SEAFood WASTE MANAGEMENT IN FLORIdA

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FLORIdA SEAFood INDUSTRY

In 1979, Florida fishermen landed over 163 million pounds of seafood with a dockside value in excess of 124 million dollars (3). This annual harvest ranked eleventh in total production and sixth in total value amongst the seafood producing states (Tables 1 and 2). This level of production is very substantial when noting that Florida does not harvest large quantities of menhaden and tuna which are characteristic of the more productive states. Also, the average dockside prices in Florida are consistently higher than in most states because Florida waters produce a larger proportion of high valued species. Preliminary statistics for 1979 indicate there were at least fourteen Florida seafoods with a dockside value in excess of one million dollars (Table 3). Presently there are over 75 commercially important seafood species harvested in Florida.

Primary reasons for valuable seafood productivity in Florida are the unique geographic features and location of the state. The extensive Florida coastline, in excess of 1,350 miles, touches two major bodies of water, the Atlantic Ocean and the Gulf of Mexico, and extends through two temperature zones. Within the state, there are over 30,000 lakes, 17,000 rivers and streams, and 200 springs. One major freshwater system, Lake Okeechobee, supports a major freshwater fishery. Thus, the extensive land-water interface combined with warm climates yields a very productive and diverse seafood industry, but for these same reasons, waste management in Florida is a large and diverse problem.

FLORIdA WASTE MANAGEMENT REGULATION

The Regulatory scheme for waste management in Florida is confused by a variety of state and federal agencies with similar responsibilities and overlapping jurisdiction. Currently, Florida
TABLE 1. U. S. SEAFOOD PRODUCTION BY STATE IN 1979

<table>
<thead>
<tr>
<th>Place</th>
<th>Million Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Louisiana</td>
<td>1,529</td>
</tr>
<tr>
<td>2. Alaska</td>
<td>899</td>
</tr>
<tr>
<td>3. California</td>
<td>728</td>
</tr>
<tr>
<td>4. Virginia</td>
<td>573</td>
</tr>
<tr>
<td>5. North Carolina</td>
<td>390</td>
</tr>
<tr>
<td>6. Mississippi</td>
<td>384</td>
</tr>
<tr>
<td>7. Massachusetts</td>
<td>375</td>
</tr>
<tr>
<td>8. Maine</td>
<td>232</td>
</tr>
<tr>
<td>9. New Jersey</td>
<td>189</td>
</tr>
<tr>
<td>10. Washington</td>
<td>170</td>
</tr>
<tr>
<td>11. Florida</td>
<td>163</td>
</tr>
<tr>
<td>12. Oregon</td>
<td>128</td>
</tr>
</tbody>
</table>

TABLE 2. U. S. SEAFOOD VALUE BY STATE IN 1979

<table>
<thead>
<tr>
<th>Place</th>
<th>Million Dollars</th>
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</thead>
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<tr>
<td>1. Alaska</td>
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<tr>
<td>2. California</td>
<td>227</td>
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<tr>
<td>3. Louisiana</td>
<td>199</td>
</tr>
<tr>
<td>4. Massachusetts</td>
<td>176</td>
</tr>
<tr>
<td>5. Texas</td>
<td>160</td>
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<tr>
<td>6. Florida</td>
<td>124</td>
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<tr>
<td>7. Washington</td>
<td>116</td>
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<tr>
<td>8. Virginia</td>
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<td>9. Maine</td>
<td>80</td>
</tr>
<tr>
<td>10. Oregon</td>
<td>65</td>
</tr>
<tr>
<td>11. North Carolina</td>
<td>58</td>
</tr>
<tr>
<td>12. New Jersey</td>
<td>53</td>
</tr>
<tr>
<td>FISH</td>
<td>MILLION DOLLARS</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Grouper</td>
<td>5.5</td>
</tr>
<tr>
<td>Red Snapper</td>
<td>4.3</td>
</tr>
<tr>
<td>Mullet</td>
<td>4.1</td>
</tr>
<tr>
<td>Swordfish</td>
<td>3.5</td>
</tr>
<tr>
<td>King Mackerel</td>
<td>3.2</td>
</tr>
<tr>
<td>Snapper (other)</td>
<td>2.3</td>
</tr>
<tr>
<td>Spanish Mackerel</td>
<td>1.4</td>
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<tr>
<td>Seatrout</td>
<td>1.4</td>
</tr>
<tr>
<td>Others</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>31.7</strong></td>
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</tbody>
</table>

Source: Preliminary 1979 statistics from the National Marine Fisheries Service.
water resource management programs are being administered by the Department of Environmental Regulation (DER), Water Management Districts, Department of Natural Resources (DNR), Department of Health and Rehabilitative Services (HRS), Department of Community Affairs (DCA), Regional Planning Councils, Department of Agricultural and Consumer Services (DACS), the U. S. Army Corp of Engineers, and the U. S. Environmental Protection Agency (EPA). The most direct regulation of water use in Florida has been divided between two main authorities. The Florida DER is responsible for regulating water quality as influenced by domestic and industrial wastes, and the Water Management Districts regulate the quantity of water used in their respective regions. This statutory division of responsibility overlooks the fact that regulation of water quality and water quantity relative to waste management are not mutually exclusive. The results can be duplication of expenses, complicated permitting, and a general prolonged regulatory process.

Actual waste treatment requirements pertinent to the Florida seafood industry are promulgated in Chapter 17-6 of the Florida Administrative Code. Florida has adopted the EPA effluent guidelines and standards set forth in the U. S. Code of Federal Regulations for Effluent Guidelines and Standards for Canned and Preserved Seafoods. These existing and changing federal regulations will apply to all new and existing Florida seafood processing operations which discharge conventional and/or toxic pollutants, and will provide pretreatment standards for processors discharging to publicly owned sewage treatment facilities. Florida has not been approved by EPA to administer the issuance of direct discharge permits under the National Pollutant Discharge Elimination System (NPDES) program. All NPDES permit applications must be filed with the regional EPA office in Atlanta, Georgia, and a duplicate application must be sent to the Florida DER for comment. The Florida DER reserves the authority to determine if the discharge guidelines in any permit could be detrimental to the current water classifications established by State Water Quality Standards. This means the Florida DER has the authority to impose discharge guidelines which are more stringent than permissible in federal effluent limitations of the NPDES permits. Thus, the process for direct discharge permitting in Florida can be confusing, requires duplication, and is time consuming.

Permitting for water consumption can also be a major obstacle for Florida processors. The Water Management Districts, which were initially authorized in 1972 and reorganized into five separate regions in 1977, have the authority to require consumptive use permitting to control water quantity as needed in their respective regions. Water is a threatened resource in many regions of Florida, and future projections indicate an ever increasing demand for water. In the 1980's, Florida's population should grow to exceed 12 million residents, making Florida the fourth most populous state in the Nation. The steady influx of new industries due to energy considerations will continue, and the annual visits by tourists will exceed 32 million. This increasing competition for Florida's limited water
resources will boost the importance of consumptive permitting. Future use of water for seafood processing may require extra permitting and costs.

In a recent outlook for Florida in the 1980's, Mr. Jacob Varn, Secretary of the Florida Department of Environmental Regulations, stated that current resource management is a "cumbersome, complex, time-consuming, costly, uncoordinated program for the State of Florida" (5). Likewise, the Florida seafood industry could view this accumulation of authority as bloated bureaucracy which offers little reason or incentive to comply with the regulatory process.

PROCESSORS PRESENT SITUATION AND FUTURE IMPLICATIONS

Currently there are over 400 individual seafood wholesaling and processing operations in Florida which generate an average annual seafood value in excess of 234 million dollars (1). These operations are scattered along the coast of Florida depending on the regional production of the various seafood species. As previously mentioned, species diversity is a unique feature of the Florida seafood industry. Likewise, there is diversity in the levels of processing per species. Some shrimp processing operations in Florida are the most sophisticated and largest of their type in the world, but within the same county a small 'cottage' type processor could be handling the same initial raw product. Regardless of their size, all seafood processors in Florida are concerned with waste management in the 1980's. Processors with the most immediate concern are those processing shrimp, blue crabs, oysters, scallops, and certain fish species.

Shrimp (Penaeus species)

Approximately 60 percent of Florida's shrimp landings are recorded along the southwest coast. Most of Florida's shrimp processors can be divided into two groups, non-breading and breading operations. The non-breading operations are usually located in less populated coastal regions near Jacksonville and Cape Canaveral, or in remote areas of the Panhandle region or Florida Keys. Most breading operations are located in major metropolitan regions like Tampa, St. Petersburg, and Miami.

Both operations handle raw headless and heads-on shrimp, and use machinery for heading and peeling. The primary waste product from these operations is shrimp shell. The amount of shell generated will depend on the quantity of headless, peeled, and deveined shrimp produced. Purchasing headless shrimp can reduce the shell waste, but shrimp deheading at sea varies depending on the size of the shrimp and the work load as determined by harvest volume. A typical non-heading operation could handle 60 to 80 percent heads-on shrimp, whereas a breading operation could handle 20 to 30 percent heads-on shrimp.

In compliance with permit regulations, most larger shrimp processors typically employ some form of screening to remove shell
and larger pieces of shrimp meat, and the remaining waste water is
directed to the nearest municipal waste treatment facility. The
recovered solids are loaded in dumpsters and deposited in city
dumps. A few processors collect solids in large, underground set-
tting tanks that are periodically pumped to remove sludge. Most
breading operations practice some form of in-plant maintenance or
dry clean-up to prevent solids from entering the waste water. The
recovered breading, batter, and shrimp bits are distributed as feed
for local hog farmers.

Smaller shrimp processors and operations located in more remote
regions are not always aware of permit requirements and direct dis-
charge of shells is not atypical. Despite some practices of direct
discharge, there have been no documented cases of water quality
deterioration in Florida which resulted due to shrimp processing.
In fact, processors in remote regions argue direct discharge is
bioenhancement and they are more concerned with the problem of
water consumption. This is especially true in the Florida Keys
where processors have been forced to install systems for salt water
utilization because of the scarcity of fresh water.

In the future, waste treatment regulations which have been
implied in the recent EPA contractual study (4) will be economically
overburdening to the shrimp industry in Florida. This EPA study
recommends chemically optimized dissolved air flotation (DAF)
treatment for pre-screened waste water generated by non-breadcr and
breaded shrimp operations. The DAF implementation date of existing
operations is in 1984, but new operations will have to comply im-
mediately. Although an economic rebuttal is beyond the scope of
the paper, simple observations will indicate that DAF treatment is
not possible for most of the Florida shrimp industry because of the
lack of available land for construction of such facilities adjacent
to the major processing operations.

Currently, the shrimp industry in Florida and throughout the
southeastern United States is severely depressed. One of the primary
reasons for this economic depression is the rising cost of diesel
fuel. Harvesting shrimp is an energy intense operation. Without
fuel subsidy, the shrimp industry must continue to adjust to inevi-
table increasing fuel costs. More stringent waste regulations could
pose the additional financial burdens which will destroy various
segments of the southern shrimp industry.

Blue Crabs

The distribution of blue crab processors usually coincides
with the regional landings of whole crabs. Most Florida blue crab
processors are located in the rural regions of the Panhandle, the
Big Bend area, and along the northeast Atlantic coast. These
processors are typically small scale handpick operations with highly
variable production schedules. Some blue crab processors do not
handle enough crabs to exceed the exemption limit for conventional
blue crab production which requires compliance with EPA effluent
guidelines.
Since most blue crab processing plants are located in relatively low populated regions, municipal waste water treatment facilities are not available. Most crab processors are not aware of the discharge permit requirements. Only a few processors have been issued a NPDES permit, but direct discharge of raw blue crab wastes is rare. Solid wastes, primarily the inedible shell and viscera remaining after handpicking to remove meat, is collected in dump trucks for various uses. Some processors have the raw waste disked into fields as a crude fertilizer for crops or tree farms. Some processors have used raw crab waste as a feed for catfish farms, and other processors rely on disposal in local landfills.

The small quantity of wastes that are generated by Florida blue crab processors does not warrant more sophisticated methods of treatment. Previous attempts to establish a centralized crab meal plant in the Panhandle region failed because it was economically impractical. Similarly, economic studies have indicated that the production of chitin/chitosan from crab shell could be a questionable venture in Florida (2). The feasibility of crab meal or chitin/chitosan production is even more questionable as cost for fuels continue to increase.

Future waste treatment regulations for the blue crab industry could require the use of chemically optimized DAF for mechanical blue crab processing. These requirements, which are implied in the recent EPA contractual study (4), would seriously threaten blue crab production in Florida. Presently, Florida blue crab producers are considering increased mechanization due to decreases in available labor. The productive option of mechanization would be limited by the excessive financial burden of sophisticated DAF waste treatment, and the application of DAF treatment with the highly variable production schedule would be impractical.

Oysters

Most oyster production and processing is concentrated in the Panhandle region. Approximately 95 percent of the Florida oyster production occurs around Pensacola and near the Apalachicola Bay system. The oyster producers are primarily small volume processors which generate a limited amount of waste. Their empty shell stock is collected for oyster planting operations or road fills, and the primary source of waste water comes from the washdown procedure.

In the Apalachicola region, the municipal treatment facilities are not adequate to receive additional sewage or waste water from the oyster processors and the geographic distribution of the processing plants make municipal hook-up economically impractical. Most sewage is treated in septic tanks, and waste water is discharged directly on the shore line below the plants. Recent changes in Florida DNR regulations are requiring some form of plumbing to direct the washwater away from the processing plant. Interestingly, the Florida DER is now concerned because their interpretation of the new plumbing requirements imply a need for NPDES permits. Most
oyster processors are not familiar with the EPA waste water requirements and most producers do not have a NPDES permit. Fortunately, some Florida oyster plants do not exceed the small scale production exemptions specified in the EPA effluent guidelines. Also the volume of waste water produced is small and will be discharged into a dynamic Bay system.

The future waste treatment requirements for the Florida oyster industry should be accomplished by simple in-plant measures, and there are no large scale oyster operations which warrant the DAF treatment implied in the recent EPA contractual study (4).

Scallops

Most Florida scallop production and processing is centered about the Cape Canaveral region. Bay and calico scallops are harvested in Florida, but the calico scallop is the bulk of the processing industry. The mechanized processing of scallops is a unique combination of heat shocking to remove the shell and specialized rollers and shakers to separate the viscera from the meat. The waste products are shell, scallop viscera, and associated waste water. Smaller, conventional processors rely on hand labor to recover the meats; consequently, their volume of waste water is reduced.

Currently there are no specific EPA effluent guidelines for calico scallop processing. Waste management of calico scallop waste have been municipal treatment for waste water, and landfills for shell and viscera. A recent crisis situation has developed in the Cape Canaveral region. Suddenly the local regulatory authorities have announced they will no longer tolerate the levels of seafood effluents being discharged into the local basin. At the same time, the municipal facility has indicated it cannot handle anymore seafood processing effluents. Thus, the scallop processing operations are faced with a no win situation.

This situation is a prime example of site specific crisis regulation which will be more typical in the 1980's. In this case, publicly owned waste treatment facilities have not been designed to anticipate the increasing loads due to the future influx of industry and residents. The local regulatory authorities have no specific EPA effluent standards for guidance. Thus, the result will be judgement calls which usually incite claims of inconsistent and inequitable regulation. The final decision may have to be resolved in courts and/or the processing operation could be forced to close. Hopefully, the processors can work with various local authorities and reach a compromising solution which will assure environmental protection and continued seafood production. Local economics and labor cannot afford to stifle the seafood processing industry in Florida.
Certain Fish

The level of fish processing in Florida is extremely variable depending on the fish species and season. Processing operations can be as simple as boxing and icing of whole fish, or more sophisticated with mechanization for filleting and freezing. Also, there is a limited amount of fish meal processing of menhaden harvested in northeastern Florida. Overall the fish processing industries in Florida are considered low-priority operations for waste management regulation.

The most common method of waste management is landfills for fish scrape which is collected in dumpsters. Waste water is directed to available municipal facilities. Certain fish scrape is packaged and frozen for fish chum or crab bait. Fresh trash fish and fish scrap has been used for production of pet foods. Production of fish meal is minimal and will become more economically impractical as fuel costs continue to increase. Attempts at production of fish fermentations for fish sauce, feeds, or fertilizer have only been investigated as bench top ventures.

Menhaden processors currently operate evaporation plants which minimize waste water, but future fuel costs may dictate modifications in their operations. These modifications may require new waste treatment practices, but the present fish meal waste is minimal and poses no regulatory problems.

In the future, certain in-plant modifications will be required to reduce waste loads from conventional fish processing operations. Modifications such as segregation of fish scales seem reasonable and practical, but the implied requirement of DAF for mechanized operation is totally impractical. The DAF requirement was determined based on the performance of mechanized bottom fish processing operations in Alaska (4). In Florida most fish processing schedules are highly variable due to seasonal abundance, the same plant can handle a varied number of species, and the volume of processing is much less than the typical large volume single species operation in Alaska. For these reasons, the operational requirements for DAF would be impractical for mechanized fish processing in Florida.

CONCLUSIONS

Seafood waste management in Florida will become a major problem as more stringent regulations become effective in the 1980's. This problem will be shared by the respective seafood industries and regulatory agencies. The seafood industry may be required to install expensive waste treatment facilities at the same time they are faced with increasing fuel cost, inflation, and growing competition for water resources. In certain regions of Florida, competition for water consumption could pose more serious problems than water quality regulations.
The complexity of regulations and the overlapping authority of the various regulatory agencies is confusing and offers little incentive for industry compliance. The unique geography of the state and the diversity in the seafood industry complicates regulatory responsibility. Currently the state regulatory agencies do not have the manpower or budgets to administer the existing regulations. Future regulations should not be adopted if they cannot be adequately enforced. The result will be continued crisis regulation which is inequitable and inconsistent. Crisis regulation will be more site specific and will require judgement calls. In this situation, the seafood processing industry should be considered a lower priority problem and attention should be focused on the more toxic pollutants.

Future regulations have been proposed to include total ammonia as a toxic pollutant. If this regulation is adopted, it could impose immediate requirements for advanced treatment methods for seafood waste. The EPA must reevaluate their proposal, which was based on bench top studies, and reconsider the actual environmental and economic implications of this regulation. Likewise, the implications for dissolved air flotation as a future treatment method warrant reconsideration in the light of the industry's current economic situation relative to increasing energy costs. Fuel costs for treatment construction and operation is of minor consequence when compared to the energy cost for harvest. The fuel costs for harvest is an integral part of seafood processing, especially with the lack of fuel subsidies to aid seafood production. This cost is most important to the major shrimp processing operations in the south which depend on an energy intense fishery.

Currently, most Florida seafood processors depend on municipal treatment for waste water and local landfills for depositing solids. The rapid population growth in Florida will increase the load on existing municipal facilities. The result could be increased sewage costs or no available treatment. Likewise, future resource and conservation recovery regulations may limit the use of landfills. Without available publicly owned treatment options, various segments of the Florida seafood industry may argue for ocean dumping, as recently approved for fish cannery wastes originating in American Samoa (45 Federal Register 56374-8/25/80). Remote areas of Florida, i.e. Keys, could argue for consideration as a remote section as requested by various locations in Alaska (45 Federal Register 52411-8/7/80), and some fisheries may consider more on-board processing to eliminate waste, assure better quality, and maximize energy expenditures during off-shore operations.

Unfortunately, the by-product options for waste utilization have not developed as predicted in original EPA regulations. Edible minced fish items are still experiencing consumer resistance and the mincing operation creates unique waste management problems. Pet food is not a trash food, and the pet food process requires quality fish with certain product specifications. Chitosan production has failed in the United States primarily due to high production costs,
variations in raw material supply, lack of profitable market outlets, and competition with less expensive synthetics. Chitosan production also creates unique waste management problems. Feeds and dry fertilizers produced from different seafoods have not been successful due to competition with less expensive and more available products. Increasing fuel costs limit the application of dehydration processes, thus fish fermentations and silage must be reevaluated.

In summary, the environmental attitudes of the 1970's must now contend with the energy decade of the 1980's. Future waste management regulations will be an arena for conflict between environment and energy considerations. Cost-benefit arguments will determine the fate of the industry. The United States seafood industries offer a future of increased production and labor and a potential for balancing the current foreign trade deficit. Hopefully, reasonable waste management regulations will assure water quality as well as the economic welfare of the seafood industry.

REFERENCES


SEAFOOD WASTE MANAGEMENT IN THE GULF OF MEXICO

Al Perry
Office of Fisheries Assistance
Gulf Coast Research Laboratory
Ocean Springs, Mississippi 39564

BACKGROUND

Throughout the five states on the Gulf of Mexico the major source of seafood waste comes from the shrimp fishery. The Gulf seafood industry derives its life force from shrimp. Boatyards build boats which fish only for shrimp. The majority of fishermen go out to catch one thing and that is shrimp. The packing and processing plants have most of their equipment capital invested in things that unload, weigh, grade, peel, and freeze or cook shrimp. As of the second week of this month 56 million pounds, heads-off, had been landed in the Gulf states. And this is a bad year. The figure comes from the National Marine Fisheries Service's Market News Report. They always adjust their numbers to a heads-off figure. Actually Texas is the only state that predominately lands its catch without the heads. The catch in the other states is usually landed whole; so, as far as total weight goes, that 56 million pounds is actually a low figure.

As you can imagine the solid waste poundage will reach into the millions too. When a whole shrimp is headed it will lose 33 to 37% of its weight. If the shrimp is headed and peeled then the total loss will be from 50 to 55% of its landed weight. In the Gulf packing plants the majority of the shrimp is headed and packed in five pound boxes, then it is frozen, and sold. The rest is peeled and frozen or canned. So between these two operations the production of solid waste in a particular plant parallels the production of product at a high percentage rate.

Along with these heads and shells there is a substantial volume of processing water which is generated. The heading and packing of shrimp uses a moderate amount of water. On the other hand, the peeling operation can use 75-80% more water so that a four peeler plant can discharge 100,000 gallons or more a day.

Shrimp, of course, is not the only thing which is produced in the Gulf. There is a sizeable oyster industry which operates the year-round in some places, but it is predominately a fall and winter fishery. This industry does not really have a solid waste problem because the whole animal is used. The shells have an economic value as building materials or culch for oyster beds, so they are in demand. The waste problems of the oyster industry are confined to grit from the mud and broken shells and the organic materials dissolved or suspended in the process water.
The blue crab industry is important to those who are in it, but its volume compared to the Chesapeake Bay is fairly low. They have a substantial solid waste production because meat recovery is no more than 15-15% and the rest is shell. Water usage is low. The largest plant in Mississippi discharges 5-10,000 gallons a day. The cooking water is the only concentrated waste load that would come out of a plant. This industry still hand picks the meat.

The Gulf produces some fish, too, but it is not an item that many plants handle. Just how much is produced in the Gulf is hard to say. However, that which is handled is predominately a whole product. We do not have a fillet industry such as is on the New England coast. The most that may be done with them is heading and gutting, but the largest snapper plant in the Gulf told me that with the labor costs what they are, if his customers will not take the whole fish he will not sell to them.

The menhaden industry is in a special category by itself. Several years ago the EPA singled them out for particular attention due mainly to their oily discharges. As a rule the plants now collect all their incidental process water, such as that which comes out of the boats when they are unloaded and cleanup water, and then it is evaporated which leaves a residue of the soluble organic materials. That has an economic value. So they have their situation pretty well in hand, even through 1984’s projected regulations.

There is one more fishery which is unique to the Gulf of Mexico that ought to be mentioned. That is the crawfish industry in Louisiana. This is a winter and spring fishery which generates a tremendous solid waste load and very little liquid waste. I was told that in a good year there could be 25-30 million pounds to be disposed of. The crawfish is in the same class as the crab as far as weight of meat ratio to the weight of the disposable shell.

As you know the seafood industry is still operating under the 1977 BPT regulations. For the Gulf fishery this is predominately screening and water management. The various state pollution control agencies have written specific parameters into their permits but they are in fact quite similar throughout the Gulf region. All require that the pH be within the ranges of 6 to 9. They also require weekly sampling of either suspended solids or settleable solids. And everyone must monitor the discharge flow rate.

Another common feature in the region is that municipal sewage treatment capacities are increasing or they are in the planning stages. Whenever these expansions are completed then the plants will be required to connect to them. That will in effect bring about the concept of zero discharge which is the basic goal of the wastewater regulations.

PRESENT SITUATION

Looking at the various states: Texas seems to be moving along with its municipal sewage expansion program. The seafood plant permits are all due to expire when municipal hookups are possible. Some plants will be connected this year and others will continue to be added through the next three years. In the meantime the majority of the wastewater is going back into the waters of the bays and harbors. There are dumps available for the solid waste for those who can haul it off. Texas does not have a peeled shrimp segment of the packing industry
so its water usage and waste loads are low compared to what it could be if there were peeling operations.

Louisiana does have peeling operations and lots of them. The greater part of them are located in the New Orleans area. There the city sewage system can accept the wastewater and landfills are accessible for those who want to use them. There are shrimp packing plants throughout the state and every local situation is different but in all, the big problem is with the solid waste. There are a few parish landfills but the shells also go in a lot of open dumps which are in the process of being closed. Where neither is available there is some dumping off the side of the roads. Outside of the larger cities the general flow of wastewater is into the bayous and bays. This wastewater can contain solid waste too. Throughout the state there are a very large number of small unloading docks on the sides of the bayous where shrimp buyers unload a boat, box the shrimp, and load them into trucks. The wash tank water of course goes directly back into the bayou. These places are so small that it is out of the question to think of sewage hookups for them.

In Mississippi the largest number of the state's seafood plants are located in a county which has a contract with a company to run the garbage collection but that company will not haul the solid waste from the plants. That leaves them in a pretty bad fix. Some have been fortunate enough to find agricultural interests who will come and get it or will let it be put on their land, but that is not very many out of the total. In another county the same company is required to haul off the shells because of a clause in their contract with a different town. Mississippi has a large number of peelers so the volume of shells is large. A very few plants send their wastewater to a treatment facility. The rest discharge it overboard.

The major seafood packing town in Alabama required the plants to send their wastewater to the treatment facility. Now, due to industry expansion, the facility is completely overloaded so that it is no more than conduit for the waste pumped into it. Its outfall is in a bay so there have been no water quality problems. In the meantime a moratorium has been imposed on the plants which prevents them from installing any more peeling machines until the treatment facility can double in size. The solid waste is contracted to a single firm who collects it and hauls it to a county landfill.

On the Florida west coast the story is more of the same. Landfills or overboard discharges account for solid waste disposal. In the larger towns the wastewater is taken by the sewage treatment facilities but other than that it goes back into the surrounding waters.

FUTURE IMPLICATIONS

So, here we are at the start of the 1980's, three years after the first set of regulations went into effect, three maybe four years away from another set, and where are we? What has been accomplished? In my part of the country we are about where we were three years ago and we are no worse off for it.

I want to say right off that I like the seafood industry. I believe that environmental legislation is needed, but the tone and intent to which it has been applied to the seafood industry is uncalled for due to the nature of their waste products. You hear
everyone talking about preserving the marshes because of the nutrients they produce for the sustenance of the estuary. Well, what do you think comes out of a seafood plant's drain pipe? It is pure nutrition. It is not some toxic substance that will make fish have five eyes and sea birds lay eggs like marshmallows. It won't stay in the bottom mud for the next thousand years. No, it feeds these animals and for the most part it is eaten within a few hours.

I have been working with seafood plant waste effluents for over two years. And I just do not view it as being a hazardous material. It can be a nuisance no doubt, but never a threat. And that very fact brings up the question of the real need for such uniform, detailed regulations for an industry which if it has problems, those problems are particular to its location and not to the national industry as a whole. If you have a major fishing port with a lot of packing plants along a small bayou such as in Bayou la Batre, Alabama, then there can be a need for wastewater regulations to prevent water quality deterioration. On the other hand, if you have another major fishing port on a waterway which has never experienced any dissolved oxygen problems such as Delcambre, Louisiana, then why should Delcambre have its plant wastes regulated to the same degree as Bayou la Batre?

I know EPA has had this matter brought up to it before. Right now is the time, I think, to get this thing stirred up again because we have seen what BPT is like and some of us after reading the E.C. Jordan report have a fair idea of what the BCT regulations may be like. And I just can't see the need for it. I believe we are getting into the realm of regulation for regulation's sake and not regulation to correct an evil.

EPA's viewpoint has been that since the industry is so diverse and scattered throughout the coastal states that they cannot possibly get to each location to have a look. Well, there is no real reason why they should. If they trust the state pollution agencies to carry out the provisions of the NPDES system why can't they be trusted to make decisions as to the application of the regulations on a case by case or regional basis?

Is there any real chance of altering the forward march of the regulations? Remember that PL 92-500 and the Clean Water Act of 1977 were both amendments. The space of time between now and 1984 would be a good period to adjust the things that need adjusting and generally get the law in a more reasonable condition as far as seafood goes.

There has always been a basic difference of thought between the regulators and the regulated. The whole thought behind PL 92-500 was that the waters of the nation were polluted and BPT and BAT were only steps toward the elimination of all industrial discharges. It was the idea of Congress at the time that all discharges were pollutants. The seafood industry has known for years that their discharges could not be detrimental pollutants otherwise catches would have declined and the industry would have declined instead of there being the growth which has actually been the case. The law talked of the "protection and propagation of a balanced population of shellfish, fish and wildlife" (1) as if they were in danger all over the country. That has not been the case. The law was passed on the wrong assumption. EPA had the right idea in 1975 when they published the interim final rules for effluent guidelines and standards for canned and preserved seafood processing in the Federal Register (2). They said "ocean
discharge of fish wastes does not subject the marine environment to
the potential hazards of toxicity and pathogens associated with the
dumping of human sewage sludges, municipal refuse and many industrial
wastes. The disposal of seafood wastes in deep water can be a prac-
tical and possibly beneficial method of ultimate disposal. Why does
the Agency think it suddenly becomes nonbeneficial in the estuaries
near shore? That is where the majority of your seafood grows up and
is caught, not out in oceanic waters.

The work of Dr. Soule in Los Angeles harbor concerning tuna can-
nery wastes is quite well known by now. During now and 1984 that work
should be added to by data from other parts of the country and it
should be taken seriously by EPA. It substantiates what every seafood
packer I've ever talked to believes. There will never be any more
than grudging compliance to any environmental law by the industry
which disregards the bioenhancement aspect of their waste material.
Part of the charge to EPA made by Congress to undertake the Section
74 study was to "examine technologies which may be used in [seafood]
processes to facilitate the use of the nutrients in [untreated
natural] wastes or to reduce the discharge of such wastes into the
marine environment." (3). I would say that the animals in the water
can facilitate the use of the nutrients quite nicely without any
technology. If you reduce the discharge then you create a solid waste
problem which technology has not solved. The EPA has always consid-
ered a solids reduction facility as a viable method of dealing with
screened effluents but that is just not how it is. The operating
costs are too high and the market potential for the meal is too low.

Everyone in the industry had really hoped that when the BCT
standards were being revised some serious consideration would be
given to bioenhancement. It appears that most of the attention has
been given to reevaluating industry vs. municipal treatment costs.
This is particularly disturbing from the viewpoint of the Gulf
seafood industry. The Agency has had a cavalier attitude about the
consequences of their regulations. Referring back again to that 1975
Federal Register they wrote,"a number of small plants are projected
to be adversely affected by these regulations, but the domestic
industry capacity is not expected to be affected by the potential
closure of these particular small plants" (2). I must strongly differ
with such a statement. The domestic capacity will be affected
because there are very few shrimp businesses in the Gulf states
which could be considered large. There are hundreds whose annual
sales are less than $300,000 or between that and $1 million. If
those get knocked out of production the whole system gets disrupted.
If you deal in terms of absolutes then that is what you get.

This country needs the EPA. But it needs them and their expert-
tise where there is a definite threat to human health and wildlife.
The cover story in this week's Time magazine (Sept. 22, 1980) will
tell you about that. The article states that EPA has estimated that
there are 50,000 toxic chemical dump sites and they have located
181,000 chemical waste lagoons. A very large percentage of these are
improperly constructed and pose a danger to ground water supplies and
public health. In addition to that the Agency estimates that more
than 77 billion pounds of hazardous chemical wastes are produced each
year with only 10% being handled safely. About 40% is being handled

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improperly and 50% is just being dumped in waterways and on the land. There is a bill in Congress now which would create a fund for the Agency to use to neutralize these dump sites and lagoons all across the country. And there is also the matter of overloaded or improperly operating sewage treatment plants which just pass along disease organisms into the water. The Gulf states have a lot of those. That is the kind of work that the Agency should be supported in. A seafood plant's effluents of BOD and Suspended Solids seems a mighty small matter beside the destructive powers of those 77 billion pounds of chemical wastes and pathogenic viruses and bacteria.

Comparison of risks is a phrase being used around Washington now. Congress seems to be getting interested in it as it relates to federal regulatory actions. Representative Don Ritter (R-PA) has introduced legislation which provides a mechanism for assessing risks in an effort to make regulations objective. Representative Ritter states that "comparison of risks is a way for regulatory agencies to reform themselves, to set priorities, and to do a better job of protecting the public. In short, comparison of risks helps set priorities and, thus, helps bring government regulation into the 1980's"(4).

The threat to the health of the bayous and estuaries along the Gulf of Mexico in the 1980's in my view does not come from seafood plants. It is just the opposite. Without them I would expect the productivity of the waters to go down. I don't think it is coincidental that after 14 years of trawl sampling at the same stations along Mississippi's coast, the area which has been shown from catch data to be the best nursery ground is also the bay where the greater number of our seafood plants are located.

REFERENCES


SEAFOOD WASTE MANAGEMENT IN THE NORTHWEST AND ALASKA

George M. Pigott
Institute for Food Science & Technology
College of Fisheries
University of Washington
Seattle, Washington 98195

INTRODUCTION

Waste! That word signifies the major product of the fishing industry and could sum up our future. We must change our thinking on the entire sequence of harvesting, transporting, processing, and marketing of seafood products as related to "total utilization," not waste. Otherwise, ten years from now we will be duplicating, as we have done for 20 years, this conference with the same papers, the same unsolved problems, and the same glorious plans for the future.

There is no such thing as "waste" in seafood as it comes from Mother Nature. This wide range of resources is a combination of primary and secondary raw materials. We are so tuned to inefficient use of foods from the sea that often nothing beyond the historic conventional product, a small percentage of the edible portion, is considered by the processor. Also, the makers and enforcers of our federal, state, and local laws are tinged as well with the same misconception. No one seems to relate to the fact that waste is our creation, not our destiny. During the balance of the conference we are scheduled to reiterate the plans for Seafood Waste Treatment and Utilization and their regulation, often based on insufficient knowledge of the industry, inaccurate data, and lack of realization that the future survival of mankind is not dependent on processing waste but on producing food.

It was interesting to review the subjects of papers being presented at this meeting that involve utilization. At the University of Washington, we participated in building the first chitosan pilot plant, and have engineered and developed pilot plant facilities for many forms of edible recoverables including batter and breaded formulated foods, dried products, and various forms of extracted proteins. In fact, as a licensed engineer who has long been active in seafood processing plant design and construction, I would be willing, today, to undertake a project resulting in a successful plant for economically utilizing the processes or producing the products that will be presented by the various speakers. The processes for utilizing "secondary raw materials" are available but
we are not paying enough attention to the limiting problem of logistics. Logistics! Not raw materials, not processing techniques, not salable products, not markets, not waste disposal, but logistics of economically collecting, handling, holding, and insuring adequate high quality secondary raw materials is the overriding factor in the "Total Utilization" of seafood.

CHANGING FISHERIES OF THE NORTHWEST AND ALASKA

Understanding the major trends taking place in the North Pacific fisheries is important in the logical planning for maximum use of the resources and for realizing the important relationship between the Pacific Northwest and Alaska. Due to the magnitude of the potential U. S. catch from the Fishery Conservation Zone and the accompanying logistic requirements, the changing fisheries are much more important to future waste management planning than a recap of the present operations.

High Cost of Present Products

Since shortly before the turn of the century, salmon has been the dominant seafood in the Northwest and Alaska. This much sought after fish has also dominated the thinking of the fishing industry, the state, federal and local bureaucracies, educational institutions, and the public. In Alaska, king crab became a major industry during the 1960's, followed by tanner crab and shrimp. Halibut, of course, has been the major long-line fishery, regulated by the international agreements between Canada and the U. S. Dungeness crab, oysters, clams, and relatively small volumes of bottomfish round out the list of seafoods that have supported the industry in the past. It should be noted that most of these raw materials are processed into high-quality, high-priced products. In fact, the cost of many of these products has risen so high that consumer opposition is beginning to be felt by the industry. This trend is particularly noted in the U. S., a beef eating nation where many seafood products are priced well above beef.

Trend Toward Frozen Products

The demand for frozen salmon, crab, shrimp, and other seafoods is growing at a much faster rate than that for canned products (Tables 1 and 2). This tendency has been reflected by the rapid increase in freezing operations in Alaska. Since the seasonal nature of these fisheries greatly limits the locations where permanent shore-based freezing and cold storage operations can be built and operated economically, there has been a tremendous increase in the number of floating freezer vessels operating in Alaska. Thus, the Alaskan processing industry is becoming more mobile. This can be demonstrated by the increase in Washington Port moorage and the projected increase in large vessels over the next two decades (1) as shown in Tables 3 and 4. Furthermore, since the frozen products are in a pre-processed condition or in the final form for marketing, a greater share of the present seafood is being shipped to the
**TABLE 1. ALASKA CANNED AND FROZEN SALMON PRODUCTION**

<table>
<thead>
<tr>
<th>Year</th>
<th>Canned (million lb.)</th>
<th>Frozen (million lb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>171.1</td>
<td>13.5</td>
</tr>
<tr>
<td>1971</td>
<td>133.4</td>
<td>12.2</td>
</tr>
<tr>
<td>1972</td>
<td>82.8</td>
<td>12.1</td>
</tr>
<tr>
<td>1973</td>
<td>55.5</td>
<td>16.8</td>
</tr>
<tr>
<td>1974</td>
<td>61.1</td>
<td>42.8</td>
</tr>
<tr>
<td>1975</td>
<td>57.0</td>
<td>43.3</td>
</tr>
<tr>
<td>1976</td>
<td>121.2</td>
<td>50.6</td>
</tr>
<tr>
<td>1977</td>
<td>140.0</td>
<td>76.7</td>
</tr>
<tr>
<td>1978</td>
<td>163.6</td>
<td>121.4</td>
</tr>
<tr>
<td>1979</td>
<td>147.9</td>
<td>149.2</td>
</tr>
</tbody>
</table>


**TABLE 2. ALASKA KING AND TANNER CRAB PRODUCTION**

<table>
<thead>
<tr>
<th>Year</th>
<th>King Crab (million lbs.)</th>
<th>Tanner Crab (million lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>76.0</td>
<td>61.2</td>
</tr>
<tr>
<td>1974</td>
<td>97.1</td>
<td>64.2</td>
</tr>
<tr>
<td>1975</td>
<td>91.7</td>
<td>46.2</td>
</tr>
<tr>
<td>1976</td>
<td>106.0</td>
<td>81.5</td>
</tr>
<tr>
<td>1977</td>
<td>99.6</td>
<td>98.5</td>
</tr>
<tr>
<td>1978</td>
<td>122.9</td>
<td>130.6</td>
</tr>
<tr>
<td>1979</td>
<td>154.4</td>
<td>131.4</td>
</tr>
</tbody>
</table>

TABLE 3. PROJECTED YEAR ROUND MOORAGE REQUIRED FOR BOTTOMFISH VESSELS, 1985 TO 2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Puget Sound</th>
<th>Washington Coast</th>
<th>Lower Columbia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Vessels</td>
<td>Length Required (linear feet)</td>
<td>Number of Vessels</td>
</tr>
<tr>
<td>1985</td>
<td>7</td>
<td>1,050</td>
<td>1</td>
</tr>
<tr>
<td>1990</td>
<td>14</td>
<td>2,100</td>
<td>2</td>
</tr>
<tr>
<td>1995</td>
<td>21</td>
<td>3,150</td>
<td>3</td>
</tr>
<tr>
<td>2000</td>
<td>27</td>
<td>4,050</td>
<td>4</td>
</tr>
</tbody>
</table>

Source CH₂M-Hill and Pigott, 1980

a Based on 90 percent of the total fleet visiting Puget Sound annually for maintenance and 5 percent of their annual time being spent in port.

b Based on 20 percent of the local fleet in port at any one time.
### TABLE 4. PROJECTED NEW VESSELS REQUIRED TO SUPPORT BOTTOM FISHERY EXPANSION, 1985 TO 2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Lower Columbia</th>
<th>Washington Coast</th>
<th>Alaska Fleet Only</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>3</td>
<td>4</td>
<td>138</td>
<td>145</td>
</tr>
<tr>
<td>1990</td>
<td>6</td>
<td>9</td>
<td>275</td>
<td>290</td>
</tr>
<tr>
<td>1995</td>
<td>9</td>
<td>13</td>
<td>431</td>
<td>453</td>
</tr>
<tr>
<td>2000</td>
<td>11</td>
<td>19</td>
<td>558</td>
<td>588</td>
</tr>
</tbody>
</table>

Source: CH_{2}M-Hill and Pigott, 1980

\( a \) Based on a 50,000 pound per day catch rate and 50 days active fishing for Pacific whiting. Total includes two vessels that are based year-round in Washington Ports.

\( b \) Based on 50,000 pound per day catch rate and 120 days of active fishing.
Northwest for final processing and storage. This trend is particularly important to the futures of both Alaska and the Northwest and to the relationship between these two geographic areas.

Present Fishery

Although yearly variations in catch will continue, current fisheries will not substantially increase in the future. Hence, any major increase in either Alaskan or Northwest fisheries will have to come from "cheaper" bottomfish. Ironically, many of the overfished segments of the marine waters under consideration continue to be pressed by new vessels being built for specific fisheries. Many of these vessels do not have the facilities and structure which would allow them to multifish or to be easily converted to other fisheries.

Fisheries Conservation Zone

The tonnage and total market value of bottomfish stocks within the 200-mile limit area dwarf those of the high-priced seafood now being caught in Alaska and the Northwest. However, it must be remembered that this contemplated bottomfishing is not a new fishery. Foreign fleets have been harvesting large amounts of fish on the high seas. The FCMA gives the U. S. management jurisdiction over the area, but we can only replace foreign fishery effort as we develop the ability to harvest and handle high seas fish.

New Processing Requirements

Species of fish such as pollock and hake have keeping qualities different from those of the bottomfish which Americans are used to catching and processing. While cod, lingcod, rockfish, flounder, sole, and other commonly caught species can be iced for some time prior to filleting, the largest volume of fish available to the high seas fishery have softer flesh and other biological properties that preclude handling by present methods. For example, hake and pollock must be processed to some degree soon after being caught. The minimum satisfactory processing is heading and gutting and then freezing. The best technique involves preparation of the final products immediately after catching.

Need for Long-Term U. S. Capital Investment

A major portion of the money invested over the past decade or so in the U. S. fisheries has come from foreign investors. The lack of a visible, well-planned future for fisheries has deterred U. S. investors. Meanwhile, foreign high seas fishing nations who know the future requirements for food have invested heavily in the U. S. fishing industry to preserve their present fishery resources coming from our waters. These investments include foreign ownership of a major fishing and fish processing companies; in fact, control of much of the industry, particularly salmon.
The basis for discussing the future management of Pacific Northwest and Alaska fisheries (including waste management) lie within the above factors. Each must be addressed if planning for the future is to be realistic.

**WASTE MANAGEMENT - PACIFIC NORTHWEST AND ALASKA**

There is no better geographical area to exemplify the problems of logistics in "total utilization" of seafoods than the Pacific Northwest and Alaska. A review of the so-called "waste management" in this widely diversified fishery must extend over many species and varying seasons for perhaps 4,000 miles of shoreline. Furthermore, there is an interrelationship between Alaska and the Pacific Northwest that is unique for two major U. S. fishing areas.

As with all processors subject to the EPA guidelines, those in Washington, Oregon, and Alaska were to have upgraded their effluent treatment to "Best Practical Technology" (BPT) by July 1, 1977, and "Best Available Technology" (BAT) by July 1, 1983. The major industry groups, salmon, crab, and shrimp, under the BAT would have to reduce waste so that the solids are passed through a 40 mesh screen and then sent to landfills or barged to sea. The possible requirement included air flotation and aerated lagoon disposal. The possible replacement of BAT by "Best Conventional Technology" (BCT) is in keeping with the present decission to re-examine the original document to determine the effectiveness or economic feasibility of the technologies. No considerations of a most important item, bio-enhancement, have been given to the preparation of EPA guidelines and regulations.

**Alaska**

The EPA manages the issuing of disposal permits in Alaska. The state is unique in that the discharge regulations include two subclass designations, remote and non-remote. Under BAT, remote areas can grind and discharge waste while non-remote areas must screen and barge or landfill solids. There is some confusion as to the definition of the two subclasses.

The present seafood harvest in Alaska and the estimated disposition of the various portions is shown in Table 5. At the best, these figures are estimates since no cumulative records are maintained in many areas of operation. For example, some salmon heads are shipped to Washington for pet food and some are used for crab bait; considerable waste is discarded at sea by shipboard processors and many fishing vessels (particularly those harvesting halibut and black cod) carry out some degree of butchering operations on shipboard. Also, a considerable amount of crab waste is generated in Washington where some 47,198,000 pounds of king crab and 32,305,000 pounds of tanner crab were received in 1979 for final processing. The waste figures in Table 5 have been estimated to take these facts into consideration. It should be noted that the 1979 estimate for waste handled in the plants was 41.3% finfish
### TABLE 5. PRODUCTS AND ESTIMATED WASTE DISTRIBUTION OF ALASKAN CATCH (EXCLUSIVE OF SHRIMP, DUNGENESS CRAB, BOTTOMFISH) IN MILLIONS OF POUNDS, 1979

<table>
<thead>
<tr>
<th>Species &amp; Product</th>
<th>Catch (Landed Weight)</th>
<th>Estimated Distribution ¹/</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon</td>
<td>297.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canned</td>
<td>147.9</td>
<td>99.1 (67%)</td>
<td>48.8 (33%)</td>
</tr>
<tr>
<td>Frozen</td>
<td>149.2</td>
<td>111.9 (75%)</td>
<td>37.3 (25%)</td>
</tr>
<tr>
<td>King Crab</td>
<td>154.4</td>
<td>84.9 (55%)</td>
<td>69.5 (45%)</td>
</tr>
<tr>
<td>Tanner Crab</td>
<td>131.4</td>
<td>72.3 (55%)</td>
<td>59.1 (45%)</td>
</tr>
<tr>
<td>Halibut</td>
<td>15.9</td>
<td>9.5 (60%)</td>
<td>3.2 (20%)³/</td>
</tr>
<tr>
<td>Black Cod²/</td>
<td>7.4</td>
<td>5.6 (75%)</td>
<td>1.1 (15%)³/</td>
</tr>
<tr>
<td>Total</td>
<td>606.2</td>
<td>383.3 (63%)</td>
<td>219.0 (36%)³/</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finfish</td>
<td>320.4</td>
<td>226.1 (71%)</td>
<td>90.4 (28%)</td>
</tr>
<tr>
<td>Total Shellfish</td>
<td>285.8</td>
<td>157.2 (55%)</td>
<td>128.6 (45%)</td>
</tr>
</tbody>
</table>

¹/ Since there are no accurate statistics available on total product vs. waste, these figures are estimates based on knowledge of the distribution in various products and forms of products.

²/ Total catch Alaska and Washington (mostly Alaska).

³/ Most halibut is gilled and gutted at sea, estimated at 20% (3.2 million pounds). Likewise much of black cod is cleaned at sea, estimated at 10% (.7 million pounds).
waste and 58.7% crab waste. No effort was made to include shrimp,
dungeness crab, and bottomfish in the estimates since the 1979 catch
and subsequent waste is relatively unimportant compared to the other
5 species.

There have been three fish meal plants operating in Alaska:
Kodiak (200 mt/day capacity), Seward (100 mt/day capacity), and
Petersburg (100 mt/day capacity). These plants have been producing
meal from crab, shrimp, and fish wastes while discharging the
stickwater (oil and solubles) through submerged pipe outlets. Con-
sidering that some 219 million pounds or approximately 100,000 mt
of waste are generated during relatively short fishing seasons, it
is obvious that most of the waste from processing seafoods in
Alaska is discharged to the sea.

The confusion on subclass definition is realized when it is
noted that processors from Ketchikan, Anchorage, Cordova, Peters-
burg, and Juneau petitioned for and won a change of status to re-
 mote. The city of Kodiak did not want reclassification for fear
that the bay would revert to the unendearably polluted area that
prevailed prior to the establishment of the meal plant. Reclass-
ifications of towns as remote areas was allowed in 1980 due to the
record fish runs. Although this was considered a temporary change,
it seems probable that it will remain on an indefinite basis. The
uneconomic nature of waste processing meal plants in Alaska is
examplified by the situation in Petersburg. After the change in
status to "remote", processors began grinding and discharging
wastes. As a result the meal plant had to shut down due to lack
of raw material.

Most remote area processors are grinding and discharging with
a few plants using "gurry scows". In the past, applicants for ef-
fluent discharge permits were encouraged to discharge below seven
fathoms depth. However, now realizing that depth may not be the
sole factor in distributing the waste, EPA is processing permits
on an individual basis with the discharge outfall being located at
a satisfactory point of dispersion, regardless of depth. Likewise,
a policy is evolving whereby the residual outfall is judged not by
strict size standards (100 foot diameter, 6 inches deep) but by the
effect of the residue on the ecology of the area.

All floating processors come under the remote classification;
however, no applications are made or permits granted for foreign
vessels operating under the Fisheries Conservation Zone Management
Plan.

Oregon

Oregon permits are processed by the Oregon State Department of
Environmental Quality. All plants in the state are operating under
BPT guidelines that call for screening solids. Solids are widely
used as mink food (Northwest Fur Breeders Association, using mainly
offal) and fertilizer on farm land (mainly shellfish waste). A
plant in Warrenton produces Oregon Moist Pellets utilizing crab shells and fish wastes. The pellets are used widely within Oregon in state fish hatcheries.

There has been a considerable amount of planning for future plants utilizing seafood waste but the slow movement is indicative of the marginal business of reducing high quality raw material to low quality products. Meal plants have been considered for Coos Bay utilizing conventional meal processes or a new ram jet engine principle. There has also been a proposal by a California company to compost wastes with sawdust.

Shrimp waste presents the most difficult disposal problem, although these plants as well as all other seafood plants in Oregon are currently in compliance with BPT. Final solids not being utilized by feed or fertilizer manufacturers are being trucked to landfill since barging is too costly. The economics of operating marginal facilities and the lack of available land for aeration lagoons would make it extremely difficult for processors to meet the BCT.

**Washington**

Permit applications are processed by the Washington State Department of Ecology. Washington is currently operating with a wide variety of waste utilization or disposal techniques and does not have any outstanding conflicts with meeting regulations. The Department of Ecology protested BCT guidelines for 1983 before they were suspended and must now wait, like other states, for new rulings from EPA.

Companies in the major Puget Sound processing area extending from Tacoma to Bellingham dispose of a large portion of their waste into the municipal sewers. Each city or municipal sewage district makes its own regulations and agreements with processors as to the form and amount of waste accepted.

Large amounts of fish waste are currently being utilized in a La Conner fish feed plant that makes Oregon Moist Pellets and other formulations for State, Federal, and private hatcheries. A unique system of shellfish waste disposal has been instigated on the Southwestern coastal area. Commercial operators and farmers collect the waste and spray it in the form of a ground slurry onto farm land. This procedure has met widespread approval by farmers and the product is in demand, although the farms receive the basic material at no charge for taking the waste from the plants.

There are several small meal plants in the state that operate intermittently. There is only one major plant (located in the Seattle area) that operates solely as a full time business of processing waste. The proximity to local meat, poultry, and fish processing plants greatly simplifies the logistics of economically collecting enough raw material to allow full-time operation. However,
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There are several small meal plants in the state that operate intermittently. There is only one major plant (located in the Seattle area) that operates solely as a full time business of processing waste. The proximity to local meat, poultry, and fish processing plants greatly simplifies the logistics of economically collecting enough raw material to allow full-time operation. However,
a significant percentage of the raw material still must be trucked from northern Puget Sound and Southwest Washington to insure sufficient raw material for economic operation.

Approximately 10 years ago, the University of Washington, through a Sea Grant project, worked with a Seattle firm in the development of their proprietary process for producing chitin and chitosan from shellfish waste. The company has continued to develop and simplify the process in order to improve the operating economics and efficiency. As always, the final limiting factor is the logistics of supplying sufficient raw material to enable economic operation of the minimum size plant. There is much optimism that a commercial chitosan plant utilizing improved processing techniques will be built in the near future.

California

Although it is not the intent of this report to cover the southern portion of the West Coast, it might be well to point out the major differences between the warmer water fisheries of California and the northern areas. Tuna and anchovy, the predominating industries in California, operate under different guidelines than those for salmon, crab, and shrimp. Air flotation is currently required in the disposal process. The tuna plants have large continuous production and, therefore, can support meal plants in San Pedro and San Diego. Bail water from vessels delivering to ports must be hauled at least three miles off shore and such wastes from fishing vessels are excluded from the Ocean Dumping Permit Regulations.

SUMMARY

Accurate information on total waste recovery is not available and many processors are reluctant to give such information unless they are assured that their specific company's production will not be disclosed. Although there is a significant volume of material being recovered in the form of usable products, the large majority of high quality protein is being discarded or sold for "cheap" animal food. The remote areas are particularly noticeable in that the present logistics problems preclude economic recovery and processing into salable products. The remoteness of Alaskan operations and the close proximity to municipal sewers of most large plants in Washington and Oregon are currently positive factors in preventing marine water pollution.

IMPACT OF FISHERIES CONSERVATION ZONE (FCZ)

Since the 200-mile limit is having a major impact on the Northwest and Alaskan fishery, this factor must be considered in relationship to waste management. This is especially true since the FCZ species are predominantly "groundfish" or "bottomfish" and represent the large volume-low priced raw material not previously harvested in large scale.
It is a delusion to talk about an expanding bottom fishery being combined with the present seasonal industry, especially salmon, to give added stability to each. There are few areas in Alaska handling large amounts of salmon that are suitable for large scale processing of bottom fish. Furthermore, the government sponsored blue sky feasibility reports (heavy on economic input and light on technology background) on the future of the 200-mile zone are severely misleading to those trying to plan for a realistic future.

Originally, bottom fish or groundfish were designated as those caught by trawling operations that drag the bottom for such fish as cod, rockfish, flounder, and sole, usually destined to be processed into fillets. However, convention has tended to designate all fish to be filleted as bottom fish even though some of the species are actually schooled pelagic fish. Depending on the size and species, the yield of fillets varies from below 20% to as high as 35%, with approximately 25% being a good average. However, these fish have 50 to 60% flesh on the carcass meaning that one half or less of the edible flesh is utilized for human food. The result is that the "frame" or filleted carcass contains an amount of flesh equal to that removed as fillets. Unless the U. S. can utilize this fraction of the bottomfish catch for some form of human food, it is doubtful at this time that we can economically enter the tremendous market that is being filled by foreign fleets. These fleets are using the total raw material in that they are either making fish meal from the waste (Table 6) or are removing the remaining flesh from frames for surimi blocks that eventually are processed into kamaboko. Furthermore, a high percentage of the high seas catch consists of small fish that will be thrown away as too small to fillet. These fish are also being utilized by foreign fleets. Small fish can be deboned to give approximately 50% of the landed weight in minced flesh. The key to future success of the U. S. bottom fishery will be our ability to amortize the catch over total utilization of the raw material rather than 25% in the form of fillets.

One of the major considerations involving bottom fish is that the catching and shipboard handling or processing of the fish, particularly the most abundant species, pollock and hake, have considerably different requirements from the high-value species. The temperature of all bottom fish must be lowered immediately after capture in order to prevent excessive quality reduction due to bacterial and enzymatic action. Furthermore, depending on the area, hake and pollock must be headed, gutted, and frozen shortly after being caught or the flesh rapidly degrades to become unmarketable. The foreign fleets solve this problem by having large "mothership" processing vessels accompany the fishing vessels to the grounds. Catches can be transferred to the mothership soon after being caught and then processed in a manner to insure high quality. If the U. S. is going to exploit the bottom fish stocks, they must choose between supporting the expensive mothership concept or altering the concept of bottom fishing through modifications of vessel design, on-board facilities, and handling procedures. Research into methods for utilizing the large volume of deboned flesh from small fish or
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*Basis: Catch consisting of 100 lbs fish for fillets + 100 lbs too small to fillet.
fillet frames is nearing the point where large volumes of minced flesh will be in demand. Although this will essentially double the marketable portion of bottom fish, the perishable nature of the flesh (made more susceptible to degradation by the cell-rupturing deboning process) imposes further alterations to the normal preparation of the fish for final processing. Minced flesh must be formulated into final products shortly after being deboned due to its short frozen shelf-life. For this reason, a large portion of the blocks frozen at sea will consist of headed and gutted fish. The fish will be thawed, filleted and the minced flesh recovered at shore based plants that can also utilize the minced flesh for formulated products.

Shore based plants in Alaska are going to find it necessary either to prepare final formulated foods when fillets are prepared or to head and gut or fillet and mince the bottom fish and then freeze and ship the primary product. Since the utilization of minced flesh is in the form of formulated products (i.e. dried, kamoboko, batter-breaded and cooked, etc.) it is questionable whether Alaska processors should install the major processing and support facilities necessary for minced fish utilization. Hence, the raw materials for the majority of the Alaskan processing facilities will most likely be limited to nearshore trawling operations. The larger volumes of frozen-blocked fillets, minced flesh, or headed-gutted fish will be transhipped from the large catcher-processor or freezer vessels operating in extended high seas fishing to the "lower 48" for final processing and packaging.

Approximately one-half the halibut and over three-fourths of the black cod presently landed by the U. S. on the West Coast and Alaska is caught in the FCZ. Halibut will increase considerably due to the expiration of the agreement allowing Canadian fishermen to harvest one-half the Alaska halibut. Black cod will show a dramatic increase since there will be a considerable amount of this species in the trawl fishery as well as in an expanding pot and long line fishery.

PROCESSING REQUIREMENTS FOR FCZ FISHERIES

It is apparent from studying catch and potential stock data that any major expansion in the Northwest Pacific fishery is going to be concentrated in the bottom fish (groundfish), commonly considered the low-value species. As has been discussed, the catching, handling, and processing of bottom fish, particularly the most abundant species, have considerably different requirements from the high-value species. The temperature of all bottom fish must be lowered immediately after the fish are caught in order to prevent excessive quality reduction due to bacterial and enzymatic action. Furthermore, depending on the harvest area, these fish must be headed, gutted, and frozen shortly after being landed or they will continue to degrade at a rapid rate.
The nature of the FCZ fish and the distances from land at which many of the fish are caught creates a relationship between fishing vessels and shore-based plants that is considerably different from the seasonal fisheries that have been the basis for the Alaskan and Washington industries. In the first place, the markets for bottom fish are such that the offshore fishery utilizing these raw materials must be developed prior to the construction of large shore-based plants.

The present discussions by a portion of the fishing industry and University and Government consultants concern whether off-season salmon and crabbing vessels can be utilized to fish for near-shore bottom fish. These vessels would be used to create a base for supplying shore-based plants with fresh fish for processing. Unfortunately, this procedure will not be the basis for a large new industry.

At the present time, the United States has a "zero base" production of fillets as compared to the volume of fillets being consumed in the country. In off-season vessels are used as the backbone of a "new" fillet industry the production of products will vary considerably throughout the year as these fishing fleets are entering and leaving the fishery. Furthermore, during years when seasonal fishermen have outstanding catches and income, they will not fish the more rigorous fishery. During these years there will be little, if any, fishing effort from seasonal fishing vessels. This practice is not compatible with the market for fillet fish. The large users of fillets, namely the fast food chains, supermarket chains, and some other institutional groups, operate year-round. The sales volume, cost of advertising, and many other factors related to a profitable consumer-oriented business cannot tolerate an inconsistent or intermittent supply of product. The only solution to this problem that will allow the U. S. fishing industry to supply large volumes of fillets to the present buyers (who are purchasing more than 80% of their fish from foreign countries) is to have full time, year-round fishing and processing operations. This is not compatible with extensive use of off-season fishing vessels.

If a large, continuous supply of fillet products is being produced by the United States, then the relatively small volume of products produced by off-season fishing could be absorbed into the market. Hence, the requirements for fishing fleets and shore-based processing operations must be considered in relationship to the nature of the raw materials and the markets for products, not the desire to create large processing plants. Furthermore, Alaska, where most of the FCZ expansion will take place, must be taken into consideration when looking at the future of Northwest Public Ports since much of the logistic and shipping support must come from the Northwest.
Shipboard Processing or Preprocessing

The nature of the fish and the distances from shore preclude taking large percentages of offshore caught fish to shore-based plants prior to some type of preliminary or final processing. Several different organizations of fishing efforts will most likely be used in FCZ fishing. The specific solution to the catching and rapid handling of delicate fish will depend on many factors such as location of the fishing grounds, type of vessels being converted to the new fishery, ability to finance new vessels designed for the specific operations, the specific mix of the species landed, the access to transshipping sites (particularly in remote areas of Alaska), cost of fuel and other controlling operating costs, and present and future environmental and regulatory restrictions. All of the following high seas operations will probably develop in response to various FCZ situations:

1. Mothership fleets whereby fishing vessels deliver to a central processing ship that periodically takes accumulated product to shore or transfers it to pick-up vessels. This procedure has been the necessary organization of foreign operations since they were operating so far from home base. The motherships are not only factory ships but supply the needed logistic support to the fishing vessels.

2. Mothership type of operations whereby the factory ship is a permanently moored barge to which the fishing vessels deliver the catch.

3. Catcher-processor vessels that both harvest and process the fish. The degree of processing will again depend on many factors but can vary from heading and gutting followed by freezing to complete filleting lines.

4. Fishing vessels that freeze fish in the round or hold in refrigerated brine or ice until shoreside delivery can be made.

The specific type of operation in Alaska is not important to the volume of product that will be handled by Northwest ports. The first three types will most likely result in transshipment directly to other ports. The fourth option will include both some FCZ product and the developing inshore products that will be processed in shore-based plants and then shipped to other areas.

An important consideration in planning of the processing facilities on shipboard is the market for which the fish are being prepared. Regardless of whether the final product is ready for use (fillets) or must be reprocessed (headed and gutted blocks), the volume of fish being handled in limited shipboard space determines that most of the output will be in the form of frozen blocks. This automatically predetermines that products processed on the high seas will be competing for the high volume, low cost markets where
fast food chains are buying blocked fillets or where reprocessors are thawing and processing the fish into products for retail and institutional markets. The current price for blocked fish, as determined by foreign competition, ranges from $0.65 to $1.00 per pound, depending on the species and form of product.

Shoreside Processing or Reprocessing

Once the United States is firmly entrenched in the FCZ fisheries, new inshore fillet plants can develop in both Alaska and the Northwest. The use of off-season fishing vessels, however, will have to be supplemented by a portion of the effort coming from trawlers that are operating on an all-year basis. Again, this is necessary to stabilize the shipping of product to markets that require constant supply. The shore-based plants can be designed and equipped with facilities to produce finished fillets and by-products for the higher-priced fresh and frozen items sold to retail outlets and restaurants.

The large volume of blocked fish from the FCZ and Alaska that will be delivered to market through Northwest ports and the landings from developing near-shore operations offer outstanding potentials for development of processing plants in the Northwest. There are several opportunities, all of which will most likely be taken by industry. These include:

1. Thawing frozen blocks of fillets, followed by either packaging for retail or other markets, or by preparing finished items such as batter and breaded fillets.

2. Thawing frozen blocks of headed and gutted fish for subsequent filleting and reclaiming of the remaining flesh for formulated products. Although the minced flesh can be refrozen for other reprocessing companies, the best products and the most profitable operation is to have both a filleting line and a formulated product facility in the same plant.

3. Filleting fresh fish landed by the nearshore fishery followed by deboning and formulated product manufacture. Although this operation is similar to item 2 above, there is an additional market in the growing demand for fresh seafood items in the United States.

CONCLUSIONS

The key to the future of both waste management and expanded seafood sales is in "total utilization" of raw materials. In many instances the amount of presently discarded edible flesh is greater than the product marketed. The use of this portion will greatly reduce the disposable solids and create an economic base to allow recovery of remaining solids for products of commerce. The trend for the expanding FCZ fisheries is to discard some waste at sea
and land a preprocessed frozen block that requires minimal disposal facilities in the processing plant. The development of minced flesh formulated products (i.e. dried, batter-breadcr, portion control, etc.) will be stimulated by the total utilization of low priced fish from the FCZ. This in turn will create markets for products from currently discarded portions of high priced fish. These developments and much of the accompanying research must be directed toward utilization of the entire raw material and designing logistic supports into the processes that give the processor an economic incentive rather than a regulatory compliance date.

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FISHERY WASTE MANAGEMENT IN THE GREAT LAKES

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INTRODUCTION

Prior to passage of environmental legislation in the mid 1960's and early 1970's, few people were aware of the effect pollution was having on the Great Lakes ecosystem. As a result of public hearings and debate on the subject, citizens of the Great Lakes basin were made aware of the Great Lakes resources and the role they play in the economy and quality of life in the region. The lakes and their water sheds had served as a source of water for heavy industry, electrical generating facilities, potable water for food processing and drinking, recreational opportunities, food fish production, a transportation network and were used as a sink for waste disposal. The indiscriminant use of Great Lakes waters changed with the realization that environmental quality and in particular, Great Lakes water quality were declining. A majority of the people in the region viewed the promulgation of regulations as positive and needed steps to preserve these bodies of water for the future.

The regulations established to deal with environmental quality are similar from state to state. In general, the laws define what constitutes a potential pollutant and outlines the restrictions for handling and disposal of the material. The laws are specific in matters concerning the direct introduction of foreign or deleterious substances into the aquatic environment and do not allow for direct dumping of any material into the lakes.

The industrial and public sectors have expended large amounts of time and money installing and operating the waste treatment facilities needed to meet the established environmental guidelines. As a result of coordinated efforts by both sectors, new and innovative approaches to waste management and treatment have been adopted and
put into practice. Although the fishery considers itself as part of the industrial sector, it follows the point of view that fishery waste management is not an industry problem but a problem of the individual, and as such, must be handled by the individual as best he can. By adopting this attitude toward waste management, the fishing industry has left itself vulnerable to criticism in the future. A clean aquatic environment is necessary to insure the stability of the ecosystem and is in the industry's interest that it be maintained. It would seem more appropriate that the Great Lakes fishing industry take a more active role in looking to the problems associated with the wastes it generates.

Great Lakes Fishery Waste

The Great Lakes fishery is essentially a day fishery meaning a producer leaves port in the morning and is back in port the same day. A typical day's catch can range from 100 pounds to two thousand pounds plus of fish. The catch may be brought back in the round and dressed ashore or, to save time, dressed aboard the boat on the trip back to port. Once the product is ashore, it is usually shipped to the processor as soon as possible. After shipping, any waste produced is the responsibility of the person receiving the fish.

The quantity of waste generated by the Great Lakes fish producers and processors is small compared to that produced by the marine fishery. Pileggi (2) lists the 1975 total U.S. Great Lakes fish production at 60.6 million pounds. If the 1975 alewife production used for fish meal and animal feed were subtracted from the total, it would leave approximately 25.4 million pounds of human food fish produced for that year. The 1975 Wisconsin commercial food fish production for 1975 was given by Pileggi as 7.3 million pounds. Stuiber et al (3) had estimated that the waste generated by the Wisconsin commercial fishery in 1975 ranged from 2 to 3 million pounds. Using this range as a base for other commercial fisheries in the region a simple calculation gives a range for the total waste generated from U.S. Great Lakes food fish production in 1975 of from 7 to 10 million pounds. This amounts to a substantial quantity of waste which must be disposed of within the region.

Typical fishery waste have been analyzed for protein content and the results are presented in Table 1. Examination of the table shows that fishery waste materials are high in protein content. This type of waste spoils rapidly, produces offensive odors and requires special care when being stored or disposed.
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Table 1. Crude Protein Content Of Fishery Waste

The type of waste generated aboard the boat would consist primarily of visceral material. If large fish such as lake trout are included in the catch, they would be gilled or headed and these items included in the waste. In addition to what can be considered as onboard processing waste, there may also be whole non-commercial fish species and fish of questionable value being discarded.

Wastes being generated in a shore-based processing facility would be of a more complex nature than the wastes generated by a fish producer. The waste produced in a plant handling fresh and frozen fish would normally consist of scales, viscera, frames, and trimmings. In addition, these may also be included, smoked fish scrap, waste batter and breading, and waste material produced from the handling and processing of other food products.

Great Lakes Fishery Waste Handling Practices

In a discussion of fishery waste management, Green and Mallick (1) state that "Important considerations limiting investment in fishery processing waste elimination, are the small size and seasonal nature of most seafood plants." Although the authors were describing the situation as it exists in the marine fishery area, the description more accurately describes the situation existing within the fresh water fishery. The present situation is such that the Great Lakes fishery does not have an established fishery waste management program nor is there any consideration being given to the development of one. The fact is
that methods employed to deal with Great Lakes fishery wastes vary from area to area and with the people involved in the fishery.

Fish producers from the Great Lakes region have long been accustomed to dumping shipboard wastes over the side. Since dumping is no longer allowed, waste disposal for some fishermen has become difficult. However, the law is also difficult to enforce and not all fishermen comply with it. It is common practice by a good number of fishermen, when well out from port, to slip the waste over the side. The ever-present gulls make short work of any floating waste material while the more dense material sinks leaving no trace. In most cases these fishermen will bring back a container or two of waste as a hedge against the possibility of someone spot-checking the boats upon their return. The amount of waste brought back is usually only a fraction of the original quantity generated and is readily disposed of by shore burial.

Those fishermen bringing all their shipboard generated waste back to port find the disposal of such waste to be costly in terms of both time and money. These fishermen have a narrow selection of methods from which to choose for disposal of the waste material. The method of choice, when available, is the dumping into the local landfill site. Local regulations dealing with the dumping of material such as fishery wastes and other highly perishable organic matter are usually restrictive and the waste has to be covered to control flies, stench and access to it by local wild and domestic animal life.

The management and supervision of dump sites requires the presence of personnel and equipment to facilitate the daily operation of the landfill site. In many of the smaller communities labor and equipment costs have been responsible for restricting type and quantities of waste allowed in the landfill as well as the hours which the site is operated. These practices have resulted in eliminating the public landfill disposal method as a viable option for many of the fishermen.

A less acceptable but available option is the use of privately owned and operated refuse collection and disposal facilities. This approach is used, but not extensively, since it involves an added cost factor in a fisherman's business operation and can result in the creation of a non-competitive situation for the individual in the marketplace.

A number of producers have the opportunity to use municipal sewage treatment facilities as a waste disposal
method. Pre-treatment of the waste involves grinding to reduce waste particle size. The resulting slurry is flushed down the drain with large amounts of water to eliminate the possibility of plugging the drain. It should be pointed out that not all sewage districts will allow this practice.

Great Lakes' fish processors experience similar problems and limitations associated with handling waste as do the producers. If one were to compare the degree of difficulty of the producer's problems to that of the processors, it would seem that the processors would have the more difficult task. In some ways the problems of the processor are more severe since the quantities of waste generated are larger. However, the larger volumes of waste open up several additional waste disposal alternatives.

Rendering and meat scrap processors are constantly looking for sources of high protein animal waste and will pick up fish scrap and process it. The key to being considered for this type of treatment is the quantity and quality of the waste. Fishery waste should be relatively fresh and show no sign of excessive lipid oxidation or putrification. Most renderers see an advantage in using fishery scrap since it helps increase the protein content and quality of their meat and bone meal.

A few processors in the Great Lakes region have developed markets for their waste. These individuals freeze the waste material and market it to fur farmers. The practice is very limited and seems to be phasing out due primarily to chlorinated hydrocarbon microcontaminants associated with Great Lakes fish and a reduction in fur farming in the region.

Another waste handling alternative used by several processors involves converting fishery waste into liquid fish fertilizer. To date, the procedure has proved to be both a successful method for processing fish waste and economically beneficial to the individuals using it. Although this procedure is attractive and could be used by many persons in the industry it is not a suitable alternative for everyone. The process requires capital investment and takes additional time and effort to develop and maintain markets for the fertilizer product.

SUMMARY

It should be evident that no one particular waste handling method can be identified as "the method" used by members of the Great Lakes fishery to handle and treat fishery wastes. The waste handling practices employed
are selected on the basis of what method can be used and its cost and not what method would be the most convenient to the user. This situation leaves much to be desired and has prompted some fishery personnel to request that the situation be investigated and methods developed which are flexible, efficient and less costly. Until a larger segment of the fishery assumes this posture, the situation will remain static and could eventually harm the industry.

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