

**IDENTIFYING RISK FACTORS TO STRENGTHEN CURRENT  
STRATEGIES AIMED AT MINIMIZING THE INTRODUCTION  
OF QUAGGA AND ZEBRA MUSSELS TO LAKE COUNTY,  
CALIFORNIA.**

**A Report Prepared by the Lake County Fish and Wildlife Committee  
January 2009**

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## Summary

The Lake County Fish and Wildlife Committee have developed a risk assessment proposal regarding the current threat posed by both the quagga mussel (*Dreissena bugensis*) and zebra mussel (*D. polymorpha*). This report identifies a number of positive actions already undertaken by the County of Lake and encourages their continued support. Secondly, this report attempts to prioritize the various risk factors associated with each Lake County waterbody with public access, and provides organizational and management guidance to direct preventative measures against mussel introduction. Lastly, the Committee, through this report, is providing support and advice to assist the County in addressing AB 2065 (Hancock) which takes affect January 1, 2009. The newly passed legislation requires “all public reservoirs allowing recreation, boating and/or fishing to assess their vulnerability to mussel infestation and develop and implement a program to prevent their introduction”.

Specifically this reports states:

1. Three primary locations exist within the boundaries of Lake County where mussels would significantly adversely affect the waters of California;
2. The large number of access points into Clear Lake presents numerous challenges to the development of an effectual prevention program. These challenges demands development of a systematic strategy that makes any program reasonable, manageable, and affordable;
3. Not all access points entering Clear Lake pose equal levels of risk for mussel introduction. A coordinated program that recognizes risk levels will assist in the prioritization of limited resources to address the threat;
4. The management of Lake Pillsbury and Indian Valley Reservoir will require close coordination and inclusion of the responsible land and facility management agencies if the County is to develop a comprehensive mussel planning and prevention program;
5. Any outreach effort to keep both the local citizenry and visitors engaged and informed must be on-going to minimizing a sense of complacency that the threat has been alleviated;

6. Improved and strengthened political efforts must be aimed at increasing broader statewide coordination. Coordination is necessary to minimize duplicated local efforts that are beyond the resource capabilities of Lake County; and
7. Finally, not all Clear Lake user-groups, points of access, and associated waters (Highland Springs and Adobe Spring Reservoirs) pose equal levels of risk for mussel introduction. Programs aimed at increasing boater awareness should recognize the risks associated with each group and site and use appropriate communication tools to improve transfer and transparency of program activities and goals.

Fig. 1. Free public boat access points on Clear Lake.



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COUNTY, CALIFORNIA.**

**Introduction**

The recent finding of both quagga (*Dreissenia bugensis*) and zebra (*D. polymorpha*) mussels in the western United States (and most importantly California) has created a sense of urgency among many interests groups to this threat of water resources. Both the public and private sectors have responded by trying to develop strategies that limit the spread of these very aggressive pest species. The threat to California business and environmental interests, measured both in terms of costs and adverse impacts, can not be overstated. The 2007 report entitled *California's Response to the Zebra/Quagga Mussel Invasion in the West* states:

“Direct economic costs are on the order of \$100 million a year in eastern North America; unquantified secondary and environmental costs could be substantially larger. Impacts in California and the West could be as great or greater than those in the East. California cities, industries and farms depend on the transport of huge quantities of water across very large distances through a complex and vulnerable system of canals, pipes, reservoirs and pumping stations. It is thus critical that aggressive, concerted efforts be undertaken immediately to *eradicate, contain and monitor* the zebra mussel infestation in the lower Colorado River system”.

This report further argues that coordinated efforts between local, state and Federal programs, to ensure successful monitoring and prevention, are critical to preventing the mussel’s spread.

Lastly, the Committee, through this report, is providing support and advice to assist the County in addressing AB 2065 (Hancock) which takes affect January 1, 2009. The newly passed legislation requires “all public reservoirs allowing recreation, boating and/or fishing to assess their vulnerability to mussel infestation and develop and implement a program to prevent their introduction”.

### **Who and what is at risk?**

Native to the Baltic region of Europe the mussels are thought to have been introduced into the Great Lakes via ballast water from trans-oceanic freighters. The resultant impacts to fisheries, water conveyance systems and recreation has been reported in the millions of dollars.

The mussel(s) threaten the water transport system that is vital to California's urban, residential and agricultural infrastructure. The additive co-concurrent threat to the recreational and ecological resources associated with California's waters suggests a worse case scenario for the State. Experience in the eastern United States has demonstrated that equipment important in the conveyance of water (*i.e.*, pumps, screens, pipes, *etc.*) can be negatively impacted by the mussels. Furthermore, the possibility of exorbitant numbers of mussels (a likely scenario in Clear Lake) in a small area can impact water clarity and quality and disrupt current ecological conditions.

### **Brief overview of quagga/zebra biology.**

Both the quagga and zebra mussels are prolific breeders. Sexual reproduction occurs (male and female) with external fertilization. A fully mature female mussel is capable of producing up to one million eggs per season. After fertilization, free floating microscopic larvae, or veligers, develop within a few days. Free-swimming veligers drift with the currents for three to four weeks while trying to locate suitable substrate to settle and become secure. Depending on environmental conditions the time between fertilization to settlement can vary between 18 to 90 days. Young mussels can become reproductively active in their first year.

The mussels are filter feeders. Each adult mussel is capable of filtering one or more quarts of water each day, where they remove phytoplankton, zooplankton, algae, and even their own veligers. Any undesirable particulate matter is bound with mucus, known as pseudofeces, and ejected. This waste material is known to negatively impact water quality.

### **Overview of principle mechanisms of spread.**

Since the larval stage of the both species are free floating forms they are easily transported in water. They can readily be taken up and spread by pumps; and transported in any vessel capable of holding water (*e.g.*, boats, bait boxes, bilges, live wells, ballast tanks, *etc.*). The adults have the ability to adhere to most solid objects and can be transported on boat hulls, trailers, motors, buoys, docks, barges, pontoons, *etc.* Both adults and veligers can readily be transported on or in containers holding live aquatic plants, fish or other sources of water coming from infested sites.

The opportunities for infestation are significant due to the large number of out-of-county boaters that enter the County. Clear Lake in particular is at a high risk of introduction of these exotic mussels due to (1) the Lake's reputation as a blue ribbon warm water fishery; (2) its multiple, free, access points for visiting boaters and (3) the Lake's water chemistry which is highly favorable to both mussel species. The potential from boaters arriving from infested waterways has been well documented since the County initiated its current program.

### **Locations of Concern for Lake County.**

There currently exist three primary locations of concern located within the boundaries of Lake County where if established the mussels would significantly impact the waters of California.

- 1) **Clear Lake.** Because of its size and relative ease of access Clear Lake poses the biggest challenge to the County of Lake in their efforts to prevent the introduction of the mussels. The lake is open to boating year-round and accessible to trailered vessels in all seasons except in very rare and extreme periods of drought. The primary exit point of water leaving Clear Lake is through Cache Creek into the Sacramento River system. The Lake is known to have at least 523 privately owned lakeside parcels with boat ramps (this number does not include areas of Clear Lake Keys, Corinthian Bay, Lands End, Pier 1800 and Pier 1900 in Lakeport, Sunrise Shores and Cache Creek.) In addition to private access points

there also exists public boat ramps at Keeling Park in Nice, Lucerne Harbor in Lucerne, Clearlake Oaks Beach in Clearlake Oaks, Thompson Harbor (Redbud) in Clearlake, Clear Lake State Park in Kelseyville, Lakeside County Park in Kelseyville, Crystal Lake Way (Hamilton Park) in North Lakeport, and in the City of Lakeport First Street, Third Street, Fifth Street and Clear Lake Avenue.

- 2) **Lake Pillsbury.** Located in the Mendocino National Forest, Lake Pillsbury is a reservoir formed by Scott's Dam on the Middle Fork of the Eel River. Water is diverted downstream of Scott's dam through the Van Arsdale dam down Potter Valley and into the Russian River system. There are currently two public boat ramps on the lake. The boat ramps are managed by the Pacific Gas and Electric (PG&E) company. Both the Eel and Russian River systems are at risk if the mussels should become established in this lake.
  
- 3) **Indian Valley Reservoir.** This water body is found in the eastern portion of the County and drains through Cache Creek into the Sacramento River system. The Reservoir is located on lands managed by the USDI Bureau of Land Management but the lake is managed by the California Department of Fish and Game. There are currently two public boat ramps on the lake. The Sacramento River system is at risk if the mussels should be established in this reservoir.

**Addressing risk associated with access points is key to program success.**

1) **Access Sites on Clear Lake.** The large number of access points into Clear Lake demands that a systematic approach be considered as a means of assisting in the development of a strategy that makes any program reasonable, manageable and affordable. [Since Highland Springs and Adobe Spring reservoirs deposit water in Clear Lake they should be included in any considerations for protecting Clear Lake.]

2) **Access to Lake Pillsbury and Indian Valley Reservoir.** The management of these waterbodies require that the responsible land and facility management agencies be included in any County mussel planning and prevention efforts.

## **Understanding and Managing Risk-**

Both Indian Valley and Lake Pillsbury posed little or no risk of infestation once their waters recede beyond access for trailered vessels late in the summer season. The primary seasons where infestation is a threat are the winter and spring seasons. The County has no direct responsibility on the management and access to these reservoirs, therefore it is critical the managers of these sites be included in any preventative plans adopted and implemented.

Clear Lake, being a natural lake, is a different matter. Because of year round access, the large size of the lake and the relative ease of access to the water, Clear Lake is at the highest risk of infestation of any of the at risk water bodies found within the county. The sheer number of access points warrants a discussion of risk factors associated with each type as a means to identify those potential access points that pose the highest risk of introduction and where limited resources can be targeted.

### **Clear Lake**

1. **Public improved trailered vessel access.** Keeling Park in Nice, Lucerne Harbor in Lucerne, Clearlake Oaks Beach in Clearlake Oaks, Thompson Harbor (Redbud) in Clearlake, Clear Lake State Park in Kelseyville, Lakeside County Park in Kelseyville, Crystal Lake Way (Hamilton Park)\* in North Lakeport, and in the City of Lakeport First Street\*, Third Street, Fifth Street and Clear Lake Avenue\*. These are the most heavily accessed points of entry into the Lake. Each facility (except for the Clear Lake State Park) provides free launch, with modern facilities and nearby parking. These sites are used most often by resident and non-resident anglers/boaters, whether as individuals or as part of an organized event. *Without question, these sites pose the greatest risk for the introduction of mussels.* (Table 1).

**Table 1. Access Points and Risk Assessment of Each type on Clear Lake.**

<b>Public improved trailered vessel access.</b>	<b>Public ramp access.</b>	<b>Private, improved trailer vessel access (resorts)</b>	<b>Private (homeowner) boat access</b>
Keeling Park in Nice; Lucerne Harbor in Lucerne; Clearlake Oaks Beach in Clearlake Oaks; Thompson Harbor (Redbud) in Clearlake; Clear Lake State Park in Kelseyville; Lakeside County Park in Kelseyville; Crystal Lake Way (Hamilton Park)* in North Lakeport; City of Lakeport First Street*; Third Street; Fifth Street; Clear Lake Avenue*.	Crystal Lake Way (Hamilton Park)* in North Lakeport, and in the City of Lakeport First Street*, and Clear Lake Avenue*	The total number of resort/business access points to the water is 66. Two launches in particular Knocti Spa & Resort and Knocti Vista Casino deserve special attention because between the two, they are host to the majority of the larger bass tournaments and other events and both allow public launch.	Though by far the most common type of access (457) these ramps/docks have very limited access to the general public.

2. **\*Public ramp access.** The public access points at Crystal Lake Way (Hamilton Park)\* in North Lakeport, and in the City of Lakeport First Street\*, and Clear Lake Avenue\* provide improved boat ramp access at the end of public streets. They are not monitored and lack the facilities to monitor their use. *Except in those cases where a local business may be directly impacted, these points of access could be permanently*

*barricaded and closed to trailered vessels to limit the points of public access to facilitate improved public access monitoring efforts.*

3. **Private, improved trailer vessel access (resorts)** – The total number of resort/business access points to the water is 66 (this number includes Mobile home Parks, Homeowners Associations and Resorts). Access is limited to registered guests or guests who must pay a launch fee. These access points provide a readily available screening/inspection “choke point” for each vessel using their facility. Though a moderate risk exists from boats entering from out of the area, the facility owner/managers provide a controlled and monitored environment that can greatly reduce the chance of unchecked access. Two launches in particular Konocti Spa & Resort and Konocti Vista Casino deserve special attention because between the two, they are host to the majority of the larger bass tournaments and other events and both allow public launch. *These facilities arguably pose a moderate risk of infestation and the owner/managers should be viewed as a key link in informing their guests of the requirements prior to boat launching.*
4. **Private (homeowner) boat access** – Though by far the most common type of access (approximately 457) these ramps/docks have very limited access to the general public. Typically, these points are accessed by residences that are already identified by County AP numbers that can receive mail and notices informing them about changes in policies or procedures regarding boat inspection programs. *In most instances boats that are associated with these parcels are moored, trailered or stored on site and rarely leave the area posing little or no risk of introducing the mussels.*

## Using Risk Factors to Direct Local, Regional and Statewide Outreach Programs.

### Low vs. High Risk Audiences-

- 1) **Public improved trailered vessel access.** *Without question, these sites pose the greatest risk for the introduction of mussels.*
- 2) **Public ramp access.** *Except in those cases where a local business may be directly impacted, these points of access could be permanently barricaded and closed to trailered vessels to limit the points of public access to facilitate improved public access monitoring efforts.*
- 3) **Private, improved trailer vessel access (resorts).** *These facilities arguably pose a moderate risk of infestation and the owner/managers should be viewed as a key link in informing their guests of the requirements prior to boat launching.*
- 4) **Private (homeowner) boat access.** *In most instances boats that are associated with these parcels are moored, trailed or stored on site and rarely leave the area posing little or no risk of introducing the mussels.*

As discussed in the Introduction, the Interagency Science Report, states a collaborative effort will be needed to limit the spread of the mussels in a State as large and diverse as California. By identifying potential risks associated with each type of access point, Lake County can begin to effectively address the multifaceted approach needed to engage various user groups, agencies and members of the public in their attempt to minimize the likelihood of mussel introduction.

### Who and what are the audiences to be identified?

- **Local efforts.** Recent efforts undertaken by Lake County's government and business interests have demonstrated strong vision and leadership. Their efforts have made it obvious that any successful effort to prevent the introduction of the mussels will require assistance from more than the good will of its local citizenry. Educational and outreach programs identifying local residents, though important, must be kept in context of the risk posed by local people. Local media has been very supportive in keeping the local populace informed of emerging policies and laws governing the use of the Lake. Though it is important to include local

residents, efforts to engage them should focus on low cost projects (*i.e.*, using local media, using existing mechanisms of communications such as newsletters, *etc.*) to keep people informed and able to contact sources of information. Programs addressing local school children, service organizations *etc.*, though important, are not delivering information to high risk constituents. As with any outreach effort care must be taken to keep the local citizenry engaged and informed on a regular basis in order to minimize a sense of complacency that the threat has been alleviated.

- **Regional vs. Statewide efforts.** Addressing non-resident individuals and groups pose both the greatest risk and greatest challenge for developing an effective outreach program. An effective outreach program must be aimed at increasing the awareness of non-residential users regarding the threat and engaging them to implement preventative measures. It is imperative that the County engage in collaborative efforts within existing programs and work to develop innovative new programs. The focus of these efforts requires outreach to the largest possible constituency of stakeholders to address outreach to potential non-residential visitors.

Important considerations to insure the maximum amount of program acceptance and compliance should include:

- Visible signage informing visitors of inspection programs and requirements;
- Outreach to websites, out of area boating organizations, fishing organizations and associated media, to inform potential visitors prior to traveling into Lake County;
- Contact information that provides timely sources of screening/inspection services on a 24/7/365 basis;
- Contact information that provides timely information regarding the availability of screening/inspection stickers; and
- Decontamination services for those boats requiring this service on a 24/7/365 basis.

- **User Group Risk Factors.** Just as certain types of access points pose varying levels of risk so do the various user groups. With an estimated 30-40,000 boats ( $\approx$ 100,000 user days) a year on Clear Lake, identifying high-risk user groups is imperative to preventative efforts.
  - **Organized Groups** – many groups that enjoy the benefits of Clear Lake are well organized. Tournament and Club anglers, Xtreme Sports enthusiasts, float-plane pilots, and other organized groups are easily identifiable and accessible through permitting processes, media outlets, internal news letters, web blogs, e-mail, *etc.* These groups need to be fully engaged in policy and procedure updates using communication tools commonly used by the group(s).
  - **Individuals** – by their very nature of not belonging to an organized group this vast and diverse group of Lake users pose the greatest risk and the greatest challenge when trying to engage them in screenings, re-inspections, and general outreach/educational efforts. This group is represented by those recreationalists who simply want to “enjoy” the Lake and may not be engaged in any discussions or interactions process that can transfer information among them.
  
- **Strategies to consider for various user groups-**
  - **Organized Groups** – most organized groups wishing to use the Lake are required to obtain a permit from an oversight organization. This obvious “choke point” provides an opportunity to get information in the hands of those individuals who can share it with their members. To date, the approach being used for the above mentioned groups seems to enjoy broad support as they have worked with the County to insure that their members/participants are aware of the threat posed by the mussel.
  - **Individuals** – this is the user group that is stretching the County beyond its organizational and financial capacities. It has proven nearly impossible for the County to re-inspect returning out-of-county boats once they have obtained an inspection sticker. It has become glaringly apparent, that in

the absence of an external system of assistance, the County's efforts at addressing this risk are inadequate.

- **Programs that appear to be working-**
  - The sticker program for local residents has proven successful. The only suggestion is to consider offering two stickers for each vessel to assist in ready identification of screened vessels.
  - The current system of the current border station inspections administered by the California Department of Food and Agriculture (CDFA) is a good example of the type of cooperative assistance that is needed to assist local efforts in indentifying and monitoring boats coming from outside the immediate area. Continued collaboration between County and State programs will be key to continued success.
  
- **Where Improvement is needed -**
  - 1) The out-of-county sticker program must be improved. Current challenges include:
    - Assuring re-inspection of returning visitors is nullified once a visitor is provided a permanent sticker;
    - many out-of-town boaters have repeatedly expressed their frustration in locating sources of sticker distribution centers upon arriving on a weekend; and
    - sticker distribution centers must keep a supply on-hand for timely distribution when a visitor needs one.
    - Owners, managers and users of minor water bodies need to be better incorporated into mussel prevention programs.
  
- **Suggestions for improvement -**
  - 1) As with other invasive species (medfly, gypsy moth, Hydrilla, pitch canker, sudden oak death and others) a statewide system of identifying zones of infestation has greatly assisted local efforts in their attempts

to focus their inspection programs. Establishing such zones would allow the development of a geographically appropriate vessel identification programs wherein registered boats and trailers in known areas of mussel occurrence can be identified at the source or within the zone vastly assisting local efforts identifying those vessels posing the greatest risk.

- 2) Limiting the days that an out-of-county sticker is valid will require returning visitors to obtain secondary screenings and a new sticker.

This can be accomplished by:

- designing a new temporary sticker/identification or;
- simply using permanent ink and writing the date of issue and length of stay on the sticker a person would have to seek a re-inspection the next time the boat entered the county. The proposed system is similar to the system used by the State Park system for its visitors. Anyone found with an un-dated or out-of-date sticker would be out of compliance.

### **Needed programs outside of Lake County to support local efforts-**

1. It is apparent to the Lake County Fish and Wildlife Advisory Committee that the magnitude of this threat is too complex, expansive and expensive for the State of California to expect counties to develop local programs while State efforts are limited to “providing guidance and technical assistance”. However, this appears to be the approach currently advocated by the California Department of Fish and Game. Additionally, the current statewide strategy of expecting local jurisdictions to develop site-specific programs will lead to a highly disconnected, incoherent and disorganized system of individual programs. This uncoordinated approach will lead to criticism and cynicism by the public further degrading the good intentions of local groups and governments, and ultimately prove ineffective at spreading the invasion of these exotic species.

2. A statewide sticker (or other appropriate identification system) identifying vessels registered, located or moored in or near waters of known mussel populations is a first step in assisting local jurisdictions direct their limited resources. This can be implemented by using the “ZONE OF INFESTATION” approach discussed above. A permanent identification marker, widely known to interested groups/organizations would facilitate and focus inspection to high risk groups.
  
3. A State lead agency must be established. Though the Department of Fish and Game has proven to be accessible, supportive and cooperative, experience has demonstrated that their resources and capacity to address these highly invasive species are very limited. Nonetheless, State agencies are better equipped to address the multifaceted complexities of managing an effective prevention program (as they have demonstrated on other food or water issues) In light of the risk factors that have been identified in this report, the Committee suggests that the role of the Department of Fish and Game as “Lead Agency” be re-evaluated to ensure that the Department has the necessary capacity to address this threat at numerous locations throughout the State.

**Need for Collaborative Efforts-**

4. The County’s Quagga Mussel Task Force is a positive start. However, this committee report identifies other state and Federal groups that need to become included its activities. Specifically, the US Forest Service and PG &E (Lake Pillsbury) and the DFG (Indian Valley Reservoir) should be included to ensure a comprehensive and coordinated approach to addressing all of the major boating waterbodies.

5. The County has made a sincere effort in communicating with all the various interest and business groups potentially impacted. These activities should continue and be strengthened where needed, particularly in the direction of high risk groups (non-resident users).
6. Interagency discussions need to expand beyond the County and DFG. A dialog should take place between the County, DFG, CDFA and the Department of Motor Vehicles (DMV) to explore the possibility of developing a recognizable identification program that assist local jurisdictions in focusing inspections on those vessels coming from areas of highest risk.
7. Similarly, regular discussions/updates between state, Federal and local jurisdictions involved in mussel quarantine programs should be included as part of the Quagga Task Force meetings.
8. Political efforts should be targeting improved and increased levels of State and Federal financial support to continue and expand local preventative efforts. The magnitude of the threat is too great for Lake County to address effectively.

### **Sources of Information**

Cal Dept. of Fish and Game <http://www.dfg.ca.gov/invasives/quaggamussel/>

U.S. Geological Survey <http://nas.er.usgs.gov/taxgroup/mollusks/zebramusel/>

100<sup>th</sup> Meridian Initiative <http://www.100thmeridian.org/zebras.asp>

Southern Nevada Water Authority [http://www.snwa.com/html/env\\_quagga\\_mussel.html](http://www.snwa.com/html/env_quagga_mussel.html)