 I-90 Rest Area, Chamberlain I-90 Rest Area, Oacoma	NA	NA

Table 2. Data collection by state—1999

State	Interviews and Inspections	Launch Area Trailer Counts	Highway Trailered Boat Counts
TX	4/10/1999-4/8/2000 I-30 Rest Stop, New Boston Lake Fork Lake Texoma Ray Roberts Lake Caddo Lake	4/10/1999-4/8/2000 Lake Fork Lake Texoma Ray Roberts Lake Caddo Lake	4/10/1999-7/5/1999 I-30 Rest Stop, New Boston I-75 Visitor Center, Denison I-35 Visitor Center, Gainesville
OK	NA	NA	5/15/1999-10/3/1999 I-40 Rest Stop, Sallisaw I-44 Rest Stop, Vinita
KS	6/5/1998 – 9/27/1998 Belle Plaine Visitor Center Cowley County Lake John Redmond Reservoir Lincoln County Rest Area Council Grove Lake Big Hill Lake Clinton Lake Milford Lake Wilson Lake Marion Reservoir Winfield Lake Hillsdale Lake Cheney Reservoir El Dorado Lake	5/29/1999-9/9/1999 John Redmond Reservoir Council Grove Lake Melvern Lake Clinton Lake Milford Lake Wilson Lake Marion Reservoir Winfield Lake Cheney Reservoir Hillsdale Lake El Dorado Lake	5/28/1999-6/30/1999 Belle Plaine Visitor Center
NE	5/31/1999-9/11/1999 Lake MacConaughy Cabela's (Sydney)	6/3/1999-7/31/1999 Lake MacConaughy	5/29/1999-10/12/1999 Cabela's (Sydney) I-80 Exit 435
SD	4/10/1999-10/6/1999 I-90 Rest Area, Chamberlain Lake Francis Case Lake Oahe Lake Sharpe	NA	4/5/1999-9/21/1999 I-90 Rest Area, Chamberlain

Nebraska

In 1998, boater surveys and inspections were conducted at two sites during the period between July 23, 1998 and September 13, 1998 (Table 1). For 1999, Nebraska researchers collected data using all four forms (Table 2). Boater inspections and interviews were conducted at two sites between the dates of June 3, 1999 and July 31, 1999. Launch area trailer counts were taken and self-survey forms were distributed at a single lake launch site between the dates of May 31, 1999 and October 12, 1999. Rest stop traffic counts were conducted at two sites between the dates of May 29, 1999 and October 12, 1999 (Table 2).

South Dakota

In 1998, boater interviews and inspections were conducted at two sites between the dates of July 3, 1998 and September 28, 1998 (Table 1). For 1999, South Dakota researchers conducted boater interviews and inspections and rest stop traffic counts (Table 2). Boater interviews and inspections were performed at four sites between the dates of April 10, 1999 and October 6, 1999. Rest stop traffic counts were conducted at one site between April 5, 1999 and September 21, 1999 (Table 2).

RESULTS

100th Meridian Initiative Survey variables analyzed in 1999 varied from state to state due to differences in the types of data collected and emphasis on particular aspects of data collection. This section will report 1998 and 1999 100th Meridian Survey results on a state-by-state basis and then provide an overall summary of the total survey results for 1999.

State Survey Results

Texas—1998

During the 1998 survey period, twenty-one interviews were conducted at five different sites (Table 3). Eighteen of these were boater interviews and inspections and three were self-survey responses. Boaters were from a total of five home states other than Texas, and these home states accounted for ten (48%) of the twenty-one total interviews. All five of these states currently host zebra mussel infestations, and all ten (100%) of the out-of-state boaters interviewed were from these states. The five home states (with number of interviews in parentheses) are: Oklahoma (4), Louisiana (3), Arkansas (1), Missouri (1), and Tennessee (1).

The state in which the vessel was last launched was reported in all twenty-one interviews, and sixteen (76%) of these were in states other than Texas. All sixteen previous out-of-state

launchings were in states with zebra mussel infestations. Previous out-of-state launchings were represented by four different states: Arkansas (10), Oklahoma (3), Louisiana (2), and Tennessee (1). The actual site of last launch was reported in all twenty-one interviews, and a total of fifteen different water bodies were represented. Ten of these locations were outside of Texas, and none were in bodies of water currently harboring zebra mussels (Table 4).

The state of next launch was reported in all twenty-one interviews, and six (29%) of these were reported to be in four states other than Texas. All six were in states with zebra mussel infestations. The four states represented were Oklahoma (2), Louisiana (2), Arkansas (1) and Missouri (1). A total of eighteen watercraft inspections were conducted with no ANS of any type recorded.

Table 3. Interview and inspection data—Texas 1998

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	21 (18 inspections; 3 mail-in responses)
Total No. of Sites	5
Total Out-of-State Interviews	10
Total Out-of-State Interviews from Zebra Mussel (ZM) States	10
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	OK(4)*, LA(3)*, AR(1)*, MO(1)*, TN(1)*
Total No. of Interviews Reporting a State of Last Launch	21
Total No. of Last Launches in a ZM State	16
States of Last Launch (* = ZM State)	AR(10)*, OK(3)*, LA(2)*, TN(1)*
Total No. of Interviews Reporting a State of Next Launch	21
Total No. of Next Launches in a ZM State	6
Total No. of Next Launches in a State West of the 100 th Meridian	0
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	OK(2)*, LA(2)*, AR(1)*, MO(1)*
Total No. of ANS Inspections	18
Total No. of Inspections Rejected by Boater	0
ANS Inspection Results	Negative

Table 4. Previous launch site locations in zebra mussel-infested states—Texas 1998

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
AR	6	Lake DeGray, Lake DeQueen, Lake Greeson, Lake Hamilton, Lake Grayson, Lake Ouachita
OK	2	Lake Arbuckle, Lake Eufala
LA	1	Cross Lake
TN	1	Norris Lake
Total	10	0 sites harboring zebra mussels

Texas—1999

During the 1999–2000 survey period, forty-four boater interviews were conducted over five different sites (Table 5). Personal interviews made up twenty-six of these interviews; the remaining eighteen interviews were mail-in boater self-survey responses. Out-of-state boaters were from a total of nine states other than Texas, representing forty (91%) of the total forty-four interviews. Thirty seven (93%) of these forty boaters were entering Texas from seven states with waters harboring zebra mussels. These states included Oklahoma (15), Louisiana (6), Indiana (6), and Arkansas (4). Of the forty out-of-state interviews, three (8%) were from states west of the 100th Meridian. Two states were represented: Arizona (2) and New Mexico (1) (Table 5).

The state of last launch was reported in all forty-four interviews, and thirty-eight of these were from water bodies in eight states outside of Texas. States with zebra mussel-infested waters made up six of these eight states, and thirty-four (89%) of the thirty-eight previous out-of-state launchings were in states with zebra mussel-infested waters. States of last launch with zebra mussel infestations included Oklahoma (10), Louisiana (5), Indiana (5), and Arkansas (4) (Table 5). The actual site of previous launch was reported in all forty-four interviews, of which thirty-nine were in water bodies outside of Texas. Of these thirty-nine different out-of-state launch sites, thirty-five were in states known to harbor zebra mussels, and five (14%) of these thirty-five sites were in waters currently colonized by zebra mussels. These five sites were represented by

three states—Arkansas (2), Louisiana (2), and Tennessee (1)—and all five sites were in separate water bodies (Table 6).

Table 5. Interview and inspection data—Texas 1999

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	44 (26 inspections; 18 mail-in interviews)
Total No. of Sites	5
Total Out-of-State Interviews	40
Total Out-of-State Interviews from Zebra Mussel (ZM) States	37
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	OK(15)*, IN(6)*, LA(6)*, AR(4)*, MO(3)*, TN(2)* IL(1)*, AZ(2) ⁺ , NM(1) ⁺
Total No. of Interviews Reporting a State of Last Launch	44
Total No. of Last Launches in a ZM State	34
States of Last Launch (* = ZM State)	OK(14)*, AR(6)*, IN(6)*, LA(5)*, TN(2)*, MO(1)*, KS(2), AZ(2)
Total No. of Interviews Reporting a State of Next Launch	41
Total No. of Next Launches in a ZM State	26
Total No. of Next Launches in a State West of the 100 th Meridian	1
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	OK(10)*, IN(5)*, LA(5)*, AR(4)*, MO(2)*, TN(1)*, AZ(1) ⁺ , KS(1)
Vessel Types (No. and Percent of Total)	Bass Boat - 36(72%), Pleasure Boat – 6(21%), Jet Ski – 1(3%), Other – 1(3%)
Total No. of ANS Inspections	26
Total No. of Inspections Rejected by Boater	0
ANS Inspection Results	Negative

The state of next launch was reported in forty-four interviews, and twenty-nine of these were in eight states other than Texas. States with zebra mussel-infested waters comprised six of the eight different states of next launch, and included twenty-seven (93%) of the twenty-nine next out-of-state launches. States of next launch with zebra mussel infestations included Oklahoma (10), Louisiana (5), Indiana (5), and Arkansas (4). Only one interviewed boater reported a state of next launch west of the 100th Meridian (Arizona).

A total of twenty-six watercraft inspections were conducted, during which no evidence of any type of ANS was discovered. Vessel types inspected included bass boats comprising the

majority at thirty-six, or 82%; pleasure boats, six, or 14%; jet skis, one, or 2%; and other, one or 2% of the total of forty-four vessel inspections.

Table 6. Previous launch site locations in zebra mussel-infested states—Texas 1999

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
OK	13	Chickasaw; Spring River; Lake Eufala; Lake Tenkiller; Arbuckle Lake; Lake Murray; Lake Keystone; Lake Broken Bow; Lake Humphrey; Dow Lake; Spavinaw Lake; Lake Grand; Carl Blackwell Lake
AR	7	Lake Maumelle*; Arkansas River*; Bold Shoals Lake; Millwood Lake; Lake Hamilton; Lake Mershak; Lake Atkins
LA	7	Red River*; Atchafalaya Basin*; Black Bayou; Toledo Bend; Henderson Lake; Vermillion Lake; Wax Lake
IN	4	Raccoon Reservoir; Summit Lake; Geist Reservoir; Sylvan Lake
TN	2	Tennessee River*; Kentucky Lake
MO	2	Table Rock Lake; Lake of the Ozarks
Total	35	5 sites harboring zebra mussels

Launch area counts and inspections of boat trailers were conducted at four water bodies during the 1999 survey period (Table 7). A total of 2,764 trailers were counted and inspected. Out-of-state trailers accounted for 274 (10%) of the total number of trailers inspected. Of these out-of-state trailers, 253 (92%) were from states harboring zebra mussel infestations. Thus, trailers from zebra mussel states comprised 9% of the total of all trailers inspected (Table 8). A total of twenty-two states were represented among the out-of-state trailers, fourteen of which harbor zebra mussel infestations. Lake Fork had the highest percentage (94%) of out-of-state trailers from zebra mussel-infested states. Three states—Oklahoma (93), Louisiana (79), and Arkansas (34)—accounted for 75% of the total out-of-state trailers and for 82% of the trailers from states harboring zebra mussels. Of the 273 out-of-state trailers, fourteen (5%) were from states west of the 100th Meridian. These trailers originated from four different states: New Mexico (6), Arizona (4), Colorado (3), and Washington (1) (Table 7).

Trailer inspections for ANS were negative, with the exception of one instance of the aquatic macrophyte *Elodea* found on a trailer from Arkansas that was parked at Lake Fork. Further inspection showed the plant to probably have come from a large *Elodea* mat located at the launch ramp, as several Texas trailers parked at the same launch site had also collected similar amounts of *Elodea* of the same species and condition.

Highway counts of westbound-trailer boat traffic were conducted at one site during the 1999 field season (Table 9). A total of ninety-five individual trailered watercraft were counted over fifteen total hours, for an average entry rate of 6.3 boats h⁻¹. Out-of-state watercraft represented twenty-two (23%) of the ninety-five westbound vessels counted; they were from five different states, all harboring zebra mussel infestations: Arkansas (12), Oklahoma (6), Missouri (2), Louisiana (1) and Illinois (1). The average rate of entry for vessels from states harboring zebra mussel populations was 1.5 vessels h⁻¹.

Table 7. Launch area trailer count and inspection data—Texas 1999

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Trailers	2764
No. of Waterbodies	4
No. of Out-of-State Trailers	274
No. of Out-of-State Trailers from Zebra Mussel States	253
State Breakdown of Trailers from Zebra Mussel States	OK(93), LA(79), AR(34), MO(15), IN(9), TN(5), MS(5), IL(3), IA(2), MI(1), MN(1), OH(1), AL (1), WV(1)
No. of Trailers from States West of the 100 th Meridian	14
State Breakdown of Trailers from States West of the 100 th Meridian	NM(6), AZ(4), CO(3), WA(1)
Trailer ANS Inspection Results	Negative

Oklahoma—1998

During the 1998 survey period in Oklahoma, fifteen interviews were conducted at two different sites (Table 10). Boaters interviewed were from Oklahoma only. None of these boaters reported previous launchings outside of Oklahoma, and none reported future launchings outside of Oklahoma. A total of fifteen watercraft inspections were conducted with no ANS of any type recorded.

Table 8. Launch area trailer count and inspection data by site—Texas 1999.

Water Body	Total Trailers	No. from Home State	No. from Out of State	% Out of State	No. from Zebra Mussel States	% of Out of State Trailers from Zebra Mussel States
<i>Lake Fork</i>	1455	1252	203	14%	190	94%
<i>Lake Texoma</i>	836	792	44	5%	39	89%
Ray Roberts Lake	340	332	8	2%	5	62%
Caddo Lake	133	114	19	14%	19	100%
Total	2764	2490	274	10%	253	92%

Table 9. Highway trailered boat count data—Texas 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
No. of Sites	1
Total No. of Boats	95
Total No. of Survey Hours	15
Total No. of Boats per Hour	6.3/h
Total No. of Boats from Zebra Mussel States	22
No. of Boats from Zebra Mussel States per Hour	1.5/h
Breakdown of Zebra Mussel States	AR(12), OK(6), MO(2), IL(1), LA(1)
Total No. of Boats from States West of the 100 th Meridian	0
No. of Boats from States West of the 100 th Meridian per Hour	0
Breakdown of States West of the 100 th Meridian	NA

Oklahoma—1999

During the 1999 field season, Oklahoma submitted highway trailered boat counts only (Table 11). Highway trailered boat counts were conducted at two sites during the 1999 field season. A total of 636 individual trailered watercraft were counted over 236 total hours, for an average entry rate of 2.7 boats h⁻¹. Out-of-state watercraft represented 373 (59%) of the 636 vessels counted, and 300 (80%) of these were from states with zebra mussel infestations. These 373 out-of-state vessels were from twenty-two different states. Ten of these states harbor zebra mussel populations. The states included Arkansas (170), Missouri (106), and Illinois (10). The average rate of entry for trailered watercraft from states harboring zebra mussel populations was 1.3 vessels h⁻¹.

Table 10. Interview and inspection data—Oklahoma 1998.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	15
Total No. of Sites	2
Total Out-of-State Interviews	0
Total Out-of-State Interviews from Zebra Mussel (ZM) States	0
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	Not Available
Total No. of Interviews Reporting a State of Last Launch	0
Total No. of Last Launches in a ZM State	0
States of Last Launch (* = ZM State)	Not Available
Total No. of Interviews Reporting a State of Next Launch	0
Total No. of Next Launches in a ZM State	Not Available
Total No. of Next Launches in a State West of the 100 th Meridian	0
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	Not Available
Total No. of ANS Inspections	15
Total No. of Inspections Rejected by Boater	0
ANS Inspection Results	Negative

Of the twenty-two different states represented, seven were states west of the 100th Meridian. These included Arizona (7), Wyoming (6), and California (4). States west of the 100th Meridian comprised twenty-six (7%) of the 373 out-of-state trailered vessels counted. The average rate of entry for trailered watercraft from states west of the 100th Meridian was 0.11 vessels h⁻¹.

Table 11. Highway trailered boat count data—Oklahoma 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
No. of Sites	2
Total No. of Boats	636
Total No. of Survey Hours	236
Total No. of Boats per Hour	2.7/h
Total No. of Boats from Zebra Mussel States	300
No. of Boats from Zebra Mussel States per Hour	1.3/h
Breakdown of Zebra Mussel States	AR(170), MO(106), IL(10), MI(3), MN(3), NY(3), MS(2), IA(1), LA(1), PA(1)
Total No. of Boats from States West of the 100 th Meridian	26
No. of Boats from States West of the 100 th Meridian per Hour	0.11/h
Breakdown of States West of the 100 th Meridian	AZ(7), WY(6), UT(5), CA(4), NM(2), CO(1), OR(1)

Kansas—1998

During the 1998 survey period, 212 interviews were conducted at a single site (Table 12). Boaters were from a total of thirteen home states other than Kansas and accounted for 78 (37%) of the 212 total interviews. Of the seventy-eight out-of-state interviews, sixty-five (83%) boaters were from seven different states that harbor zebra mussels. The states included Oklahoma (54), Missouri (3), and Nebraska (3) (Table 12). Three (4%) of the seventy-eight out-of-state boaters were from two states west of the 100th Meridian: Colorado (2) and Idaho (1).

The state in which the vessel was last launched was reported in 206 interviews. One hundred and six (51%) of these were launched in eleven states other than Kansas. Ninety- six (91%) of the 106 previous out-of-state launchings were in seven states with zebra mussel-infested waters. The states included Oklahoma (82), Missouri (7), and Nebraska (3). The actual site of last launch was reported in 206 interviews. One hundred eight of these previous launches were at twenty-one different sites outside of Kansas. Of these twenty-one sites, fifteen were in states with zebra mussel populations, and one (5%) was from a location currently harboring zebra mussels (Table 13).

Table12. Interview and inspection data—Kansas 1998.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	212
Total No. of Sites	1
Total Out-of-State Interviews	78
Total Out-of-State Interviews from Zebra Mussel (ZM) States	65
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	OK(54)*, TX(8), MO(3)*, NE(3)*, SD(2), CO(1) ⁺ , ID(1) ⁺ , IL(1)*, IN(1)*, LA(1)*, PA(1)*, TN(1)*, WY(1) ⁺
Total No. of Interviews Reporting a State of Last Launch	206
Total No. of Last Launches in a ZM State	96
States of Last Launch (* = ZM State)	OK(82)*, MO(7)*, TX(7), NE(3)*, CO(1), ID(1), IL(1)*, LA(1)*, PA(1)*, TN(1)*, SD(1)
Total No. of Interviews Reporting a State of Next Launch	172
Total No. of Next Launches in a ZM State	114
Total No. of Next Launches in a State West of the 100 th Meridian	3
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	OK(101)*, TX(6), MO(5)*, NE(3)*, SD(3), CO(2) ⁺ , LA(2)*, MN(2)*, ID(1) ⁺ , IN(1)*
Total No. of ANS Inspections	212
Total No. of Inspections Rejected by Boater	0
ANS Inspection Results	Negative

The state of next launch was reported in 172 interviews, of which 126 (60%) were reported in ten states other than Kansas. Of the 126 boaters next launching out-of-state, 114 (90%) were planning launches in six different states with zebra mussel infestations. The states included Oklahoma (101), Missouri (5), and Nebraska (3). Three (2%) of the 126 boaters next launching out-of-state were launching in two states west of the 100th Meridian: Colorado (2) and Idaho (1). A total of 212 watercraft inspections were conducted with no ANS of any type recorded.

Table13. Previous launch site locations in zebra mussel-infested states—Kansas 1998.

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
OK	7	Birch Lake, Kaw Lake, Keystone Lake, Lake McMurtry, Lake Skiatook, Smidler Lake, Grand Lake
MO	3	Mark Twain Lake, Table Rock Lake, Reno Lake
IN	1	Patora Lake,
LA	1	Lake St. Joseph
NE	1	Lake MacConaughy
PA	1	Raystown Dam
TN	1	Chickamauga Lake*
Total	15	1 site harboring zebra mussels

Kansas—1999

During the 1999 survey period, 175 interviews were conducted at fourteen sites (Table 14). Boaters were from a total of thirteen home states other than Kansas, and these out-of-state boaters accounted for fifty-six (32%) of the 175 total interviews. Of the fifty-six out-of-state interviews, thirty-seven (66%) of the boaters were from six states with zebra mussel infestations. These states included: Oklahoma (19), Missouri (8), and Nebraska (4). Five (9%) of the fifty-six out-of-state interviews were from two states west of the 100th Meridian: Colorado (4) and New Mexico (1).

The state of last launch was reported in 151 interviews. Eighty-three (55%) of these were in eleven states/provinces other than Kansas. Sixty-nine (83%) of the eighty-three previous out-of-

state launchings were in eight states with zebra mussel-infested waters. The states included Oklahoma (38), Missouri (19), Arkansas (4), and Iowa (3) (Table 14). The actual site of last launch was reported in 149 interviews (Table 15). Eighty-one (54%) of these previous launchings were outside of Kansas, representing a total of twenty-nine different sites. Of these

Table 14. Interview and inspection data—Kansas 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	175
Total No. of Sites	14
Total Out-of-State Interviews	56
Total Out-of-State Interviews from Zebra Mussel (ZM) States	37
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	OK(19)*, TX(11), MO(8)*, CO(4) ⁺ , NE(4)*, IA(3)*, LA(2)*, AR(1)*, FL(1), NC(1), NM(1) ⁺ , SD(1)
Total No. of Interviews Reporting a State of Last Launch	151
Total No. of Last Launches in a ZM State	68
States of Last Launch (* = ZM State)	OK(38)*, MO(19)*, TX(11), AR(4)*, IA(3)*, CO(2) ⁺ , NE(2)*, LA(1)*, MS(1)*, SD(1), Canada (province not given)(1)
Total No. of Interviews Reporting a State of Next Launch	162
Total No. of Next Launches in a ZM State	100
Total No. of Next Launches in a State West of the 100 th Meridian	6
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	OK(56)*, MO(23)*, TX(10), AR(8)*, CO(5) ⁺ , WI(4)*, IA(3)*, NE(2)*, MN(1)*, MT(1) ⁺ , Ontario, Canada(3)*
Vessel Types (No. and Percent of Total)	Pleasure Boat – 88(51%), Bass Boat - 64(37%), Jet Ski – 19(11%), Canoe – 2(1%), Other – 1(.6%)
Total No. of ANS Inspections	170
Total No. of Inspections Rejected by Boater	5
ANS Inspection Results	1 – unidentified vegetation removed from boat deck (KS resident with previous launch in KS waters)

eighty-one previous launchings, seventy (86%) boaters reported launching in states with zebra mussel-infested waters, with one launch occurring on a water body harboring zebra mussels (Table 15).

The state of next launch was reported in 162 interviews (Table 14). One hundred and sixteen (72%) of these were in twelve states/provinces other than Kansas. One hundred (86%) of these 116 boaters were planning launches in eight states with zebra mussel-infested waters. These states included Oklahoma (56), Missouri (23), Arkansas (8), and Wisconsin (4). Six boaters (5%) were planning to launch next in two states west of the 100th Meridian: Colorado (5) and Montana (1). A total of 170 watercraft inspections were conducted with no ANS of any type recorded, with the single exception of a small amount of unidentified vegetation removed from the deck of a boat operated by a Kansas resident whose previous launch was in Kansas waters. The vessel type was reported in all 175 interviews and included eighty-eight pleasure boats (51%), sixty-four bass boats (37%), and nineteen jet skis (11%).

Table 15. Previous launch site locations in zebra mussel-infested states—Kansas 1999.

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
OK	12	Canton Lake; Copan Lake; Fort Gibson Lake; Kaw Lake; Keystone Lake; Lake Oologah; Lake Texoma; Perry Lake; Sooner Lake; Kerr Lake; Grand Lake; Carl Blackwell Lake
MO	6	Bourbois River; Lake of the Ozarks; Smithville Lake; Stockton Lake; Table Rock Lake; Truman Lake
AR	3	Maumelle Lake*; Beaver Lake; Lake Ouachita
IA	3	Desoto Lake; Browns Lake; Rathman Lake
NE	2	Pawnee Lake; Branch Stone
MS	1	Aberdeen Lake
LA	1	Cross Lake
Canada	1	Berrault Lake
Total	29	1 site harboring zebra mussels

Launch area counts and inspections of boat trailers were conducted at twelve Kansas water bodies during the 1999 survey period (Table 16). A total of 950 trailers were counted and

inspected. Out-of-state trailers from nine different states accounted for ninety-two (10%) of the total number of trailers inspected. Of these, eighty-three (90%) were from six states with zebra mussel-infested waters. The states included Missouri (46), Oklahoma (27), and Nebraska (7). Of the ninety-two out-of-state trailers, two (2%) were from Colorado (Table 17). Hillsdale Lake and Winfield Lake had both high numbers and high percentages of out-of-state trailers from states with zebra mussel-infested waters. Kansas trailer inspections for ANS were all negative.

Table 16. Launch area trailer count and inspection data—Kansas 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Trailers	950
No. of Waterbodies	12
No. of Out-of-State Trailers	92
No. of Out-of-State Trailers from Zebra Mussel States	83
State Breakdown of Trailers from Zebra Mussel States	MO(46), OK(27), NE(7), AR(1), MN(1), PA(1)
No. of Trailers from States West of the 100 th Meridian	2
State Breakdown of Trailers from States West of the 100 th Meridian	CO(2)
Trailer ANS Inspection Results	Negative

Table 17. Launch area trailer count and inspection data by site—Kansas 1999.

Water Body	Total Trailers	No. from Home State	No. from Out of State	% Out of State	No. from Zebra Mussel States	% of Out of State Trailers from Zebra Mussel States
Cheney Reservoir	41	41	0	0	0	0
Clinton Lake	77	66	11	17%	11	100%
Council Grove Lake	9	9	0	0	0	0
Cowley County Lake	1	1	0	0	0	0
El Dorado Lake	116	107	9	8%	7	78%
Hillsdale Lake	128	103	25	19%	24	96%
John Redmond Reservoir	5	5	0	0	0	0
Marion Reservoir	87	85	2	2%	1	50%
Melvorn Lake	6	6	0	0	0	0
Milford Lake	93	80	13	14%	13	100%
Wilson Lake	64	64	1	1%	1	100%
Winfield Lake	308	277	31	10%	24	77%
Total	950	858	92	11%	81	76%

Kansas highway trailered boat counts were conducted at one site during the 1999 field season (Table 18). A total of 118 individual trailered watercraft were counted over 28.4 hours, yielding an average entry rate of 4.2 boats h⁻¹. Twenty-seven (23%) were out-of-state watercraft from nine different states. Twenty (74%) of these twenty-seven out-of-state watercraft were from six states with zebra mussel-infested waters. These states included Oklahoma (9), Missouri (4), and Nebraska (3). The average rate of entry for vessels from states harboring zebra mussels was 0.7 vessels h⁻¹. Of the twenty-seven out-of-state vessels counted, two (7%) were from Colorado. The average rate of entry for boats from states west of the 100th Meridian was 0.07 h⁻¹.

Table 18. Highway trailered boat count data—Kansas 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
No. of Sites	1
Total No. of Boats	118
Total No. of Survey Hours	28.4
Total No. of Boats per Hour	4.2/h
Total No. of Boats from Zebra Mussel States	20
No. of Boats from Zebra Mussel States per Hour	0.7/h
Breakdown of Zebra Mussel States	OK(9), MO(4), NE(3), AR(2), IA(1), LA(1)
Total No. of Boats from States West of the 100 th Meridian	2
No. of Boats from States West of the 100 th Meridian per Hour	0.07/h
Breakdown of States West of the 100 th Meridian	CO(2)

Nebraska—1998

During the 1998 survey period, seventy-six interviews were conducted at two sites (Table 19). Interviewed boaters were from a total of seven home states other than Nebraska, accounting for seventy-three (96%) of the total interviews. Of the seventy-three out-of-state interviews, two (3%) of the boaters—Ohio (1) and Iowa (1)—were from states with zebra mussel infestations.

Seventy (96%) of the total seventy-three out-of-state interviews were from states west of the 100th Meridian and included Colorado (63) and Wyoming (5).

Table 19. Interview and inspection data—Nebraska 1998.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	76
Total No. of Sites	2
Total Out-of-State Interviews	73
Total Out-of-State Interviews from Zebra Mussel (ZM) States	2
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	CO(63) ⁺ , WY(5) ⁺ , ID(1) ⁺ , IA(1)*, NM(1) ⁺ , OH(1)*, KS(1)
Total No. of Interviews Reporting a State of Last Launch	71
Total No. of Last Launches in a ZM State	5
States of Last Launch (* = ZM State)	CO(25), WY(6), UT(5), MO(2)*, SD(2), AL(1), CA(1), IA(1)*, MI(1)*, MN(1)*, NV(1), NM(1)
Total No. of Interviews Reporting a State of Next Launch	47
Total No. of Next Launches in a ZM State	4
Total No. of Next Launches in a State West of the 100 th Meridian	34
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	CO(26) ⁺ , WY(4) ⁺ , UT(3) ⁺ , SD(2), ID(1) ⁺ , KS(1), MI(1)*, MN(1)*, MO(1)*, OH(1)*, TX(1)
Total No. of ANS Inspections	64
Total No. of Inspections Rejected by Boater	11
ANS Inspection Results	Negative

The state in which the vessel was last launched was reported in seventy-one interviews (Table 19). Forty-seven (66%) of the boaters interviewed had last launched in twelve states other than Nebraska. Five (11%) of the forty-seven previous out-of-state launchings were in four states with zebra mussel-infested water bodies. The states included Missouri (2), Minnesota (1), Michigan (1), and Iowa (1). The actual site of last launch was reported in fifty interviews. Twenty-seven of these were at sites outside of Nebraska, representing seventeen different sites. Three of these seventeen sites were in states with zebra mussel populations, including two water bodies currently colonized by zebra mussels (Table 20).

The state of next launch was reported in forty-seven interviews (Table 19). Forty-two (89%) of these were at sites in eleven states other than Nebraska. Four of these states had water

bodies with zebra mussel infestations and accounted for four (10%) of the forty-two boaters with an out-of-state next launch. States of next launch with zebra mussel-infested water bodies included Ohio (1), Missouri (1), Michigan (1) and Minnesota (1). Thirty-four boaters (81%) reported a next launch in four states west of the 100th Meridian, including Colorado (26), Wyoming (4), Utah (3), and Idaho (1). A total of sixty-four watercraft inspections were conducted with no ANS of any type recorded.

Table 20. Previous launch site locations in zebra mussel-infested states—Nebraska 1998.

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
MI	2	Lake Michigan*, Lake Superior*
MO	1	Lake of the Ozarks
Total	3	2 sites harboring zebra mussels

Nebraska—1999

During the 1999 survey period, 263 interviews were conducted at two sites (Table 21). Interviewed boaters were from a total of fourteen home states other than Nebraska and accounted for all 263 interviews. Of the 263 out-of-state boater interviews, nine (3%) were from four states with water bodies infested by zebra mussels including, Iowa (3), Michigan (3), Missouri (2), and Tennessee (1). Five of the fourteen home states were west of the 100th Meridian. Boaters from these states accounted for 245 (93%) of the total 263 out-of-state interviews. Home states west of the 100th Meridian included Colorado (230), Wyoming (11), and Utah (2).

The state of last launch was reported in 259 interviews (Table 21). One hundred and sixty five (64%) of these launches were in fifteen states other than Nebraska. Nine (5%) of these out-of-state launches occurred in five states with zebra mussel-infested water bodies. These states included Michigan (3), Missouri (2), Wisconsin (2), Iowa (1), and New York (1). The actual site of last launch was reported in 257 interviews (Table 22). One hundred and sixty four (64%) of these occurred at sites outside of Nebraska. Nine (5%) of these launches were at nine different

sites in five states with zebra mussel-infested water bodies. Three of these nine launch sites were at locations currently harboring zebra mussels (Table 22).

Table 21. Interview and inspection data—Nebraska 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	263
Total No. of Sites	2
Total Out-of-State Interviews	263
Total Out-of-State Interviews from Zebra Mussel (ZM) States	9
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	CO(230) ⁺ , WY(11) ⁺ , SD(4), IA(3)*, MI(3)*, KS(2), MO(2)*, UT(2) ⁺ , CA(1) ⁺ , ID(1) ⁺ , MD(1), TN(1)*, TX(1), VA(1)
Total No. of Interviews Reporting a State of Last Launch	259
Total No. of Last Launches in a ZM State	9
States of Last Launch (* = ZM State)	CO(116) ⁺ , WY(16) ⁺ , UT(10) ⁺ , SD(5), KS(3), MI(3)*, TX(3), CA(2) ⁺ , MO(2)*, WI(2)*, AK(1) ⁺ , IA(1)*, NV(1) ⁺ , NY(1)*
Total No. of Interviews Reporting a State of Next Launch	245
Total No. of Next Launches in a ZM State	6
Total No. of Next Launches in a State West of the 100 th Meridian	99
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	CO(71) ⁺ , WY(16) ⁺ , UT(6) ⁺ , SD(5), IA(3)*, CA(2) ⁺ , MO(2)*, AK(1) ⁺ , AZ(1) ⁺ , MT(1) ⁺ , ND(1), TX(1), WA(1) ⁺ , WI(1)*, Saskatchewan, Canada(1)
Vessel Types (No. and Percent of Total)	Bass Boat - 132(50%), Pleasure Boat – 93(35.5%), Jet Ski – 27(10%), Canoe – 2(1%), not recorded – 9(3.5%)
Total No. of ANS Inspections	262
Total No. of Inspections Rejected by Boater	1
ANS Inspection Results	1 – live zebra mussels removed from a large sailboat owned by a Michigan resident; boat last launched in Lake Michigan

The state of next launch was reported in 245 interviews, and 113 (46%) of these were reported to be in sixteen states or provinces other than Nebraska (Table 21). Seven (6%) of the 113 interviewed boaters planned an out-of-state next launch in three states harboring zebra mussels: Iowa (3), Missouri (2), and Wisconsin (1). Ninety-nine (88%) of the interviewed

boaters planning a next launch out-of-state were launching in eight states west of the 100th Meridian including, Colorado (71), Wyoming (16), Utah (6), and California (2). A total of 262 watercraft inspections were conducted with no ANS of any type recorded, with the single exception of live zebra mussels removed from the hull of a sailboat operated by a Michigan resident whose previous launch site was Lake Michigan. Vessel type was reported in 254 interviews and included 132 bass boats (52%), 93 pleasure boats (37%), and 27 jet skis (11%) (Table 21).

Table 22. Previous launch site locations in zebra mussel-infested states—Nebraska 1999.

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
MI	3	Lake Michigan*; Ausable River; Duck Lake
WI	2	Lake Michigan*; Woodruff Lake
MO	2	Truman Lake; Smithville Lake
IA	1	Missouri River*
NY	1	Hudson River*
Total	9	3 sites harboring zebra mussels

Launch area counts and inspections of boat trailers were conducted at a single site during the Nebraska 1999 survey period (Tables 23 and 24). A total of 233 trailers were counted and inspected. Out-of-state trailers from four states accounted for 110 (47%) of the total number of trailers inspected, and none were from states with zebra mussel-infested waters. Of the 110 out-of-state trailers, 109 (99%) were from states west of the 100th Meridian, including Colorado (107), Wyoming (1), and Arizona (1). Nebraska trailer inspections for ANS were all negative.

Nebraska highway trailered boat counts were conducted at two sites during the 1999 field season (Table 25). A total of 970 trailered watercraft were counted over 278 total hours, yielding an average entry rate of 3.5 boats h⁻¹. Out-of-state watercraft from thirty states accounted for 233 (24%) of the 970 vessels counted. Of these, 102 (44%) were from twelve states harboring zebra

mussel infestations. The states included Iowa (40), Illinois (19), Wisconsin (10), Minnesota (10), and Michigan (7). The average rate of entry for vessels from states harboring zebra mussel populations was 0.37 vessels h⁻¹. Of the thirty different states represented, eight were west of the 100th Meridian, and accounted for 105 (45%) of the 233 out-of-state vessels counted. These states included Colorado (71), Utah (8), Oregon (7), and Idaho (6). The average rate of entry for trailered watercraft from states west of the 100th Meridian was 0.38 vessels h⁻¹.

Table 23. Launch area trailer count and inspection data—Nebraska 1999.

Survey Variable	Survey Results (parenthetical Numbers are n-values)
Total No. of Trailers	233
No. of Waterbodies	1
No. of Out-of-State Trailers	110
No. of Out-of-State Trailers from Zebra Mussel States	0
State Breakdown of Zebra Mussel Trailers	NA
No. of Trailers from States West of the 100 th Meridian	109
State Breakdown of Trailers from States West of the 100 th Meridian	CO(107), AZ(1), WY(1)
Trailer ANS Inspection Results	Negative

Table 24. Launch area trailer count and inspection data by site—Nebraska 1999.

Water Body	Total Trailers	No. from Home State	No. from Out of State	% Out of State	No. from Zebra Mussel States	% of Out of State Trailers from Zebra Mussel States
<i>Lake MacConaughy</i>	233	123	110	47%	0	0
Total	233	123	110	47%	0	0

South Dakota—1998

During the 1998 survey period, thirty-five interviews were conducted at two sites (Table 26). Interviewed boaters were from a total of nine home states other than South Dakota and accounted for twenty-eight (80%) of the thirty-five total interviews. Of the twenty-eight out-of-state boaters interviewed, twenty-four (86%) were from five zebra mussel-infested states,

including Iowa (11) and Nebraska (10). Three (11%) of the out-of-state boaters were from states west of the 100th Meridian including: Colorado (1), Washington (1), and Alaska (1).

Table 25. Highway trailered boat count data—Nebraska 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
No. of Sites	2
Total No. of Boats	970
Total No. of Survey Hours	278
Total No. of Boats per Hour	3.5/h
Total No. of Boats from Zebra Mussel States	102
No. of Boats from Zebra Mussel States per Hour	0.37/h
Breakdown of Zebra Mussel States	IA(40), IL(19), MN(10), WI(10), MI(7), MO(4), TN(3), IN(2), OH(2), OK(2), PA(2)
Total No. of Boats from States West of the 100 th Meridian	105
No. of Boats from States West of the 100 th Meridian per Hour	0.38/h
Breakdown of States West of the 100 th Meridian	CO(71), UT(8), OR(7), ID(6), WY(6), CA(4), AZ(2), AK(1)

The state of last launch was reported in twenty-nine interviews (Table 26). Twelve (41%) of these were in states other than South Dakota. Seven (58%) of the twelve previous out-of-state launchings were in states with zebra mussel infestations. Previous out-of-state launchings occurred in six different states and Canada (province not given), and three of these were in states with zebra mussel infestations—Minnesota (4), Michigan (1), and Nebraska (1). Actual site of last launch was reported in twenty-seven interviews, of which eleven were at ten different sites outside of South Dakota. Eight of these ten sites were in states with zebra mussel-infested waters, and one of these eight sites currently harbors zebra mussels (Table 27).

The state of next launch was reported in twenty-nine boater interviews (Table 26). Nine (31%) of these launches were planned for five states other than South Dakota. Two of these states, Iowa (3) and Nebraska (2), harbored zebra mussel infestations and accounted for five (56%) of the nine out-of-state next launches. Two (22%) of the nine boaters launching out-of-

state reported a next launch in two states west of the 100th Meridian: Colorado (1) and Montana (1). A total of thirty-two watercraft inspections were conducted with no ANS of any type recorded.

Table 26. Interview and inspection data—South Dakota 1998.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	35
Total No. of Sites	2
Total Out-of-State Interviews	28
Total Out-of-State Interviews from Zebra Mussel (ZM) States	24
Home States Represented (* = ZM State; ⁺ = State West of the 100 th Meridian)	IA(11)*, NE(10)*, AK(1) ⁺ , CO(1) ⁺ , MD(1), MN(1)*, MO(1)*, TN(1)*, WA(1) ⁺
Total No. of Interviews Reporting a State of Last Launch	29
Total No. of Last Launches in a ZM State	6
States of Last Launch (* = ZM State)	ID(4), MN(4)*, AZ(1), MD(1), MI(1)*, NE(1)*, Canada (province not given)(1)
Total No. of Interviews Reporting a State of Next Launch	29
Total No. of Next Launches in a ZM State	5
Total No. of Next Launches in a State West of the 100 th Meridian	2
States of Next Launch (* = ZM State; ⁺ = State West of 100 th Meridian)	IA(3)*, AK(2) ⁺ , NE(2)*, CO(1) ⁺ , MT(1) ⁺
Total No. of ANS Inspections	32
Total No. of Inspections Rejected by Boater	3
ANS Inspection Results	Negative

Table 27. Previous launch site locations in zebra mussel-infested states —South Dakota 1998.

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
IA	3	Clear Lake, Lake Okoboji, Lake Icaria
MN	3	Loon Lake, White Iron Lake, Aitkin
MI	1	Long Lake*
NE	1	Branched Oak
Total	8	1 site harboring zebra mussels

South Dakota—1999

During the 1999 survey period, 263 interviews were conducted at two sites (Table 28). Interviewed boaters were from seventeen home states other than South Dakota and accounted for 257 (98%) of the 263 interviews. Of the 257 out-of-state boaters interviewed, 242 (94%) were from eight states with zebra mussel infested-waters. These states included Iowa (97), Nebraska (80), Minnesota (52), and Wisconsin (6). Boaters from five states west of the 100th Meridian—including Colorado (5) and Wyoming (4)—accounted for twelve (5%) of the total 257 out-of-state interviews.

Table 28. Interview and inspection data—South Dakota 1999.

Survey Variable	Survey Results (parenthetical numbers are n-values)
Total No. of Interviews	263
Total No. of Sites	4
Total Out-of-State Interviews	257
Total Out-of-State Interviews from Zebra Mussel (ZM) States	242
Home States Represented (* = ZM State; + = State West of the 100 th Meridian)	IA(97)*, NE(80)*, MN(52)*, CO(5) ⁺ , WI(6)*, WY(4) ⁺ , MO(3)*, IL(2)*, AZ(1) ⁺ , IN(1)*, KS(1), ND(1), NV(1) ⁺ , PA(1)*, VA(1), WA(1) ⁺
Total No. of Interviews Reporting a State of Last Launch	256
Total No. of Last Launches in a ZM State	95
States of Last Launch (* = ZM State)	MN(40)*, IA(28)*, NE(16)*, WI(3)*, ND(3), CO(2), KS(2), MI(2)*, MO(2)*, FL(1), IL(1)*, IN(1)*, KY(1)*, NM(1), TX(1), WY(1), Ontario, Canada(1)*, Manitoba, Canada(2)
Total No. of Interviews Reporting a State of Next Launch	223
Total No. of Next Launches in a ZM State	56
Total No. of Next Launches in a State West of the 100 th Meridian	7
States of Next Launch (* = ZM State; + = State West of 100 th Meridian)	MN(27)*, IA(11)*, NE(7)*,MO(4)*, WY(4) ⁺ , KS(3), AR(2)*, CO(2) ⁺ , IN(1)*, ND(1), OK(1)*, WA(1) ⁺ , WI(1)*, Ontario, Canada(2)*, Manitoba, Canada(1), British Columbia, Canada(1)
Vessel Types (No. and Percent of Total)	Bass Boat - 195(74%), Pleasure Boat - 57(22%), Jet Ski - 0(0%), Canoe - 0(0%), Other - 11(4%)
Total No. of ANS Inspections	263
Total No. of Inspections Rejected by Boater	0
ANS Inspection Results	Negative

The state of last launch was reported in 256 interviews (Table 28). One hundred and eight (42%) boaters had last launched in seventeen states/provinces other than South Dakota. Ninety five (88%) of these launches occurred in ten states/provinces with zebra mussel-infested waters. These states/provinces included Minnesota (40), Iowa (28), Nebraska (16), and Wisconsin (3). Site of last launch was reported in 252 interviews. One hundred and five (42%) of these launch sites were outside of South Dakota, with ninety-four (90%) boaters reporting a prior launch in states with zebra mussel-infested waters at seventy-one different launch sites. Six of these seventy-one launch sites were at bodies of water currently colonized by zebra mussels (Table 29).

Table 29. Previous launch site locations in zebra mussel-infested states—South Dakota 1999.

Zebra Mussel State	Total No. of Sites	Individual Site (* = Zebra Mussel Site)
MN	30	Mississippi River*; St. Croix River*; Bass Lake; Battle Lake; Belletaine Lake; Brainerd Lake; Horseshoe Lake; Kremer Lake; Lac Qui Lake; Lake Amelia; Lake Andrew; Lake Benton; Lake Darling; Lake Edwards; Lake Madison; Lake Mary; Lake Minnesota; Lake of the Woods; Lake Shaokaton; Lake Wimibigoshish; Lake Zumbro; Leech Lake; Little Elk Lake; Mill Lake; Mille Lacs; Pine Lake; Sankwood River; Sleepy Eye Lake; Smith Lake
IA	19	Mississippi River*; Missouri River*; Rock Creek Lake; Silver Lake; Syder Bend; Sioux City; Storm Lake; Twelve Mile Lake; Twin Lakes; Big Creek Park; Blackhawk Lake; Browns Lake; Clear Lake; Deer Island; Ingram Lake; Lake Henry; Lake Okoboji; Lake Poha; Long Lake
NE	11	Missouri River*; Burwell Lake; Calamus Reservoir; Elwood Lake; Grove Lake; Harlan Lake; Johnson Lake; Merrit Reservoir; Sherman Reservoir; Willow Creek; Yankton
WI	3	Chippawa River; Crystal Lake; Willow Flowage
MO	2	Stockton Lake; Lake Shome
MI	1	Detroit River
IN	1	Lake Michigan*
IL	1	Fox Chain Lake*
Canada	3	Hudson River*; Red River; Winnipeg River
Total	71	6 sites harboring zebra mussels

The state of next launch was reported in 223 interviews (Table 28). Of these, sixty-nine (31%) planned their next launch in fourteen states/provinces other than South Dakota. Fifty-six (81%) of the 69 boaters planned their next launch in nine states/provinces with zebra mussel-infested waters. The states/provinces included Minnesota (27), Iowa (11), Nebraska (7), Missouri (4), Ontario (2), and Arkansas (2). Seven (10%) of the sixty-nine planned out-of-state launches were to occur in three states west of the 100th Meridian—Wyoming (4), Colorado (2), and Washington (1). A total of 263 watercraft inspections were conducted with no ANS of any type recorded.

South Dakota highway trailered boat counts were conducted at a single site during the 1999 field season (Table 30). A total of 459 individual trailered watercraft were counted over 174 total hours, for an average entry rate of 2.6 boats h⁻¹. Information on state of origin was not reported.

Table 30. Highway trailered boat count data—South Dakota 1999.

Survey Variable	Survey Results
No. of Sites	1
Total No. of Boats	459
Total No. of Survey Hours	174
Total No. of Boats per Hour	2.6/h
Total No. of Boats from Zebra Mussel States	Not Available
No. of Boats from Zebra Mussel States per Hour	Not Available
Breakdown of Zebra Mussel States	Not Available
Total No. of Boats from States West of the 100 th Meridian	Not Available
No. of Boats from States West of the 100 th Meridian per Hour	Not Available
Breakdown of States West of the 100 th Meridian	Not Available

North Dakota—1998 and 1999

During the 1998 and 1999 survey periods, North Dakota researchers submitted independent annual reports to the U.S. Fish and Wildlife Service. While survey methodology was somewhat different from that used by other 100th Meridian Initiative Survey participants, much of the information reported was similar in format to several of the 100th Meridian Initiative Survey variables. Results from the 1998 and 1999 North Dakota surveys are summarized here so that they can be compared with data collected from other 100th Meridian states. Due to incongruent

methodologies, North Dakota survey data were not included in the overall 1999 100th Meridian Initiative database or in the overall summary Tables.

North Dakota data for 1998 (Table 31) consisted mainly of timed counts of trailered westbound watercraft passing a designated highway rest stop, with interviews and inspections conducted with those boaters who responded to highway signage and stopped for voluntary watercraft inspections (Grier, unpublished). The survey period was from September 4, 1998 to October 18, 1998. A total of 726 trailered watercraft were identified by state of origin. Of these, 242 (33%) were from twenty-two states/provinces outside of North Dakota. A total of 196 (81%) of the 242 out-of-state boats counted were from eight states/provinces with zebra mussel-infested water bodies—these included Minnesota (171), Wisconsin (9), Michigan (5), and Illinois (5). Twenty-six (11.5%) of the 242 out-of-state boats counted were from nine states west of the 100th Meridian, including: Montana (12), Wyoming (5), and California (3) (Table 31).

Twenty-three boaters were interviewed and inspected. Twelve (52%) boaters were from states other than North Dakota, of which ten (83%) were from four states/provinces with zebra mussel-infested waters. The states/provinces included Minnesota (6), Wisconsin (2), Illinois (1), and Ontario (1). Five boaters reported previously launching in bodies of water known to currently harbor zebra mussels (Table 31). ANS inspections were all negative.

North Dakota researchers shifted the focus of their 1999 survey towards an increased emphasis on personal interviews and watercraft inspections (Grier and Sell, unpublished). Data for the 1999 North Dakota survey were collected from May 29, 1999 until September 6, 1999. During the 1999 survey, interviews and inspections were conducted at various boat launching sites on four different water bodies. North Dakota researchers reported that one of the survey sites, Devil's Lake, was the site of the majority of boat traffic, and was also a major center for out-of-state boater movement into and out of the state.

A total of 534 interviews and inspections were conducted. Of these, fifty-four (10%) involved boaters from home states other than North Dakota (Table 32). Forty-eight (89%) of

Table 31. North Dakota ANS survey results—1998.

Survey Variable	Survey Results
Number of Sites	1
Total No. of Trailered Boats Identified by State	726
Total No. of Out-of-State Boats	242
Total No. of Out-of-State Boats from Zebra Mussel States	196
Breakdown of Out-of-State Boats from Zebra Mussel States	MN(171), WI(9), MI(6), IL(5), IA(2), IN(1), TN(1), Ontario, Canada(1)
Total No. of Out-of-State Boats from States West of the 100 th Meridian	28
Breakdown of Out-of-State Boats from States West of the 100 th Meridian	MT(12), WY(5), CA(3), ID(2), WA(2), AK(1), CO(1), NM(1), UT(1)
Total No. of ANS Inspections	23
ANS Inspection Results	Negative
Total No. of Inspections of Boats from Zebra Mussel States	10
Breakdown of Interviewed Boaters from Zebra Mussel States	MN(6), WI(2), IL(1), Ontario, Canada(1)
No. of Previous Launches in Zebra Mussel Waters	6
Breakdown of Previous Launches in Zebra Mussel Waters	Mississippi River, Illinois River, St. Croix River, Lake Erie, Lake Michigan, Sand Lake(Ontario)

Table 32. North Dakota ANS survey results—1999.

Survey Variable	Survey Results
Total No. of Interviews	534
Total No. of Sites	4
Total No. of Out-of-State Interviews	54
Total Out-of-State Interviews of boaters from Zebra Mussel States	48
Breakdown of Interviews of Boaters from Zebra Mussel States	MN(25), WI(15), IA(4), NE(1), AL(1), KY(1)
Total No. of Interviews of Out-of-State Boaters from States West of the 100 th Meridian	2
Breakdown of Interviews of Boaters from States West of the 100 th Meridian	CO(1), WY(1)
Total No. of Interviews Reporting a State of Last Launch	526
Total No. of Last Launches in a Zebra Mussel State	17
Total No. of ANS Inspections	534
ANS Inspection Results	Negative

these out-of-state boaters were from states harboring zebra mussels. The states included Minnesota (25), Wisconsin (15), and Iowa (4). Two (4%) of the fifty-four out-of-state boaters were from states west of the 100th Meridian: Colorado (1) and Wyoming (1). Location of previous launch was reported by 526 boaters, of which sixty-seven (13%) had previously

launched in states outside North Dakota. Seventeen (25%) of these prior out-of-state launches occurred in six states with zebra mussel-infested waters. The states included Minnesota (25), Wisconsin (15), and Iowa (5) (Table 32). No instances of ANS were reported in the 534 inspections that were conducted.

Overall Summary of Results—1999

Four states using the same forms and methodologies (Texas, Kansas, Nebraska, and South Dakota) conducted boater interviews and inspections as part of the 1999 100th Meridian Initiative. A total of 730 interviews were conducted during the 1999 field season. The percentage of out-of-state boaters interviewed ranged from a low of 32% for Kansas to a high of 100% for Nebraska, with a mean percentage of 80.2% (SD ± 28%). Analysis of the data relating to previous and future launchings showed similar results among the reporting states, with the notable exception of data collected from Nebraska (Table 33).

Table 33. Overall summary of interview and inspection data—1999.

State	TX	KS	NE	SD	Mean (no NE) ¹	Standard Deviation (no NE) ¹
% of Out-of-State Interviews	91%	32%	100%	98%	80.3%	± 28.1
% Out-of-State Interviews from Zebra Mussel States	93%	66%	3%	94%	64% (84.3)%	± 36.9 (± 13.0)
% of Out-of-State Interviews from States West of the 100 th Meridian	8%	9%	93%	5%	28.7% (7.3)%	± 37.1 (± 1.7)
% of Out-of-State Last Launches in a Zebra Mussel State	90%	83%	5%	88%	66.5% (87.0)%	± 35.6 (± 2.9)
% of Out-of-State Next Launches in a Zebra Mussel State	93%	86%	6%	81%	66.5% (86.7)%	± 35.2 (± 4.9)
% of Out-of-State Next Launches in a State West of the 100 th Meridian	2%	5%	88%	10%	26.3% (5.7)%	± 35.8 (± 3.3)
Total Number of ANS Inspections	724					
Total Number of ANS Inspections Rejected by Boater	6					
ANS Inspection Results	1 – NE. Live zebra mussels removed from a large sailboat owned by a Michigan resident; boat last launched in Lake Michigan					
Last Launch Sites Harboring Zebra Mussels	Mississippi River, Missouri River, Lake Michigan, Red River (Canada), Hudson River (NY), Arkansas River, Lake Maumelle (AR), Fox Chain Lake (IL), St.Croix River (MN), Tennessee River, Atchafalaya Basin (LA)					

¹Parenthetical values exclude Nebraska

Texas, Kansas, and South Dakota all reported relatively high percentages of out-of-state boaters from home states harboring zebra mussels (Table 33). These percentages were: Texas, 93%; Kansas, 66%; and South Dakota, 94% (mean = 84% SD \pm 12.9%). These values compare favorably with data from the 1999 North Dakota survey, which reported that 89% of out-of-state boaters interviewed were from home states harboring zebra mussels. Texas, Kansas, and South Dakota also reported a high percentage of previous out-of-state launches in states with zebra mussel populations. These values were: Texas, 90%; Kansas, 83%; and South Dakota, 88% (mean = 86.8% SD \pm 2.8%). Texas, Kansas, and South Dakota reported very low percentages of out-of-state boaters from home states west of the 100th Meridian (mean = 7% SD \pm 1.6%), and low percentages of boaters planning future launchings in states west of the 100th Meridian (mean = 5.9% SD \pm 3.1%) (Table 33). Although fewer boaters were interviewed in 1998, interview and inspection results showed similar trends in out-of-state visitation for these states. The 1998 percentages of out-of-state boaters from home states with zebra mussel-infested waters were similar to 1999 values (Texas = 100%, South Dakota = 89%, and Kansas = 83%; mean = 90.7% SD \pm 7%). In 1998, these states also reported low percentages of out-of-state boaters from states west of the 100th Meridian: 0% in Texas, 4% in Kansas, and 7% in South Dakota (mean = 3.7% SD \pm 2.9%).

In contrast, 1999 data from Nebraska indicated a low percentage of out-of-state boaters from home states harboring zebra mussels (3%), as well as a low percentage of previous out-of-state launches in states with zebra mussel populations (6%), but revealed high percentages of boaters visiting from, and traveling to, states west of the 100th Meridian. Thus, 93% of out-of-state boaters interviewed in Nebraska were from states west of the 100th Meridian, and 88% of

boaters who planned their next launch outside of Nebraska were planning to launch in states west of the 100th Meridian (Table 33). Although fewer interviews were conducted in 1998, 1998 Nebraska data for percentages of out-of-state visitation were similar to those recorded in 1999. For 1998, the percentage of out-of-state boaters from home states with zebra mussel infestations was 3%, while that for out-of-state boaters from states west of the 100th Meridian was 96%.

In 1999, the site of previous launch was reported in 687 interviews from Texas, Kansas, Nebraska, and South Dakota. Prior launches occurred in twenty-eight different states and four Canadian provinces. Fourteen of these states and Ontario had waters colonized by zebra mussels. Of the 136 different previous launch sites recorded in these states, eleven (8%) were in water bodies infested by zebra mussels (Table 33). Only one of a total of 724 inspections revealed the presence of any ANS. This inspection found zebra mussels attached to the hull of a sailboat (Sydney, Nebraska) (Table 33).

Table 34. Overall summary of launch area trailer count and inspection data—1999.

State	TX	KS	NE	Mean (no NE) ¹	Standard Deviation (no NE) ¹
% Out-of-State Trailers	10%	10%	47%	22% (10%)	± 17.6 (± 0.0)
% Out-of-State Trailers from ZM States	92%	90%	0%	61% (91%)	± 42.9 (± 1.0)
% Out-of-State Trailers from States West of the 100 th Meridian	5%	2%	99%	42% (3.5%)	± 40.8 (± 1.5)
Total Trailers Inspected	2764	950	233	N/A	N/A
ANS Inspection Results	Negative for 3,945 trailers inspected				

¹Parenthetical values exclude Nebraska

Texas, Kansas, and Nebraska reported launch area trailer count data for 1999 (Table 34). Percentages of out-of-state trailers at launch sites were: Texas, 10%; Kansas, 10%; and Nebraska, 47%. The proportions of home states represented among out-of-state trailers were similar to those recorded in interview and inspection data. Texas and Kansas reported high

percentages of out-of-state trailers from states harboring zebra mussels (Texas = 92%, Kansas = 90%) and low percentages from states west of the 100th Meridian (Texas = 5%, Kansas = 2%). In contrast, Nebraska reported no out-of-state trailers from states with zebra mussel populations, while 99% were from states (almost all from Colorado) west of the 100th Meridian. A total of 3,945 trailers were inspected for all three states, and no instances of ANS were reported.

Table 35. Overall summary of highway trailered boat count data—1999.

State	TX	OK	KS	NE	SD	Mean	Standard Deviation
Number of Boats per Hour	6.3/h	2.7/h	4.2/h	3.5/h	2.6/h	3.9/h	± 1.35
Number of Boats From Zebra Mussel States per Hour	1.5/h	1.3/h	0.7/h	0.37/h	N/A	0.96/h	± 0.45
Number of Boats from States West of the 100 th Meridian per Hour	0	0.11/h	0.07/h	0.38/h	N/A	0.14/h	± 0.14
Percent Out-of-State Boats from Zebra Mussel States	100%	80%	74%	44%	N/A	74.5%	± 20.1
Percent Out-of-State Boats from States West of the 100 th Meridian	0%	7%	2%	45%	N/A	13.5%	± 18.4

Highway westbound boat count data were submitted by all five participating states (Table 35). Average rates of westbound boats passing highway checkpoints varied from 2.6 h⁻¹ in South Dakota to 6.3 boats h⁻¹ in Texas. Home states for these watercraft were reported by Texas, Oklahoma, Kansas, and Nebraska. In these states, the average rate of entry for boats from home states with zebra mussel-infested waters ranged from 1.5 boats h⁻¹ in Texas to 0.37 boats h⁻¹ in Nebraska. Percentages of out-of-state boats entering from states harboring zebra mussels were: Texas, 100%; Oklahoma, 80%; Kansas, 74%; and Nebraska, 44%. The 1998 North Dakota trailered boat count survey reported that 81% of out-of-state boats were from states harboring zebra mussels, a value similar to those reported by Texas and Oklahoma in 1999. Boaters from states west of the 100th Meridian passed checkpoints at average rates ranging from 0.0 boats h⁻¹ (Texas) to 0.38 boats h⁻¹ (Nebraska). The percentage of westbound out-of-state boats passing

check points from states west of the 100th Meridian ranged from 0.0% (Texas) to 45% (Nebraska) (Table 35).

DISCUSSION

The 100th Meridian Initiative survey data collected during 1998 and 1999 indicated that, for Texas, Oklahoma, Kansas, and South Dakota, a large percentage of out-of-state boaters were from states with waters harboring zebra mussels. These high percentages were reflected in data from personal interviews, launch area trailer counts, and, to a lesser extent, highway trailered boat counts. Even more importantly, survey data showed that, for Texas, Kansas and South Dakota, an average of 87% of responding boaters last launched in a state with zebra mussel populations and that 8% of these boaters had previously launched in bodies of water known to harbor zebra mussels.

Not all 100th Meridian Initiative states reported high percentages of boater traffic from states with zebra mussel infestations. Nebraska was visited by few out-of-state boaters from zebra mussel-infested states (3%), with most out-of-state boaters coming from states west of the 100th Meridian (93%).

The results of the 1998 and 1999 surveys indicated that Texas, Oklahoma, Kansas, and South Dakota were exposed to high percentages of out-of-state visitation by boaters from states with zebra mussel-infested waters. In contrast, Nebraska had low percentages of visitation by boaters from states harboring zebra mussels but had high percentages of out-of-state boats coming from states west of the 100th Meridian.

Survey Analysis by State

Texas

Texas had high percentages of out-of-state visitation by boaters from states with zebra mussel infestations. Of interviewed out-of-state boaters, 93% were from states with

zebra mussel infestations. The majority were from Oklahoma (38%), the state in which the majority of prior and subsequent launchings occurred. Seventy-seven percent of all boaters interviewed last launched in a state harboring zebra mussels. Five of these boaters (7%) last launched in bodies of water infested by zebra mussels, and three had been out of the water for less than ten days, a period within this species' emersion tolerance (McMahon *et al.* 1993).

Of boaters next launching in an out-of-state location, 93% were returning to states with zebra mussel infestations, suggesting that there is continuous boater traffic between Texas and states with zebra mussel-infested waters. In addition, 2% of all subsequent out-of-state launches were in states west of the 100th Meridian, suggesting that Texas water bodies could act as staging points for westward ANS dispersal.

The 1999 interview and inspection data indicated that Texas waters are exposed to potential zebra mussel introduction by boaters entering Texas directly from nearby waters harboring zebra mussels. While ANS inspections for Texas were negative, and a very high percentage of entering boats were clean, Texas was one of two 100th Meridian Initiative states where transportation of live, adult zebra mussels on a recreational boat was reported in 1999. In November 1999, a marina owner at Lake Grapevine (a North Texas reservoir not surveyed as part of the 100th Meridian Initiative) reported that he found live zebra mussels attached to the hull of a large recreational boat commercially hauled to Lake Grapevine from Lake Michigan (Lightfoot 1999). Officials from the Texas Parks and Wildlife Department oversaw the removal and disposal of the mussels prior to its launch.

The trends in out-of-state boater visitation were also reflected in Texas launch area trailer counts and inspections, where 92% of all out-of-state trailers observed were from states harboring zebra mussels. Trailer ANS inspections were negative; however, these inspections were of trailers only and not accompanying watercraft. As reflected in interviews, a small percentage (5%) of these out-of-state trailers were from states west of the 100th Meridian,

confirming movement of boaters between Texas waters and those of western states. Of the four Texas water bodies surveyed, two reservoirs, Lake Texoma and Lake Fork, displayed high levels of overall usage. These lakes are generally considered to be among the North Texas lakes most often visited by out-of-state boaters. After adjusting for slight differences in survey pressure, it was found that the proportion of trailers from states harboring zebra mussels relative to the total number of trailers observed was significantly higher at Lake Fork (14%) than at Lake Texoma (5%) (William's corrected G-test; $G_{adj} = 75.21$, $p < 0.001$). Such information regarding lake usage by boaters from zebra mussel and other ANS infested areas could be useful in determining where best to direct ANS prevention, awareness, and educational resources.

Texas highway trailered boat counts also reflected the trends recorded in other survey components. Although total survey hours were low compared to other states, 100% of out-of-state vessels observed entering Texas were from states harboring zebra mussels. Boaters from zebra mussel-infested states passed Texas checkpoints at an average rate of 1.5 boats h^{-1} . This value was higher than any recorded in the other participating states and was congruent with the observation that the highest densities of trailers from zebra mussel-infested states were also recorded at Texas launch sites.

The 1998 and 1999 100th Meridian Initiative Survey data indicated that a large majority of the out-of-state boaters visiting Texas were from states with zebra mussel infestations, increasing its risk for zebra mussel introduction. The elevated risk of zebra mussel introduction into Texas was reinforced by the independently reported occurrence of adult zebra mussels on the hull of a commercially hauled vessel just prior to launch in a North Texas reservoir during the 1999 survey period (Lightfoot 1999, see above for details). The sustained high summer temperatures associated with Texas surface waters have been considered likely to preclude establishment of zebra mussel populations because they are generally greater than the 30°C upper thermal limit of this species (McMahon *et al.* 1994). However, a reproducing zebra mussel population has

become established in the Arkansas River in Oklahoma, in areas where summer water temperatures routinely exceed their generally accepted upper thermal limit (R. F. McMahon, personal communication). Spawning and juvenile settlement have also been observed at a power station on the Ohio River, where water temperatures consistently exceed 28°C (Stice 1997). Thermally tolerant races of zebra mussel also appear to have developed in the southern Mississippi River (Hernandez 1995). The extensive boater traffic into Texas from Oklahoma revealed by the 100th Meridian Initiative survey suggests that Texas aquatic ecosystems may be susceptible to colonization by zebra mussels introduced from thermally tolerant populations in nearby states.

Oklahoma

Oklahoma highway trailered boat count data for 1999 indicated that a large portion of the out-of-state boaters observed (80%) were from states with zebra mussel infestations. The majority of these boaters were from Arkansas (57%) or Missouri (35%). Seven percent of out-of-state boaters were from states west of the 100th Meridian, the highest value recorded among highway count data in any surveyed state (excluding Nebraska). Westward boater movement through Oklahoma may be of special concern, as Oklahoma is the only 100th Meridian state currently harboring zebra mussels. Oklahoma boaters were also the most frequent out-of-state visitors to Texas and Kansas. Thus, it may be efficacious to increase 100th Meridian Initiative educational and awareness efforts in Oklahoma due to the state's potential as a southern staging area for westward zebra mussel dispersal.

Although Oklahoma did not conduct boater interviews or inspections as part of the 100th Meridian Initiative survey during 1999, there is evidence of overland dispersal of adult zebra mussels both into and within the state. There have been three confirmed instances of adult zebra mussels being transported overland on recreational boats in Oklahoma since 1997 (Laney and Spirlock 1999). One of these vessels (May 1997) was being moved from an infested Oklahoma

reservoir (R. S. Kerr) to an uninfested lake (Lake Eufala) within Oklahoma. Two boats were discovered transporting zebra mussels from out-of-state—one at Lake Eufala, which had come from the Ohio River (July 1998, state not specified), and one at Grand Lake (October 1998), arriving from Lake Michigan. These boats had been out of the water for ten and five days, respectively, a time too short to ensure lethal adult mussel desiccation (McMahon *et al.* 1993), further demonstrating the potential for the long-distance overland dispersal of live, adult zebra mussels on the hulls of recreational boats.

Kansas

Kansas boater interviews and inspections in 1999 also revealed a high percentage of out-of-state boaters from home states harboring zebra mussels (66%), although less than those reported in Texas (93%) or South Dakota (94%). Of the boaters previously launching out-of-state, 83% last launched in a state with zebra mussel infestations, a value similar to those reported in Texas (90%) and South Dakota (88%). Of the 29 boaters specifying the location of their last launch, one had previously launched in a water body harboring zebra mussels. Of boaters reporting a planned out-of-state next launch, 86% planned to launch in a zebra mussel-infested state, a value intermediate to those recorded in Texas (93%) and South Dakota (84%). Thus, boater movement patterns in Kansas were similar to those in Texas and South Dakota, suggesting continuous cyclic movement by recreational boaters between Kansas and zebra mussel-infested states. As in Texas, the majority of out-of-state boaters interviewed were from Oklahoma (66%), which was the state most frequently cited as the location of both previous and subsequent launchings. Of the boaters planning their next launch out-of-state, 5% were planning to launch in a state west of the 100th Meridian, suggesting that Kansas waters could serve as potential staging points for ANS transport by small numbers of westward moving boaters.

Kansas launch area trailer counts for 1999 reflected trends in out-of-state visitation recorded in boater interviews. Ninety percent of out-of-state trailers observed at launch sites

were from states harboring zebra mussels. Missouri was the state most frequently represented (55%), followed by Oklahoma (33%). Of the twelve water bodies surveyed, Hillsdale Lake, Milford Lake, and Winfield Lake exhibited the highest percentages of both total out-of-state trailers and out-of-state trailers from states with zebra mussel-infested waters. Trailers from states west of the 100th Meridian comprised 2% of the total number of out-of-state trailers observed, again indicating that small numbers of boaters are likely to enter western states directly from Kansas waters.

Kansas 1999 highway trailered boat count data yielded an average entry rate of 4.2 boats h⁻¹, a value higher than any other state except Texas (6.3 boats h⁻¹). Of the out-of-state boaters observed, 74% were from states harboring zebra mussels, a figure approaching values for Oklahoma (80%) and Texas (100%). However, average rate of entry for boaters from states with zebra mussels (0.7 boats h⁻¹) was lower than recorded in either of these states. The large number of interviews obtained (175) and trailers counted (950) suggest that the highway boat counts may have underestimated the actual movement of out-of-state boaters into Kansas.

Kansas surface waters are more temperate than those of Texas or Oklahoma, making them more thermally suitable for zebra mussel colonization. Kansas also shares borders with Oklahoma and Missouri, which currently harbor zebra mussels. Survey results reported significant visitation from these states, suggesting the potential for short-distance overland dispersal of zebra mussels and other ANS from Oklahoma and Missouri into Kansas. In addition, adult zebra mussels have been sited in the Missouri River along the Nebraska-Iowa border, north of the Omaha-Council Bluffs area (S. Schainost, personal communication). Their extensive capacity for rapid downstream dispersal (Carlton 1993, Kraft and Johnson 2000) may allow zebra mussels to extend into eastern Kansas via downstream expansion from upstream populations in the Nebraska/Iowa portions of the Missouri River.

Nebraska

Nebraska survey data revealed trends in out-of-state visitation incongruent with those recorded in other states. The percentage of out-of-state boaters visiting Nebraska from zebra mussel-infested states was very low, whereas the percentage of out-of-state boaters from home states west of the 100th Meridian (most from Colorado) was very high. Among out-of-state boaters interviewed, only 3% were from states that harbored zebra mussels. In contrast, 93% were from states west of the 100th Meridian, of which the vast majority (94%) were from Colorado. Of boaters previously launching out-of-state, only 5% previously launched in a state harboring zebra mussels, a much lower value compared to a mean of 87% recorded among boaters previously launching out-of-state in Texas, Kansas, and South Dakota. Although this percentage was low, it should be noted that, of the nine boaters who reported the actual site of their previous launchings within a zebra mussel-infested state, four had come directly from a body of water harboring zebra mussels and three of these boaters had last launched within the past seven days, well within the emersion tolerance limits of zebra mussels (McMahon *et al.* 1993). Of the boaters who indicated that their next launch would be out-of-state, 88% reported that they would be launching in a state west of the 100th Meridian, and 72% were planning to launch next in Colorado. Comparable trends were apparent in the limited 1998 interview data. Analysis of launch area trailer counts and inspection data also revealed similar trends in Nebraska out-of-state boater movements for 1999. All of the 110 out-of-state trailers observed were from states west of the 100th Meridian (Colorado = 107).

Nebraska was also the only state that reported intercepting any ANS as part of the 100th Meridian Initiative survey inspections, despite being the state with by far the lowest percentage of visitation by boaters from states with zebra mussel infestations. At the *Cabela's* boater interview site in Sydney, Nebraska (*Cabela's* is a national fishing/sporting goods chain), a large sailboat being hauled from Lake Michigan was found to have adult zebra mussels attached to the

hull. The boater's destination was Lake Tahoe. The vessel would have been out of the water for a total of fourteen days upon reaching its destination, at period of emersion likely to have been survived by at least some adult mussels (McMahon *et al.* 1993). The zebra mussels were removed by inspectors and the boat owner.

The location of the boater interviews and trailer counts within Nebraska may have accounted for results indicating that out-of-state boaters entered Nebraska primarily from western states. Almost all Nebraska boater interviews (255 of 263), and all trailer counts, were conducted at Lake McConaughy. Lake McConaughy is the largest and most visited reservoir in Nebraska. It is located in the western area of the state, near the Colorado border. Lake McConaughy's position near the western edge of Nebraska caused it to be favored by boaters visiting from western states, particularly Colorado.

Nebraska highway counts of trailered watercraft were less heavily skewed than interview and trailer count data as a result of being conducted near Lincoln, at the eastern edge of the state. Highway count data indicated that incoming trailered boat traffic was nearly equally divided between western and zebra mussel-infested states. Boaters from states harboring zebra mussels represented 44% of all out-of-state vessels observed, passing observation points at an average rate of 0.37 boats h⁻¹. Boaters from states west of the 100th Meridian comprised 45% of all out-of-state vessels, passing at an average rate of 0.38 boats h⁻¹. These numbers suggest that Nebraska may be visited equally by eastern and western boaters.

Even though it occurred at relatively low levels, Nebraska is visited by boaters coming directly from zebra mussel-infested waters. Thus, because it has high levels of visitation by western boaters, Nebraska (especially Lake McConaughy) could serve as an important staging point for the westward dispersal of zebra mussels and other ANS, should any become established there. The 100th Meridian Initiative survey results indicated that public awareness and educational efforts directed at Lake McConaughy would reach not only large numbers of

Nebraska residents, but large numbers of Colorado boaters as well. Thus, Nebraska may be an important area in which to expend ANS educational resources, especially as there is already some evidence of zebra mussels being transported into Colorado by recreational boaters (Loeffler 1999).

South Dakota

Data collected in South Dakota for 1999 revealed trends in out-of-state boater visitation similar to those in Texas, Oklahoma, and Kansas. Of the out-of-state boaters interviewed, 94% were from home states harboring zebra mussels, the highest percentage reported by any surveyed state. This value may have slightly overestimated actual exposure since 33% of these boaters were from Nebraska. Nebraska boaters were counted as being from a “zebra mussel-infested state” even though current Nebraska zebra mussel sightings are limited to a single report of an adult individual in the Missouri River (S. Schainost, personal communication). This trend in Nebraska visitation was only observed in South Dakota, as Nebraska boaters comprised only a small fraction of those visiting Kansas and no boaters from Nebraska were encountered by Texas observers. It should be noted that, of the Nebraska boaters reporting the location of their most recent launch, one boater had last launched in the Missouri River six days prior to the interview. Discounting Nebraska boaters, 67% of the out-of-state boaters interviewed in South Dakota were from home states harboring zebra mussels. Of these boaters, 91% were from either Minnesota or Iowa, a pattern repeated in data collected for both previous and subsequent launchings.

The South Dakota data from boaters previously launching out-of-state was less heavily influenced by Nebraska boaters. The adjusted percentage of these boaters previously launching in a state harboring zebra mussels was 75%, slightly less than the levels reported in Texas and Kansas (90% and 83%, respectively). Six of the 71 boaters previously launching in a state harboring zebra mussels (including the Missouri River location mentioned above) had launched in bodies of water currently harboring zebra mussels. The time elapsed since last launching at

these locations ranged from four to forty-one days, with two boaters launching within ten days. Seventy-four percent of boaters reporting a next launch out-of-state were planning to launch in a zebra mussel-infested state (excluding Nebraska), and 75% of these boaters were planning launches in either Minnesota or Iowa. As with Texas and Kansas, the previous and subsequent launch site data suggested a pattern of continuous movement by boaters between South Dakota and states harboring zebra mussels, with the majority of out-of-state boaters visiting South Dakota coming from states with zebra mussel populations.

Of the boaters next launching in states outside of South Dakota, 10% were planning to launch in a states west of the 100th Meridian. This value was twice as high as that reported in Kansas (5%), and five times that reported in Texas (2%), indicating that substantial numbers of boaters launching in South Dakota next launch in waters of western states. ANS inspections for South Dakota during 1999 were negative, however, the high percentages of out-of-state visitation by boaters from states harboring zebra mussels and other ANS (notably Minnesota), as well as the recent zebra mussel sightings in the Missouri River, suggests that recreational boat traffic could expose South Dakota to ANS introductions from eastern waters.

North Dakota

An independent ANS survey report was submitted to the North Dakota Game and Fish Department in 1998 (Grier, unpublished) and 1999 (Grier and Sell, unpublished). These surveys employed methodologies different from, but similar to, those used by participants in the 100th Meridian Initiative Survey. A brief analysis of the North Dakota data is included here and compared with the 100th Meridian Initiative survey results for 1999.

North Dakota data for 1998 consisted mainly of highway trailered boat counts, with interviews and inspections conducted with boaters stopping for voluntary checks at the observation site (Grier, unpublished). Of out-of-state boats observed passing the site, 81% were from states harboring zebra mussels (87% of these boaters were from Minnesota). This level of

out-of-state trailered boat traffic from zebra mussel-infested states was similar to that reported from highway count data in Texas, Oklahoma, and Kansas (mean = 85%). A total of 23 boaters were interviewed and their vessels inspected. Six of these boaters last launched in waters harboring zebra mussels. This was a much higher proportion than those reported by other states; however, the small sample size makes it difficult to determine if North Dakota is exposed to increased risks of zebra mussel introduction compared to other 100th Meridian states. ANS inspection results were negative. Of the out-of-state boaters passing the inspection site, 12% were from states west of the 100th Meridian, a percentage higher than that recorded in any other surveyed state except Nebraska.

The 1999 North Dakota survey focused mainly on boater interviews and inspections at four different bodies of water (Grier and Sell, unpublished). Of the out-of-state boaters interviewed, 89% were from home states harboring zebra mussels, numbers similar to those reported in 1999 for Texas, Kansas, and South Dakota (mean = 84%). Of the boaters who last launched out-of-state, only 25% launched in a state infested by zebra mussels, a value much lower than that reported by any of the surveyed 100th Meridian Initiative states (with the exception of Nebraska), all of whom reported values > 80%. All 534 ANS inspections were negative.

North Dakota 1999 highway trailered boat counts and 1998 boater interviews and inspections indicated relatively high percentages of visiting out-of-state boaters from zebra mussel-infested states, a pattern similar to other 100th Meridian Initiative survey states (excluding Nebraska). In North Dakota there were lower levels of boaters previously launching in zebra mussel-infested states than was recorded in other surveyed states. Data on ANS inspections did compare favorably with inspection results reported by the 100th Meridian Initiative states, with all inspections for 1998 and 1999 yielding negative results. The data indicated that North Dakota has boater visitation levels and risks of zebra mussel introductions similar to those of the other surveyed states (excluding Nebraska).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Research into the dynamics of long distance overland dispersal of ANS have led to the hypothesis that the events leading to such dispersal are likely to be rare, random, and unpredictable (Buchan and Padilla 1999, Higgins and Richardson 1999). In the case of most ANS, these dispersal events are hypothesized to result from anthropomorphic vectors, since there are natural barriers that prevent long distance dispersal by most ANS species (Johnson and Padilla 1996). Survey data collected as part of the 100th Meridian Initiative appears to support these hypotheses. Seven hundred and twenty-four boater interviews and inspections reported only one instance of live zebra mussel transport, yet the sighting occurred in the state with by far the lowest percentage of out-of-state visitation by boaters from zebra mussel-infested states (Nebraska, 3% vs. a mean of 84% for all other surveyed states). As of the writing of this report in 2001, the rate of overland dispersal of zebra mussels between isolated water bodies has been low and limited to relatively short distances, especially when compared to the rapidity of their expansion throughout the contiguous North American waterways into which they have been introduced (Kraft and Johnson 2000). This low rate of overland dispersal is also reflected in the distribution of zebra mussels within their home range in Eastern Europe, where many ecologically suitable isolated inland lakes remain uncolonized (Johnson and Carlton 1996).

The low rate of overland dispersal of zebra mussels is likely to be a result of a combination of its life history traits and the unique set of human activities necessary to transport viable populations. Zebra mussels are dioecious and have a planktonic veliger larval stage prior to juvenile settlement on hard substrata. Successful zebra mussel colonization of isolated water bodies by introduction of veligers or small numbers of juveniles transported by recreational boaters is unlikely, as these forms would be dispersed and diluted in the water column. Such dispersal would generally preclude the establishment of aggregated adult populations, preventing

the successful external fertilization required to maintain self-sustaining populations. In addition, the natural mortality of these life stages is quite high, as much as 98% (O'Neill 1996).

It has been suggested that the successful colonization of isolated waters would require introduction of groups or "clumps" of adult mussels, which would provide a concentrated source of gametes, greatly increasing the chances for continued successful reproduction (Ricciardi *et al.* 1995, Johnson and Padilla 1996). While transport by recreational boats has been implicated in the transfer of zebra mussels and other ANS between closely adjacent water bodies (Johnson and Carlton 1993), this vector's potential to move ANS between more widely separated water bodies was not assessed until the 100th Meridian Initiative Survey was implemented. In order for a recreational boat to transport adult zebra mussels, the vessel would have to remain in an infested body of water long enough for juveniles to attach and grow to desiccation-resistant sizes, an average period of approximately twelve months (O'Neill 1996). It is usually vessels of larger size that are berthed in a single water body for such extended periods. Such larger vessels are not readily hauled out and transported to another water body. Both 100th Meridian Initiative and independent sightings of zebra mussels on recreational boats during 1999 support this observation. The sighting in Nebraska by 100th Meridian Initiative participants was of adult zebra mussels on a large Lake Michigan sailboat being moved for the winter, and independent sightings in Texas (Lightfoot 1999) and Arizona (B. Pitman, personal communication) were both instances of adult zebra mussels being transported on large vessels. All three vessels had been held in zebra mussel-infested waters for long periods prior to transport.

A major focus of the 100th Meridian Initiative concerns the westward dispersal of macrophytic ANS as well as zebra mussels. Research has indicated that patterns of long distance overland aquatic macrophyte dispersal may be similar to those of zebra mussels (Johnson and Carlton 1996). Most macrophytic ANS reproduce vegetatively and are dispersed overland by anthropomorphic vectors, primarily recreational boaters. Such dispersal appears to occur at very

slow rates (Johnstone *et al.* 1985). As with zebra mussels, the overland dispersal of viable macrophytic ANS appears to be a relatively rare event (Johnstone *et al.* 1985, Johnson and Carlton 1996). Low levels of long-distance anthropomorphic macrophyte dispersal may be due to a combination of the rapid, lethal desiccation experienced by emersed plant fragments and sporadic encounters between recreational boaters and large concentrations of macrophytes.

If the long-distance movement and establishment of populations of zebra mussels and macrophytic ANS (such as Eurasian watermilfoil) results from rare and unpredictable events, it is likely that even intensive inspection efforts would fail to detect the majority of such translocations, given the large numbers of boaters travelling from infested areas and the resources needed to conduct such efforts. Data from the various components of the 1999 100th Meridian Initiative Survey revealed high percentages of visitation by boaters from zebra mussel-infested areas for all surveyed states with the exception of Nebraska, yet reported only one instance of boater-mediated zebra mussel transport and no instances of boater-mediated macrophytic ANS movement. Survey results, however, should not be interpreted as indicating that the anthropomorphic dispersal of zebra mussels by recreational boaters is a “non-event” of no concern. To the contrary, the survey sighting of zebra mussels on a boat hull in Nebraska, as well as independent sightings in Texas, Arizona, and Colorado during 1999, confirm that the long distance dispersal of adult zebra mussels is likely to be occurring on a continuous, although random and unpredictable basis, particularly on large vessels spending considerable time in zebra mussel-infested waters prior to transport. Thus, it may be a much more enforceable and effective zebra mussel dispersal prevention measure to require inspection for and removal of ANS from large vessels hauled from infested waters prior to overland transport.

Since the detection and control of individual instances of ANS transport by recreational boaters seems unlikely, westward ANS dispersal may best be prevented by focusing 100th

Meridian Initiative activities in the areas of ANS education and outreach, supported by more precise demographic information and increased interagency cohesiveness and cooperation.

Recommendations

It has been suggested that successful prevention of ANS dispersal will require an emphasis on “the three C’s”: communication, collaboration, and cooperation (Reutter 1997). An increased emphasis on the communication of ANS information and the expansion of educational efforts would seem to be the most cost-effective way to directly impact ANS dispersal, given the difficulties associated with the detection and control of infrequent and unpredictable ANS transport events. Education can be an effective tool in dealing with ANS, as evidenced by a Minnesota boater survey that followed several seasons of coordinated Minnesota ANS awareness and education activities (Gunderson 1994). This study indicated that 70% of Minnesota boaters took active precautions to prevent ANS spread, versus 39% in Wisconsin and 33% in Ohio, both states with less comprehensive ANS public information and enforcement programs. Low levels of ANS awareness maybe widespread, as indicated in a 1994 boater survey conducted in the Canadian province of Manitoba (Williamson, unpublished). Despite the fact that 93% of all survey respondents (n=1,631) originated from U.S. states or Canadian jurisdictions harboring zebra mussels, only 32% of boaters cleaned their vessels prior to next launch. A similar 1999 Manitoba study revealed that 50% of the boaters interviewed did not inspect their vessels for ANS, despite exposure to five years of increasing ANS publicity (Lindgren *et al.*, unpublished).

Such results suggest that future versions of the 100th Meridian Initiative may be improved by development of some type of ANS awareness assessment within the survey, which could be correlated with boater zip code data (indicating the concentrations of uninformed boaters by zip code), as well as “home lake” usage data, in order to determine geographically where best to focus ANS educational efforts. Educational programs should be directed at non-infested western states as well, since these areas could be susceptible to sporadic ANS importation as revealed by

the sightings of zebra mussel-fouled boats in Colorado and Arizona during 1999. Future 100th Meridian Initiative surveys may also need to record destination data in greater detail in order to quantitatively determine any patterns or focal points of boater movements into the waters of western states. Successful educational efforts will need to be widespread and well coordinated, and the wide-scale coordination and implementation of these efforts among all involved federal, state, local, and non-governmental agencies is likely to prove the greatest challenge for successful prevention of ANS dispersal.

The 100th Meridian Initiative survey potentially could be improved by expanding survey activities to incorporate increased communication and cooperation with the various state and municipal agencies involved in local ANS and boater issues. Effective education and awareness activities will require accurate and useful demographics. Information such as water body usage, boater registration by zip code, and even contact data on the owners of larger boats could be obtained through collaboration with state and municipal agencies and combined with 100th Meridian Initiative survey data to help better target education and enforcement activities.

Despite early warnings forecasting the rapid westward dispersal of the zebra mussel to all the ecologically suitable waters of North America (Strayer 1991), this species' overland dispersal and that of some macrophytic ANS seems to be occurring at a much slower pace than initially predicted, providing a window of opportunity to implement programs designed to prevent the westward spread of ANS (Kraft and Johnson 2000). Studies of boater behavior at the local level in states harboring zebra mussels have shown that local patterns of boater movement correlate well with the local inland distribution of zebra mussels (Buchan and Padilla 1999). If this trend holds true for long-distance dispersal, then programs like the 100th Meridian Initiative Survey will be important sources of demographic data needed to predict the long-distance movement patterns of recreational boaters into the areas most susceptible to ANS introduction. In this regard, data from the 1999 100th Meridian Initiative Survey has proven useful in highlighting

some qualitative trends in boater movement. Survey data revealed that Texas, Oklahoma, Kansas, and South Dakota all have high percentages of out-of-state boaters arriving from zebra mussel-infested states, with smaller percentages coming directly from waters harboring zebra mussels. In Texas and Kansas, most of these boaters were coming from Oklahoma, suggesting the importance of Oklahoma as a potential southern staging point for zebra mussel dispersal. In contrast to these states, Nebraska had high percentages of out-of-state boaters visiting from western states, especially Colorado, indicating that Nebraska (i.e., Lake McConaughy) could serve as an important point for westward ANS expansion, should any non-indigenous species become established there.

Perhaps more importantly, the survey results compared well with research that suggested that the long-distance dispersal of zebra mussels and macrophytic ANS by recreational boaters is likely to result from rare and isolated events. Thus, programs relying heavily on physical inspections to prevent westward ANS expansion may not prove adequate or cost-effective. The results also suggest that the 100th Meridian Initiative Survey should be continued, but could be improved by collection of the types of quantifiable demographics needed to accurately predict long distance boater movements and effectively target educational programs. Examples of such demographics include more precise destination data, identifying “home lakes,” and determining boater ANS awareness levels by geographic area. The survey could also incorporate demographic data from state and municipal sources as a supplement to the 100th Meridian Initiative data being collected, providing a comprehensive recreational boater database that could be a useful tool in preventing or managing future ANS introductions. Concentrations of registered boaters by zip code, and contact information for owners of large vessels are examples of useful data that could be obtained from local sources and incorporated into future 100th Meridian Initiative surveys. With a complete database, education and monitoring efforts could be

effectively targeted at specific groups of boaters and specific areas of ANS introductions, greatly increasing the chances for successful containment and control.

The westward expansion of ANS currently established in the eastern United States is by no means a certainty, and could possibly be prevented or greatly restricted. Successful prevention efforts will depend on cooperation and coordination among all the federal, state, and local agencies involved in order to produce consistent and effective educational and enforcement programs. In this regard, the 100th Meridian Initiative Survey could be further refined and expanded to provide the critical types of data needed for the future development of programs designed to prevent the further spread of aquatic nuisance species. This report has demonstrated the potential utility of the sorts of data collected in the initial 1998 and 1999 surveys in assessing patterns of recreational boater movement between drainage systems and isolated water bodies and their potential to facilitate the spread of ANS into uninfested waters. Expansion of a refined survey to states both east and west of the original six 100th Meridian States and eventually to all of the U.S. states and Canadian provinces will assist in the identification of the major avenues for the recreational boater dispersal of ANS within North American freshwater drainage systems. Maintenance of the sorts of data accumulated by the 100th Meridian Initiative Survey for all states and provinces in North America would greatly improve efforts to predict and control the future spread of ANS on local, state, regional and national levels. It would also allow specific targeting of prevention and educational activities to areas most susceptible to ANS invasion.

APPENDIX 1

100th Meridian Initiative to Prevent the Westward Spread of Zebra Mussel

TRAILERED BOAT SURVEY INTERVIEW FORM

Interviewer: _____ Date: _____ Time: _____ am/pm

Location: _____ Type of Survey: Contact _____ Observe _____

Where From?

Purpose of Transport: Commercial _____ Personal _____ Other (explain) _____

Home State: _____ Zip Code: _____ Boat Number: _____ Trailer Tag: _____

How often has this boat been launched this year? _____

Do you remember where (you launched most recently)?

Water body 1 _____ State: _____ County: _____

Water body 2 _____ State: _____ County: _____

Water body 3 _____ State: _____ County: _____

Water body 4 _____ State: _____ County: _____

Comments _____

Where are you going?

Do you have a definite destination? Do you know where you are going to launch next?

Water body 1 _____ State: _____

Water body 2 _____ State: _____

Comments _____

Information Exchange: Viewed _____ Read _____ Brochures Accepted _____

Results of boat inspection

Rejected: _____ Undertaken by: Party _____ Interview _____ Both _____

Results	Zebra Mussels	Still Alive?	Any Vegetation?	Other Exotics	Action Taken
Boat Deck	_____	_____	_____	_____	_____
Boat Hull	_____	_____	_____	_____	_____
Bilge, bait wells	_____	_____	_____	_____	_____
Motor	_____	_____	_____	_____	_____
Trailer	_____	_____	_____	_____	_____
Fishing/other equip.	_____	_____	_____	_____	_____
Other	_____	_____	_____	_____	_____

APPENDIX 2

THE 100TH MERIDIAN INITIATIVE INSTRUCTIONS FOR: TRAILERED BOAT SURVEY INTERVIEW FORM

General Instructions:

The large number of participants collecting data for the 100th Meridian Initiative means that it is very important for all respondents to report data that is complete, legible and standardized. All the information on the “Trailerred Boat Survey Interview Form” will be used to answer questions concerning travelling boaters as potential carriers of harmful exotic organisms, so interviews should be directed towards out-of-state boaters visiting your state, or resident boaters returning from out of state.

If you have any questions concerning this or other forms please contact:

Dr. Robert McMahon
University of Texas at Arlington
ph: 817-272-2412
fax: 817-272-2855
Email: r.mcmahon@uta.edu

Kevin L. Buch
University of Texas at Arlington
ph: 817-272-5577
ph: 817-649-0828 (home)
fax: 817-272-2855
Email: kbuch@exchange.uta.edu

Specific Instructions:

Interviewer: name of person conducting the interview, preferably last name first

Date: date the interview was conducted

Time: time the interview was conducted, including AM or PM

Location: give the full name of the site where the interview was conducted.

Example: “Lake Oahe” NOT: “Oahe”

“John Doe Visitor Center, I-20” NOT: “Doe Visitor Center”

State: indicate the state where the interview was conducted

Purpose of Transport: Commercial – someone trailering/launching for business purposes (commercial boat transporters, commercial fishermen, etc.)

Personal – recreational boaters

Other – an unusual situation not covered by personal or commercial

Home State: home state of the person being interviewed

Zip Code: zip code of the person being interviewed

Boat Number: registration number that is on the vessel

Trailer Tag: license plate number of the trailer/tow vehicle

Type of Vessel: check the box that best describes the trailerred vessel

How many times have you launched this vessel in the past year: the number of times the boat has been launched this year. An estimate is okay, but try not to leave this field blank.

Where have you been: include the full location and state of previous launchings.

Example: “Lake Fork, TX ” NOT: “Fork” or “Texas” or “around Tyler area”

Date: try and get accurate dates for the previous launchings, and give calendar dates for estimates.

Example: “Oh, sometime in early August,” record: “8/5/99” for “Oh, around the second week in June,” record: “6/14/99,” and so on.

Where are you going to launch next: give the full location and state of upcoming launches.

Example: “Pueblo Reservoir, CO” NOT: “Pueblo” or “somewhere in Colorado” or “Denver area”. Try to get a best estimate, please do not record “Don’t know.”

APPENDIX 2 (Cont.)

Date: try and get accurate dates for upcoming launchings, and give calendar dates for estimates.

Example: “Oh, sometime in early August,” record: “8/5/99” for “Oh, around the second week in June,” record: “6/14/99,” and so on.

Comments: in order to recall meaningful data from this section, we are using letter codes to designate common responses.

Example:

[I] = informed. Aware of zebra mussels and other exotics

[U] = uninformed. Generally ignorant of zebra mussels and other exotics

[R] = receptive. Exceptionally receptive/helpful.

[NR] = not receptive. Exceptionally uncooperative/negative attitude

[T] = tournament fisherman

[D] = dirty. Trailer/vessel exceptionally dirty.

These are just some examples, feel free to create codes that cover other responses, just make sure to describe your code so that it can be standardized. As long as a code is included, written comments can be input as well.

Information Exchange:

Viewed: boater casually looked over, but did not accept literature

Read: boater read over, but did not accept literature

Brochures Accepted: boater took literature away with them

Results of Boat Inspection:

Rejected: boater refused an inspection for some reason. Might have been non-receptive ([NR], see Comments) or simply in a hurry.

Undertaken By:

Party – the boater conducted the inspection with no help, or participation from, the interviewer.

Interview – the interviewer conducted the inspection with no help from, or in the absence of, the boater.

Both – the boater was present and involved in some aspect of the inspection.

Results:

Nothing found – check this box if an inspection was conducted and no organisms were discovered.

Positive inspections – check the appropriate box for the organism(s) and location(s) where a plant or animal was found.

Other Exotics - organisms other than zebra mussels or vegetation. (Examples: snails, clams, baitfish, etc.)

Action Taken - indicate whether the organism(s) was removed, removed and collected, left alone, etc.

APPENDIX 2 (Cont.)

**THE 100TH MERIDIAN INITIATIVE TO PREVENT THE
WESTWARD SPREAD OF ZEBRA MUSSEL
TRAILERED BOAT SURVEY INTERVIEW FORM**

Interviewer: _____ Date: _____ Time: _____ am/pm
 Location: _____ State: _____ Type of Survey: Contact Observe

Where are you from?

Purpose of Transport: (Check One) Commercial _____ Personal _____ Other (explain) _____
 Home State: _____ Zip Code: _____ Boat Number: _____ Trailer Tag: _____
 Type of Vessel: Bass Boat Pleasure Boat Jet Ski Canoe Other (Type) _____
 How many times have you launched this vessel in the past year? _____

Where have you been?

Where have you launched most recently?

Water body 1: _____ State: _____ County: _____ Date: _____
 Water body 2: _____ State: _____ County: _____ Date: _____
 Water body 3: _____ State: _____ County: _____ Date: _____

Where are you going to launch next?

Do you know where you are going to launch next?

Water body 1: _____ State: _____ County: _____ Date: _____
 Water body 2: _____ State: _____ County: _____ Date: _____

Comments:

Information Exchange: Viewed Read Brochures Accepted

Results of boat inspection

Rejected: Undertaken by: Party Interview Both

Results: Nothing Found

	Zebra Mussels	Still Alive	Vegetation Present?	Other Exotics	Describe other Exotic	Action Taken
Boat Deck	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
Boat Hull	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
Bilge, bait wells	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
Motor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
Trailer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
Fishing/other equip.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____

APPENDIX 3

THE 100TH MERIDIAN INITIATIVE INSTRUCTIONS FOR: “BOATER SURVEY FOR NONNATIVE AQUATIC SPECIES”

Many of the participants in the 100th Meridian Initiative have indicated difficulty in obtaining useful numbers of boater interviews for the database. Leaving these postage-paid, return addressed self-interview forms on unattended out-of-state vehicles at launch ramps and other related facilities will add valuable survey information to the database, and help to increase public awareness. Please remember to record the complete location, state, and date when leaving the form. Also remember to leave the envelope unsealed so the boater can fill out, and then mail the form.

The correct return address for the form is:

Dr. Robert McMahon
University of Texas at Arlington
PO Box 19498
Arlington, TX 76019

Please review the enclosed sample form, and if you have any questions concerning this or other forms please contact the following:

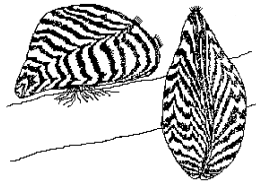
Dr. Robert McMahon
University of Texas at Arlington
ph: 817-272-2412
fax: 817-272-2855
email: r.mcmahon@uta.edu

Kevin L. Buch
University of Texas at Arlington
ph: 817-272-5577
ph: 817-649-0828 (home)
fax: 817-272-2855
email: kbuch@exchange.uta.edu

APPENDIX 3 (Cont.)

The Zebra Mussel

BOATER SURVEY FOR NONNATIVE AQUATIC SPECIES



LOCATION _____ STATE _____ DATE _____

THE 100TH MERIDIAN INITIATIVE is a multi-agency partnership effort to prevent the westward spread of zebra mussels and other aquatic nuisance species to western North American waters. The U.S. Fish & Wildlife Service is sponsoring and coordinating education outreach and voluntary trailered boat surveys with other agencies in the states on the 100th meridian. Surveys similar to this are being conducted in Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota and the Canadian Province of Manitoba. Boaters are being asked to voluntarily inspect their trailers, boats and related equipment for any transported aquatic species, such as the **zebra mussel**, which may be carried accidentally to new locations. Your assistance and participation is appreciated in completing this survey and returning it in the provided, stamped envelope to the agency who is conducting this survey for the U.S. Fish and Wildlife Service. Please review the enclosed information on introduced aquatic species and boat and trailer inspections. Be sure to clean your boat, trailer and equipment after loading the boat and before leaving the ramp. Thanks for your help!

The following instructions will help you complete the survey.

Part One – Where are you from?

Please state the purpose of your visit, and fill in the boxes relating to your boat and home state. Your most recent launchings are very important information, so please be as complete as possible.

Part Two – Where are you going?

Please indicate where you will be launching next **after you leave this lake**. Do not list further launchings at this lake. Again, please be as complete as possible in filling out this section.

Part Three – Returning the survey.

That's all there is to it! All you need to do is place this page in the provided, stamped, return envelope, seal it, and drop it in the mail.

SURVEY INFORMATION (Please Print)

Part One – Where are you from?

Purpose of Transport: (Check One) Commercial _____ Personal _____ Other (explain) _____

Home State: _____ Zip Code: _____ Boat Number: _____ Trailer Tag: _____

Type of Vessel: Bass Boat Pleasure Boat Jet Ski Canoe Other

About how many times have you launched this vessel in the past year? _____

Where have you launched most recently? _____

Water body 1: _____ State: _____ County: _____ Date: _____

Water body 2: _____ State: _____ County: _____ Date: _____

Water body 3: _____ State: _____ County: _____ Date: _____

Water body 4: _____ State: _____ County: _____ Date: _____

Part Two – Where are you going?

Where are you going to launch next?

Water body 1: _____ State: _____ County: _____ Date: _____

Water body 2: _____ State: _____ County: _____ Date: _____

Comments (Is there any other information which could be important to the survey?):

APPENDIX 4

THE 100TH MERIDIAN INITIATIVE INSTRUCTIONS FOR: TRAILER COUNTS FOR LAUNCH AREAS AND RELATED FACILITIES

General Instructions:

Surveying out-of-state traffic at launching areas of major water bodies and related facilities as well (bait stores, tackle shops, etc.), will provide important information on the usage and movement patterns of boaters visiting 100th Meridian states. These counts can be collected relatively easily, and this type of survey also provides the opportunity to obtain additional personal interviews, or to distribute copies of the self-interview form. These surveys also provide the opportunity to perform cursory inspections of out-of-state trailers, recording the presence of absence of aquatic organisms. Be sure to record and count all trailers, with and without vessels, for all the various types of watercraft included in the survey.

If you have any questions concerning this or other forms please contact:

Dr. Robert McMahon
University of Texas at Arlington
ph: 817-272-2412
fax: 817-272-2855
Email: r.mcmahon@uta.edu

Kevin L. Buch
University of Texas at Arlington
ph: 817-272-5577
ph: 817-649-0828 (home)
fax: 817-272-2855
Email: kbuch@exchange.uta.edu

Specific Instructions:

Surveyor: name of person conducting the survey, preferably last name first

Date: date the survey was conducted

Day: the day of the week the survey was conducted

Time: the time of day the count was made at the site, including AM or PM

Water Body or Facility: the complete location of the water body or other facility.

Example: "Joe's Tackle, Hwy. 4, Topeka" NOT: "Joe's Tackle" or "Topeka"

Example: "Lake Sam Rayburn" NOT: "Rayburn"

State: indicate the state where the water body or facility is located

Site: record the specific location of the site where trailers were counted. **Use one form per site.**

Example: "Caddo Lake State Park Ramp" NOT "state park" or "park ramp".

States and Numbers of Trailers: record the states represented, starting with your state first, and record the number of trailers (with or without vessels) from each state. Use the correct two-letter abbreviation for each state. Use the "other" column if more states are represented than there are spaces available.

Total (all): all trailers counted for the site. Example: "Total (all): 30"

Total (your State) _____: record your state and the total number of trailers from your state present at the site. Example: "Total OK: 22."

Total (Out of State): all out-of-state trailers counted for the site. Example: "Total (Out of State): 8."

Percent Out of State: Total (Out of State) divided by Total (all), times 100. Example: $[8/30 * 100] = 26.7\%$

Self-Interview Forms Distributed: The total number of return forms left at the site. These numbers will be used to determine the response rate of the self-interview form. A response form should be left on each unattended out-of-state vehicle/trailer.

Organisms Found: While conducting the survey, briefly inspect the out-of-state trailers for obvious signs of aquatic organisms, and record the type of organism and the state abbreviation of each trailer where organisms were found. Check "Nothing Found" if no organisms were seen at that site.

APPENDIX 4 (Cont.)

**THE 100TH MERIDIAN INITIATIVE TO PREVENT THE
WESTWARD SPREAD OF ZEBRA MUSSEL**
TRAILER COUNTS FOR LAUNCH AREAS AND RELATED FACILITIES

Surveyor: _____ Date _____ Day: _____ Time: _____ am/pm

Location: _____ State: _____

STATES AND NUMBERS OF TRAILERS
(Your State)

SITE										
TOTALS (by state):										
TOTAL (All):						Your State	TOTAL (from your state)			
TOTAL (Out of State):						Percent Out of State:				
Self-Interview Forms Distributed:										

Organisms:

Nothing Found: Zebra Mussels: States of Origin: _____
 Vegetation: States of Origin: _____
 Other: States of Origin: _____

If other is checked indicate types of organisms found:

APPENDIX 5

**THE 100TH MERIDIAN INITIATIVE INSTRUCTIONS FOR:
TRAILERED BOAT TRAFFIC SUMMARY REPORT**

General Instructions:

This form should be used whenever a surveyor is set up at a point of entry into your state. While waiting to conduct personal surveys, the surveyor can monitor and record boat traffic entering the state, thus providing important information about the movement patterns of boaters entering 100th Meridian states.

If you have any questions concerning this or other forms please contact:

Dr. Robert McMahon
University of Texas at Arlington
 ph: 817-272-2412
 fax: 817-272-2855
 Email: r.mcmahon@uta.edu

Kevin L. Buch
University of Texas at Arlington
 ph: 817-272-5577
 ph: 817-649-0828 (home)
 fax: 817-272-2855
 Email: kbuch@exchange.uta.edu

Specific Instructions:

Surveyor: name of person conducting the survey, preferably last name first

Date: date the survey was conducted

Day: the day of the week the survey was conducted

Time Begin: time the monitoring was started, including AM or PM

Time End: time the monitoring was concluded, including AM or PM

Location: give the full name of the site where the monitoring was conducted.

Example: "I-30 Rest Stop, TX/AR Border" NOT: "I-30 Rest Stop" or "TX/AR Border"

State: indicate the state where the survey was conducted

Weather: check the appropriate box

Good – weather very good for boating (little or no wind, clear, moderate temperature, etc.)

Fair – weather okay for boating (slightly higher winds, cloudy or overcast, less than ideal temperature)

Poor – weather not conducive to boating (high winds, threat of precipitation, extreme temperatures)

General Traffic:

Light – little movement overall into the state

Medium – average traffic flow

Heavy – highway is crowded and very busy. Example: holiday weekends

Boat Traffic Summary: record the state for each type of vessel passing the location per hour (write small).

Example:

HOUR	BASS BOAT	PLEASURE BOAT	JET SKI	CANOE	TOTAL (BY STATE)
1	TX, TX, TX, OK, TX, AR, MO, AR, TX, MO	TX, TX, OK, TX, AR, MO, AR, TX, MO	AR, TX, TX, TX, OK	-----	12-TX; 3-OK; 5-AR; 4-MO

Total (by State): the total number of boats for each state represented, per hour.

Total (all): all boats counted for the entire day. Example: "Total (all): 69

Total (your State) _____: record your state and the total number of boats from your state for the entire day.

Example: "Total OK : 41.

Total (Out of State): all out-of-state boats counted for the entire day. Example: "Total (Out of State): 28.

Percent Out of State: Total (Out of State) divided by Total (all), times 100. Example: $[28/69*100] = 40.6\%$.

APPENDIX 5 (Cont.)

**THE 100TH MERIDIAN INITIATIVE TO PREVENT THE
WESTWARD SPREAD OF ZEBRA MUSSEL
TRAILERED BOAT TRAFFIC SUMMARY REPORT**

Surveyor: _____ Date: ____/____/____ Time: Begin: _____ am/pm
Day: _____ End: _____ am/pm

Location: _____ State: _____

Weather: Good Fair Poor General Traffic: Light Medium Heavy

Boat Traffic Summary: Type of Boat and State per Hour

HOUR	BASS BOAT	PLEASURE BOAT	JET SKI	CANOE	TOTAL (BY STATE)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
TOTAL (by type):					
TOTAL (All):			TOTAL (Your State):		
TOTAL (Out of State):			Percent Out of State:		

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