

Clamming in Casco Bay: Money in the Mud

Casco Bay clams have richly provided, both nutritionally and economically, for the people residing around Casco Bay since prehistoric times. Shell mounds and middens, the pre-colonial piles of clamshell wastes that dot the bay, attest to their use by Native Americans, while historical data on clam landings document their more recent importance.

But despite the importance and opportunities afforded by soft-shell clams, Casco Bay represents missed opportunities for clam harvesting and the economic benefits of a clean bay. In 1993, 44.5 percent of the soft-shell clam flats in the bay were closed to harvesting due to pollution or lack of information. To document the cost of these closures to the regional economy, the Casco

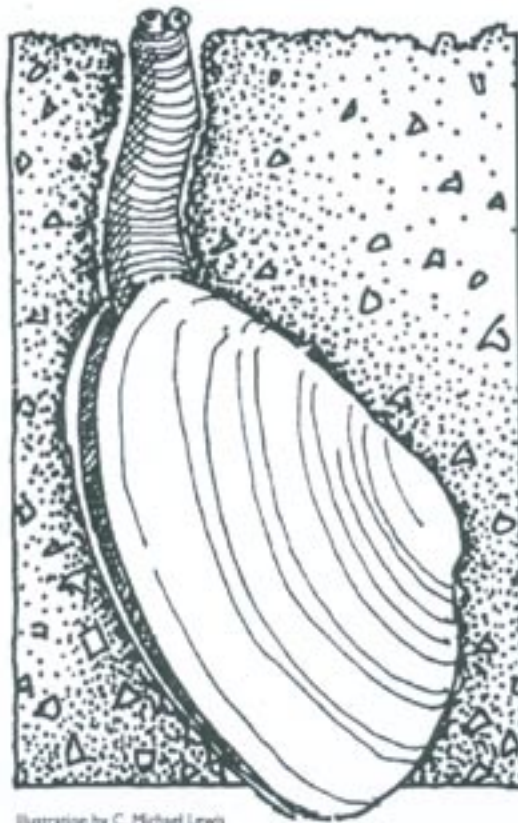


Illustration by C. Michael Lewis

Bay Estuary Project commissioned a study of the economic value of the soft-shell clam fishery in Casco Bay. This fact sheet outlines the findings of that study, *Economic Analysis of the Soft-shell Clam, Mya arenaria, Industry in Casco Bay*.

The study estimated the total economic value of the clam resource in Casco Bay, including the direct income to diggers and the broader economic benefit to the region; researched the economic benefit of removing pollution sources from representative closed areas; and provided a brief overview of the clam fishery's non-market values.

This fact sheet also puts these findings into the context of the

Life Cycle of the Soft-shell Clam

Soft-shell clams, *Mya arenaria*, are found in soft mud and silty areas in the intertidal zone from the Arctic Ocean to Cape Hatteras. They spend their adult lives buried in sand or mud, with a siphon or "neck" extending through the mud into the water. The clam pumps water through the siphon, removing oxygen, food, and other particles from the water. The water circulates through the clam, picking up wastes, then is pushed out through another channel in the siphon. Clams eat small plants, clumps of bacteria, and decomposing organic material.

Beginning in late spring or early summer, the male and female clams release tremendous amounts of sperm and eggs into the water column that drift freely and form larvae soon after they join. Larvae float in the water column for three to four weeks before they

settle out onto the mud as "spat." Wind and tides can distribute larvae and spat miles from their source. Soft-shell clams generally settle more heavily in the north-northeastern sections of the finger bays of Casco Bay, such as Maquoit Bay, Upper Middle Bay at Crow Island, and Thomas Point Beach in Brunswick, and Rich Cove, Brickyard Cove, and Orr's Cove in Harpswell. This may be due to tidal patterns and predominant winds. South-facing flats also are warmer in the summer, which may encourage larvae to settle.

Upon settling, the spat burrow into the surface layers of the mud. Within one or two years they are considered adult clams. In Maine, clams must be at least two inches in size before they can be legally harvested. This usually takes three to four years.

conomic boom times often mean that fewer clams are harvested.

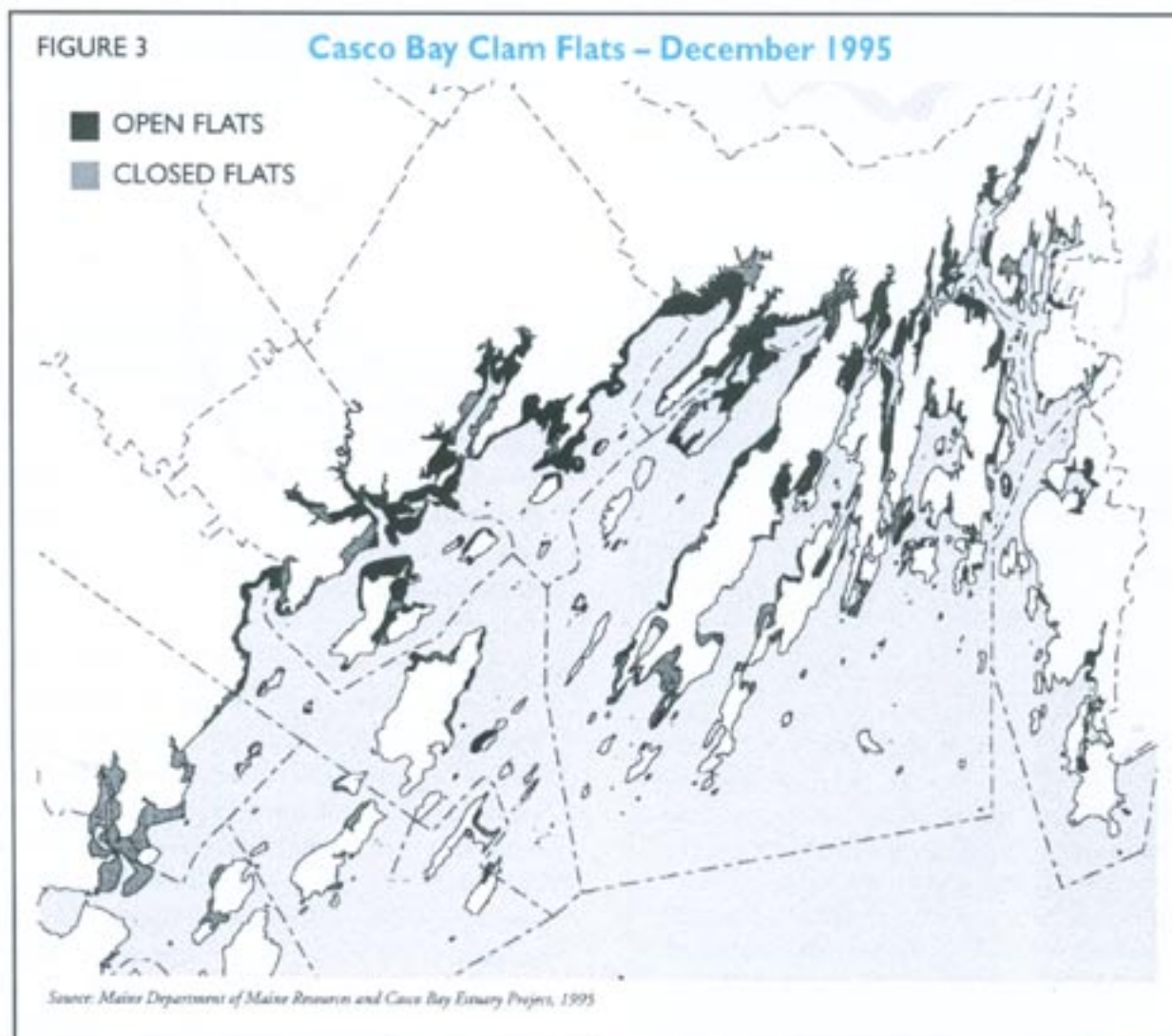
Figure 1 shows the wide variability in Maine clam landings over time. Harvesting peaked in the 1930s, possibly due to the economic hardships of the Depression. The declines of the 1940s are probably related to harvesters being sent off to war or employed in ship-building or other wartime work. The end of the war in 1945, and the return of harvesters from the armed services, strongly correlate with increased harvesting in that time period.

In the 1950s, milder winter temperatures allowed the green crab to survive in unprecedented numbers. These crabs, the primary predator of soft-shell clams, decimated the clam population along the entire Maine coast in the late 1950s and early- to mid-1960s. The cyclical return of harsher winters allowed clam populations to rebound in the late 1960s as fewer green crabs survived the winter.

By the mid 1970s, clam populations had once

again regained their earlier strength. Since then, clam landings have been stable or gradually increasing in southern Maine. Downeast in Washington and Hancock Counties, however, new and as yet undetermined problems have caused the resource to decline over 80 percent. Traditionally, 50 to 80 percent of the clams harvested in Maine originate Downeast. This decline has brought statewide production down to nearly 1960 levels. Researchers speculate that the cause for this decline may be overharvesting, an increase in predation by other species, chemical contamination, or changes in bottom substrate that influence the settling and establishment of spat. However, the actual source of the problem is not clear.

The demise of the clam resource Downeast has increased the pressure to harvest clams in the rest of the state, particularly around Casco Bay. Cumberland County now accounts for almost 30 percent of Maine's clam production, with most of that coming from Casco Bay.



Natural and Manmade Threats to Clam Resources

A variety of natural threats can cause soft-shell clam populations to fluctuate considerably, affecting the overall abundance of the resource and the industry that relies on it. Natural predators such as snails, fish, and other animals abound, many feeding on the larvae while they are still suspended in the water column.

Green crabs are the foremost predator in subtidal areas. In the 1950s, milder winter temperatures allowed more green crabs to survive and their population to grow. Their numbers were so high that people devised elaborate nets and fences to prevent them from preying on clams before they could be harvested. Despite these desperate attempts, the overall harvest of clams declined precipitously during this period. Currently, the Friends of Casco Bay organization is tracking green crab populations near Mackworth Island in Falmouth to see if they may be responsible for the currently low clam population in these flats.

Mussels also compete with clams in their habitat. Mussels can affect clam habitat in three ways: 1) by competing for and depleting their food source, phytoplankton; 2) by entraining clam larvae during filter feeding; and 3) by competing for space by encroaching into clam habitat, then suffocating clams by depositing waste materials. This study documented several areas in Casco Bay where this appeared to be happening.

Toxic pollution, including chlorine from overboard discharge systems and municipal waste water treatment plants, toxic by-products from manufacturing processes, pesticides, and herbicides have the potential to affect clam recruitment and survival. However, no relationships have been established and little work has been done in this area.

Finally, the most abundant predator on soft shell clams are humans. Casco Bay clam diggers harvest about 70 percent of the available market-size clams growing in an open flat. Clam production in Casco Bay has been high over the past several years, but the recent high prices paid for clams has dramatically increased digging pressure. Intense harvesting and lack of management can lead to overharvesting and local depletion of the resource.

Clam Flat Closure

Harvestable clam flats are a valuable resource. So what causes their closure? The reasons are myriad, but generally fall into three categories: pollution, conservation, and red tide.

Pollution Closures

Shellfish flats are closed when high bacteria levels in water over the flats indicate the presence of human or animal waste. Shellfish exposed to contaminated water can cause illness if consumed by people. Sources of bacteria include malfunctioning or improperly installed or maintained septic systems, overboard discharge systems, municipal and industrial discharges of wastewater, illegal sewage discharge from boats, waterfowl and wildlife wastes, and polluted stormwater runoff. The Maine Department of Marine Resources also closes areas where pollution is suspected, such as adjacent to overboard discharge systems and around marinas where sewage dumping from boats is a potential threat. Sometimes clam flats are closed because of a lack of information: the required number of water quality samples has not been taken or there has been no recent shoreline survey to identify potential sources of pollution. For the purposes of this study, closed clam flats refer to those flats closed because of bacterial pollution sources.

Conservation Closures

Clam flats also can be closed for conservation purposes. Municipalities with shellfish ordinances and active management programs can close certain flats to seed them with small clams, to foster natural seeding and growth after a period of intense harvesting, or to allow a flat with predominantly small clams to grow undisturbed to the two-inch legal size.

Red Tide Closures

Shellfish harvesting may also be interrupted due to episodic red tide blooms responsible for paralytic shellfish poisoning in humans. Red tide is caused by a dinoflagellate, a microscopic plant, which produces a toxin that if consumed affects the human nervous system. When red tide organism populations reach high densities, they pose a potential health risk to consumers. Once levels of toxin in shellfish reach an established threshold, shellfish harvesting is stopped in affected areas. The Maine Department of Marine

Resources conducts an intensive monitoring program to track toxin levels in shellfish.

Classification of Clam Harvesting Areas

The Maine Department of Marine Resources classifies each shellfish growing area by whether or when it is open to harvesting. This classification is based on the results of a sanitary survey which includes a shoreline survey to identify potential sources of bacteria such as nearby discharge pipes or streams, an evaluation of meteorological and hydrographic influences, and analyses of bacterial concentrations found in water samples from the area. The water sample analyses look for fecal coliform bacteria, indicating a possible source of disease or infection-causing bacteria. The sanitary survey must be updated annually and re-evaluated every three years, with a new survey conducted at least every twelve years.

Based on results of the sanitary survey and other factors (for example, closures around wastewater discharges and marinas), the Maine Department of Marine Resources classifies clam flats as approved (open), conditionally approved, restricted (harvesting permitted under special conditions), conditionally restricted, or prohibited (closed to clamming). Occasionally flats are closed because the required number of water quality samples has not been taken or because there is no recent shoreline survey.

To open a clam flat to harvesting after it has been closed, the Maine Department of Marine Resources requires a new shoreline survey to verify the absence of bacterial sources and between 15 to 30 water samples (depending on the sampling strategy) that register below the threshold for the presence of fecal coliform bacteria. This process often takes at least two years to complete. To maintain the open status of a clam flat, samples must continue to meet approved water quality standards.

The percentage of clam flats open within Casco Bay fluctuates over time, as new flats are closed due to new sources of contamination and other flats are reopened as a result of the elimination or remediation of pollution sources. In general, the area open for harvesting soft-shell clams in Casco Bay has been increasing over the past few years. As of December 1995, 63% of the clam flats within Casco Bay were open (see Figure 3).

The Economic Benefits From Clam Resources in Casco Bay

In 1993, 44.5 percent of the clam flats in Casco Bay were closed to shellfish harvesting due to the threat or existence of bacterial pollution. To estimate what this means in terms of foregone clam harvests and lost economic activity, the Casco Bay Estuary Project initiated an economic study of the soft-shell clam industry in Casco Bay in 1994. This study provides convincing evidence of the economic benefit of reopening closed flats. While there are twelve towns on Casco Bay, just three (Brunswick, Freeport, and Harpswell) account for the majority of clam flats that remain open.

Lost Opportunities

The study estimates that in 1994, there were 91,150 bushels of soft-shell clams available for harvest from open clam flats in Casco Bay. Assuming that harvesters are able to retrieve 70 percent of the available clams, *an estimated 63,805 bushels were harvested in 1994, with a landed value of about \$4.7 million.*

Recent average harvests are estimated at between 58,575 and 62,760 bushels per year. Using a 1994 mean annual price of \$72.95 per bushel of soft-shell clams, this translates into a landed value of about \$4.3 to \$4.6 million per year. While this figure is 20 percent higher than that reported by the Maine Department of Marine Resources and the National Marine Fisheries Service, it is assumed to be accurate based on suspected underreporting of harvests.

The study also tried to quantify the value of the harvest lost due to pollution closures in Casco Bay by estimating the potential harvest available from these areas. Assuming that closed areas have the same production potential as open areas, the production from the 1994 closed area in Casco Bay could increase the harvest by 51,160 bushels, worth approximately \$3.7 million.

This figure may overestimate actual production, as the study found considerable variation between flats. Clam populations in closed areas in the eastern bay (Harpswell, Brunswick) are greater than in closed areas in the western bay (Falmouth, Cumberland). This may be a natural occurrence resulting from wind and tide patterns or indirectly related to the closure. Further, the study found that the boundaries of areas closed to harvesting often significantly overestimate the actual productive habitat in the flats.

Employment and Broader Economic Impacts

The study also estimated the number of jobs directly and indirectly related to soft-shell clam harvesting in Casco Bay. Direct jobs include 268 licensed commercial clam diggers within the bay and about 35 individuals employed by Casco Bay-area licensed shellfish dealers. The study also tried to estimate the number of restaurant jobs attributable to Casco Bay soft-shell clams. Clams are popular entrees on the menu of many Casco Bay-area restaurants. Interviews and surveys suggest that about 80 restaurant jobs can be attributed to the sales of Casco Bay clams.

Translating these figures into full-time equivalent jobs means that about 242 people are employed full-time based on Casco Bay clam harvests.

Casco Bay clams have an economic impact that reaches beyond the people who harvest them. An income multiplier estimates that portion of the total

economic activity generated by an industry that stays within the local economy. When those with clam-related income buy other goods and services, additional money enters the local economy. In-state consumption of Casco Bay clams appears to be on the rise and now accounts for about 20 to 30 percent of the harvest, up from 10 percent estimated in the early 1980s. This increase yields a local income multiplier, about 3.0, up from the previous estimate of 1.65 in 1982. *For Casco Bay soft-shell clams, this could result in additional economic activity of between \$11.6 and \$15.7 million annually.*

While much of this study had to rely on published data and figures from the Maine Department of Marine Resources and the National Marine Fisheries Service, state and federal resource managers suggest that 20 to 30 percent of the harvest of Casco Bay soft-shell clams is unreported. Anecdotal information from certified dealers suggests that even this estimate

Update on Casco Bay Activities

Friends of Casco Bay

The nonprofit group Friends of Casco Bay has been actively working to reopen clam flats and to research some of the reasons behind clam flat closures and poor production in some flats. Its work is focused in three shellfish harvesting areas of Casco Bay:

- **Mackworth Island, Falmouth** – The Mackworth flat in Falmouth has been closed to unrestricted harvesting for most of the past ten years. Friends of Casco Bay is working to open the flats through shoreline survey work. They also are researching the reasons behind the currently low clam production in the flats. They are reseeding the flat and looking at potential differences in viability between natural and hatchery seed.
- **Long Cove, West Bath** – In contrast to the Mackworth flat, the soft-shell clam resource in Long Cove is abundant, exceeding 200 bushels per acre. However, water quality problems have caused the flat to be closed since 1990. While several homeowners have repaired their septic systems over the past year, further testing shows that fecal coliform levels are still high. No one source has been positively identified as yet, but Friends of Casco Bay, working in conjunction with the Maine Department of Marine Resources and the West Bath Shellfish Commission, is trying to pinpoint the source.

- **White Cove, Yarmouth** – Friends of Casco Bay recently began work with the Yarmouth Shellfish Conservation Committee to reopen this clam flat. Preliminary survey work suggests that potential pollution sources have been eliminated, but a shoreline survey is needed to verify that information.

Maine Department of Marine Resources

The Maine Department of Marine Resources has been working with towns to strengthen their clam management and water quality monitoring abilities. Its new Watershed Division is working with municipalities to identify obstacles to effective municipal programs, bring municipal programs into full compliance, and strengthen existing programs. It is focusing efforts on providing towns with a higher level of expertise for enforcement of clam-harvesting laws and regulations.

The Maine Department of Marine Resources also has been working with the University of Maine's Cooperative Extension Program to train volunteer water quality monitors throughout the coast. It also has been training volunteers to carry out preliminary shoreline surveys to identify potential sources of bacterial contamination.





is low. Discussions and interviews with shellfish dealers tend to bear this out. While the official estimate of 1994 landings for Cumberland County was 52,974 bushels, interviews suggest that at least 60,600 to 65,600 bushels of Casco Bay clams are harvested each year. In 1994, two of eleven Casco Bay dealers were not reporting; their landings would further increase the estimate.

Shellfish dealers interviewed for this study also reported considerable variation in the price paid to harvesters for a bushel of clams. The published mean annual price estimate from the National Marine Fisheries Service in 1994 was \$72.95, while dealers participating in the study reported that their prices range from about \$40 to \$115 per bushel, depending on the time of year, with some dealers at times paying as low as \$30 per bushel and as high as \$130 per bushel.

Non-market Values

Economics aside, there are broader values of a healthy soft-shell clam resource in Casco Bay. These values include the satisfaction of harvesting one's own meal, or eating clams fresh out of the mud flats. There also is value in carrying on a family tradition of recreational digging, passed on by grandparents and parents, or watching commercial diggers take part in a centuries-old fishery. These values, while difficult to quantify, are essential to recognize in determining the value of the clam resource.

One indicator of the non-market value of Casco Bay's soft-shell clam fishery is the strong demand for recreational clamming licenses in local towns. Recreational licenses allow people to harvest up to one peck per day for personal use. These clams cannot be sold.

Four Casco Bay towns surveyed in 1994 (Harpwell, Freeport, Brunswick, and Cumberland) sold 1,020 recreational licenses. This figure has been increasing every year, and in 1994 for the first time Harpswell and Cumberland each sold all of their total available recreational licenses.

Extrapolating data from a recent Town of Cumberland survey, each of the 1,020 licenses represents about 6 pecks harvested over the course of the year, with about 14 percent of license holders not actively harvesting. Given these assumptions, the harvest in these four towns represents about 5,262 pecks or 1,316 bushels in 1994. Trying to put a dollar figure on these harvests is difficult, but if the recreational harvesters had bought equivalent clam dinners at a restaurant at \$8 per plate (about 1.5 lbs.), the harvest would have been worth \$449,024.

Case Studies

As part of this study, two areas closed to shellfish harvesting were evaluated to determine what the costs and benefits would be of opening the flats. These two case studies clearly point out that when there is a sizable resource, the potential return on a municipality's initial investment is high. The two areas chosen for analysis, Buttermilk Cove in Brunswick and Town Landing Cove in Cumberland, were selected because they represent two different pollution problems and consequent abatement schemes.

Buttermilk Cove, Brunswick

Buttermilk Cove is a north-south oriented cove opening into a tidal marsh that hosts a small but productive area of clam habitat. The cove is surrounded by a mosaic of seasonal and year-round residences,

many built in the early 1900s and renovated or modified over the years. The lots are small and steep with limited soil cover. Consequently, homeowners have turned to overboard discharge systems for their wastewater treatment, and seven such systems flank the cove. The presence of these systems requires the closure of the area to harvesting despite the fact that water quality sampling data satisfies the requirements for approved areas.

Recent survey work estimated Buttermilk Cove could sustain an annual harvest of clams worth about \$55,500. The cost of redeeming the area can be broken into four steps:

- 1) The seven overboard discharge systems need to be removed and a new wastewater treatment system installed for a one-time cost of \$88,800. The State of Maine has a grant program for overboard discharge system removal that would pay 90 percent of the capital cost, or \$79,920. The residents would pay \$8,880.
- 2) The Town of Brunswick would be responsible for the \$2,590 annual operating and maintenance cost of the new system over its projected twenty-year life.
- 3) A shoreline survey must be completed to document the absence of other pollution sources. This type of work is routinely done and would cost about \$630.
- 4) Water quality sampling must be continued for two years at a projected cost of \$1,485.

The present value of the projected income from the clam flats over twenty years is over six times the cost of opening the flats.

Copies of the study, *Economic Analysis of the Soft-shell Clam, Mya arenaria, Industry in Casco Bay*, by Christopher S. Heinig, Peter J. Moore, Donald W. Newberg, and Louisa R. Moore, are available at your local library or from the Casco Bay Estuary Project.

Town Landing Cove, Cumberland

Sometimes the cost of opening a closed shellfish area has to be measured in terms of human energy and tenacity rather than in dollars. In some cases, a pollution source can be remediated or changed without much effort. However, without a deliberate strategy to retest and focus attention on the area, the flats will remain closed.

Town Landing Cove in Cumberland had been closed since 1983 based on high fecal coliform counts found by water quality monitoring. The source of the problem was suspected to be a local pond teeming with domestic waterfowl. When the pond owner

moved, taking the waterfowl with him, subsequent testing showed that the cove satisfied water quality requirements for open areas. The Town of Cumberland began asking for the flat to be reclassified and reopened. Staff shortages and other priorities kept the Maine Department of Marine Resources from approving the area for harvesting until 1994, after the study was completed. While the cost of opening the area was estimated to be about \$755 annually for a \$39,600 annual return, the greater cost for the municipality was in maintaining the interest and commitment to reopening the flat.



Want to know more?

The mission of the Casco Bay Estuary Project is to preserve the ecological integrity of Casco Bay and ensure the compatible human uses of the bay's resources through public stewardship and effective management. For more information, call or write:

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