Special Report

NOTES ON WASHINGTON TRIP CONCERNING SHELLFISH RESOURCES OF THAT STATE

Purpose and scope of trip: It was strongly belived that much benefit in program planning and carrying out of investigations could be derived by this lab by a member of its staff taking a general survey trip of the shellfish resources of Washington and British Columbia and the biological, as well as managerial, proglems involved. As it turned out Washington was the only state visited.

Time Period Covered During Survey: Actually the time period involved was from the evening of August 29 to noon of September 4, 1952. The trip had originally been planned to include time in British Columbia but as Dr. D. B. Quayle, currently in charge of all shellfish investigations for British Columbia, was called away this trip did not materialize.

Areas Visited: August 30: Tideland area adjacent to the Washington State Shellfish Laboratory at Purdy (Gig Harbor address), Washington.

Sept. 1: Tidelands about Samish Island near Burlington, Washington.

Sept. 2: Paulsbo Bay, Liberty Bay & North Bay.

September 3: Oyster Bay

Personnel Contacted During Trip:

Cedric Lindsay, biologist in charge of shellfish research in Washington.

Charles Woelke: Formerly with Oregon Fish Commission but presently in charge of oyster drill control work for Washington.

John Lorey, biologist working on drill control.

Harold Wikston, biologist working on native oyster setting prediction.

Mr. Lindsay and Mr. Woelke were very lenient with their time and it was through their efforts that the trip was a success.

General Information Gathered:

It must first be understood that the primary shellfish resource of Washington is the oyster. This involves firstly the Japanese oyster or Pacific oyster, Ostrea gigas, and secondly the native oyster, O. lurida. As the state of Washington holds property titles to about 25% of the state it can be seen why the state should put forth considerable effort to effectively manage these areas. The policy of the state has been to lease ground to those growers who want to lease it. Some of the state owned ground is in areas where natural seeding (spawning and setting) of the Japanese oyster takes place. When crops of these oysters have reached marketable size the state auctions the oysters on the particular area(s) by requesting bids from the various growers. The state must first know what bushelage of oysters might be expected to be taken off an area and this entails surveys by the biologists for this purpose. We then can place one general part of the Washington Shellfish Program as Taking care of the state-owned oyster beds.

Service work to the oyster industry is another large part of the Shellfish Program. Under this is a major problem of oyster drill control. The main oyster drill causing damage is the introduced Japanese oyster drill, Tritonalia japonica, a snail. Urosalpynx cinereus, the east coast oyster drill and Thais lamellosa, the native drill, are also present but do not cause the damage that the Japanese drill does. The drill(snail) actually drills a hole in the oyster shell and then feeds upon the soft body parts the oyster being killed in the process. Depending upon the size of the population (s) of drills in an area & corresponding amount of damage is done. In some areas oyster farmers have been forced out of business by this pest. An effective measure of con-

trol of the drill is needed. This program involves:

1. State control of the moving of oysters from a drill infested area to a non-drill infested area. An oyster farmer must first obtain permission from the state to transport any oysters. ~~[illegible]~~

2. A biologist from the state of Washington each year is sent to Japan to inspect the seed as it is being boxed for shipment to the West Coast to insure clean seed.

3. Chemical and other means of actually killing or inhibiting the reproduction or otherwise spreading of the drill.

a. Actual poisoning of the drill although no practical poison has been found to date. New poisons are being tried continually.

b. Starving the drill out of an area by not planting in badly infested areas for a period of years.

4. Life history studies of the drill to tie in with control.

Probably the most effective means of controlling the drill today is for the growers to continually pick up the drills by hand off the oyster beds. This keeps the population down and thereby the damage also.

Service work also includes protection of the oyster grounds from various types of polution.

Perhaps still under the service to the industry category can be classed the <u>oyster set prediction work</u> for both the native and the Japanese oyster. This involves a considerable amount of time. Bulletins are written in weekly intervals during the critical period informing the industry and interested parties of their chances of collecting oyster ~~[illegible]~~ set and when to do it.

Another major heading of shellfish work in Washington involves the study of the various species of clams. These, as in Oregon, may be divided into the groups <u>Ocean and estuary or bay clams</u>.

The razor clam, any ocean clam, is the object of detailed study, two full time biologists being employed for this purpose. A quota system is now in effect for Washington's razor clam beaches. As it was not possible to talk with the biologists studying razor clams at this time no more will be said about this species.

Probably the most important bay clam in Washington is the little-neck clam, which now includes two species, the native little-neck, Paphia staminea, and the Japanese little-neck, P. phillipinarum. The Jap little-neck has been introduced with the Japanese oyster seed from Japan and has proved to be a most prolific clam extremely adaptable to varying conditions of habitat. The commercial possibilities are great for this species. It might be well to attempt to introduce in Oregon's waters although the exact method of introduction is in doubt at this time. It is an excellent steam clam and a colorfull market clam.

The butter clam, although present in relatively substantial quantities, is not used commercially to any large extent. Commercial landings comprise those clams that are dug incidentally while digging the little-neck clam.

The horse-clam is rather scornfully looked at in Washington and, although present in good abundance, is not used to any extent.

The geoduck is reserved for sport digging.

Although the soft shell clam is present I do not believe it is used to any extent.

The cockle clam is present but not used in large quentities.

Another shellfish resource of Washington, the Dungeness crab, has been studied rather extensively in the past but at present no biological investigation is in progress. Some work may be done in the near future. It is the general concensus of opinion that the work done in the past is generally holding true.

Specific Information -- Field Notes:

August 29, 1952 (Notes from talk with Cedric)

Butter clams are incidental to take of little necks commercially. Although not harvested directly small beds of commercial size are present. Saw sample of Ostrea rivularis (this oyster was same as sample given to me by an oyster farmer in Coos Bay). This oyster is found with the Kumamota seed. Japs cannot isolate pure seed of rivularis as yet. It matures or rather reaches marketable size in a year's time.

August 30, 1952

Went out on the flats immediately adjacent to the Shellfish Lab at Purdy and observed some clam beds containing little-neck clams, horseclams, geoducks and butter clams. Dug one geoduck weighing three pounds fourteen ounces. Learned that the more substance to the neck and the size of the neck is indicative of the size of the clam you can expect to dig. Observed both V. staminea and V. phillipinarum in about equal numbers living together. The Jap little-neck was found nearer the surface of the flat, many could be seen only partly buried. The ground is of very heavy gravel.

Oyster ground in this area about aplus 4.0 feet in height. Extreme low runout to a minus 4.0 feet and high tide at a plus 17.0 feet extreme. Average height of oyster beds in Washington at about a plus 1.0 feet to a plus 2.0 feet. Saw oysters planted on an almost pure sand flat. No good for planting but fairly good for transplanting.

Cedric believed deepwater populations of clams, particularly geoducks and horseclams, insured perpetuation and reseeding of the tideland with clams. Regulations need only be applied if maxiumum yield is desired. Legal limit of geoduck (possession limit of three) set without any biological reason.

Cedric believed that many areas in both Puget Sound and Willapa were overplanted in oysters the result being a slower maturing crop. Average production per acre 800-1000 gallons. Very good production 2000 gallons per acre. Growers plant on the average of 20 cases of oyster seed per acre. As high as 100 cases per acre where the growers are just holding the oysters for one year and then transplanting on other areas.

September 1, 1952 (With Chuck on Samish Island Beds)

Rockpoint Oyster Company grounds are the site of the oldest and first successful planting of the Japanese oyster. Many drills of the three species mentioned earlier were present here. Chuck had a study area to check natural mortality and total mortality of the oysters in an effort to measure the effect of the drills on the oysters. The Jap drill lays eggs in March, April and May and again in the fall. The Jap drill is not hermaphroditic. Extreme salinities are lethal. Rockpoint Oyster Company's grounds are about ankle deep with mud. Across the lagoon in a westerly direction is the Lauren Howard Oyster Co. Here the ground was of firm sand generally. A drill problem also existed here.

September 2, 1952 - Paulsbo Bay with Chuck

This area was formerly, and still is potentially, excellent fattening and growing ground but it is useless now due to the heavy infestation of drills (Tritonalia).

- Liberty Bay with Chuck

Coast Oyster Co. (Verne Hayes manager)/flats of the silt type ankle deep to calf deep. This ground has been hardened with oyster and clam shell/and gravel. A minus 0.5 to a minus 1.5 feet height of flats. Observed drill drilling hole in native oyster. Some old shells of the Japanese oyster

had more than one hole in them indicating perhaps a random selection of the oyster by the drill rather than the drill actually selecting out a live oyster.

-North Bay with Chuck

State reserve grounds are here. Took samples of Ostrea edulis, Kumamoto, O. lurida, O. rivularis. Saw state owned dykes which are at about a plus 4.0 feet tide level and made of concrete. Disadvantage of concrete dykes is that they have tendency to settle in the mud and crack. The state has growth studies here from Japanese oyster seed obtained from the various growing areas in Japan.

Across the bay from the state reserve grounds observed Clem Sargent's native oyster beds which consisted entirely of dyked land. The largest dyke was 150 feet by 900 feet and of the self flushing type. Elevated 2-3 feet above surrounding ground. The ground within the dykes had been hardened by placing first a layer of plank, then several layers of tarpaper, a layer of shiplap or plywood, and finally a layer of gravel on top. Sargent used cement coated lathe racks for catching his seed. No drill problem here.

September 3, 1952 - Oyster Bay with Chuck

Observed more dyked areas here where native oysters were being cultivated. Water in dykes upon arrival was 71°F, 75°F when leaving. The dykes were constructed of creosoted one inch by 12 inch by 2-3 feet boards. Definitely a drill problem. Grower picks up all drills he can see whenever out on the beds. Freshwater flushing of dykes is being considered for the control of the drills.

September 4, 1952 -- at Shellfish Lab

Looked over Cedric's collection of clam shells he has made for growth studies. Talked over some algae problems with the staff. Left for Newport about noon.

Lowell D. Marriage
Oct. 13, 1952

NOTES ON WASHINGTON TRIP - Rough Notes from Field Book
AUG-29- Sept. 9, 1952

Arrived at Washington State Shellfish Laboratory August 29, 1952 at 1600. Met Harold Wikston and John Lorey as well as the other fellows I knew, Cedric Lindsay and Chuck Woelke. Arranged a rough schedule for the following tides as follows:

Monday-Sept 1 - Samish Bay- will see Pacific Oyster grounds that are badly infected with drills, Tritonalia japonica. Also see Chuck's work on seed oyster mortality. While in the area we will also see some pea vine pollution.

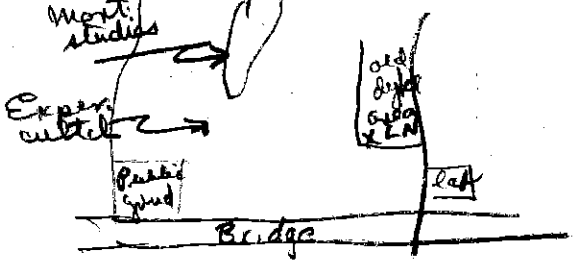
Tuesday-Sept 2 - Paulsbo Bay-Good growing ground and drill infested grounds.
North Bay--State Reserve Beds.

Wednesday-Sept 2 - Oyster Bay - Active drill infestation control being carried out by growers.
Native oysters.
State Oyster Reserve
Clam ground

August 29, 1952. notes from talk with Cedric. Butter clams are incidental to take of little necks commercially. They are not harvested directly in Washington although small beds of commercial size are present.

Saw sample of Ostrea rävularis. Probably example of the "round" oyster given me by Cooper. These are found with some frequency with the Kumamota seed.

August 30, 1952. Went out with Cedric in front of lab on Whiz Fish Company and Victor Oulette's oyster beds as well as some public clam beds containing little necks (native) & horseclams, geoducks, & butter clams. Dug one geoduck weighing 3 lbs 14 ounces on area just across from lab. Saw geoduck necks (shows) -- the more substance to the neck and size denotes pretty well the size of the clam that can be expected to be dug. On oyster grounds in heavy gravel we found both V. staminea and V. phillipinarum in equal numbers living together. The Jap little neck ismore of a surface clam than the native little neck. We found Jap littlenecks lying on surface or slightly dug in with most of shell showing. The ground is of very heavy gravel with some (very little) mud binding(Cedric said -- I could not see the mud - LDM)



Cedric said the oyster ground in this part of the lagoon was about a plus 4.0 feet in height. Extreme low runout to a minus 4.0 feet and high tide at a plus 17.0 feet extreme. Average height of oyster beds in Washington at about a plus 1.0 feet to a plus 2.0 feet. Saw oysters (on island) planted on an almost pure sand flat. No good for planting but fairly good for transplanting. Even older oysters had difficulty in maintqining themselves somewhat.

Deepwater populations of clams (geoducks, and probably horseclams) insured oncoming clams. Regulations needed only to be

applied if maximum yield is desired, i.e., large clams. Legal limit of 3 geoducks set by guess and by gosh.

Cedric stated the native little neck was from 3-5 inches beneath the surface of the flat generally while the jap littleneck was from 1-3 inches generally. Silt, crowding, tidal range, feed -- all of these were able to be stood better with the jap little neck -- indicating a much hardier species.

Southern puget Sound areas of the Japanese little neck. Colder or Northern areas the jap little neck is not abundant. The jap littleneck requires warmer conditions. In 1942 Oalkland Bay was the site of large kills of the Jap little neck due to cold weather. By 1946 they were coming back in commercial numbers. Another kill in 1949. By 1952 they were commercially present again. 400-600 pounds of jap LN per man tide is a good average catch commercially. 4-6 bushels per man tide of the native LN is good. A successful digger would have to average 200-300 pounds of clams per tide to stay in business.

Butter clams are taken incidentally to taking of Little necks. No concentrated effort to harvest butter clams in Washington.

(See Quayle about Butter clam yield on Study Island 00 Ecological conditions.)

Silting and over digging cause of decline of butter clams in Dabob and Hoods canal.

Japanese oyster spawning apparently running in a six year cycle of heavy setting although light sets are occuring annually.

The japanese use a method of brushing an area to increase clam set. A chunk of brush is staked out every 10 to 15 feet. This aids in the set of clams apparently. In Japan.

Clam food versus oyster food competition. Walter Chipman at Beaufort, Connecticut is using radioactive tracers for working on bivalve food.

Anatomy of feeding apparatus of oyster such that it selects the smaller organisms and rejects the larger. See Coe.

Nelson, T.C.

1933. On the Digestion of Animal Forms by the Oyster. Proc. Soc for Exper. Biol. & Med., 1933, XXX pp. 1287-1290.

Conseil Permanent International Pour L'Exploration De La Mer

Extrait du Rapports et Proces - Vergaux, Vol. CXXVIII, 1951. The Governement Institute for Fishery Investigations(RIJKSINSTITUUT VOOR VISSERIJONDERZOEK)
OOST-INDISCH HUIS AMSTERDAM * B. Havinga, Director

I. Difficulties encountered in Tank Breeding of Oysters (O. edulis) by P. Korringa.
II. Investigations on shell disease in the oyster, O. edulis L. by Korringa.
III. Crepidula fornicata as an oyster pest by Korringa.

Cedric has some growth studies on the cockle, littleneck and geoduck but it is strictly in raw form. The samples are present but have never been measured. Plans to work it up this winter.

R.T. has not sent Cedric dope on geoduck take.

The following information was taken from wall in shellfish lab at Purdy's.

Ostrea lurida

eggs - 105 mm in dia
Straight hinge larvae at time of liberation 180 microns long X 160 microns high
Larvae at setting size - 320 to 340 microns hight(?).

Ostrea gigas

egg: 45-65 microns wide.
Trochophore larvae not completely covered by shell - 60 microns high, 70 microns ~~wide~~ long.
Late straight hinge larvae 76 microns high
Early umbo, shells assymmetrical, left umbo more pronounced ~~than~~ and larger than right 75-80 microns high.
Veliger larvae at time of setting 255 - 320 microns high.

Ostrea rivularis dyked area growth 6-8 months gives a small D size oyster.

Washington tideland titles (State Ground) are all known, the state spend $40,000 for a detailed survey just recently. About 1/4 of all tidelands are state held.

Asked Cedric about possibility of having areas overplanted in both Puget Sound and Willapa. On Stoney Point beds in Willapa it takes from 2½ to 4 years to produce a marketable size oyster. Some of fattening grounds there turn out three crops per year. Cedric believed many of the growers have overplanted there areas.

Production per acre (average). Average production 800-1000 gallons per acre. Good ground 2000 gallongs per acre. 1.6 bushels equals 1 gallons. A goal to reach is 1 bushel per gallong. Growers plant on the average of 20 cases per acre. 40-50 cases per acre in places where just holding. As high as 100 cases per acre for holding during the first year. Break up very easy when transplanting. Time of transplant is critical.

September 1, 1952. With Chuck on Samish Island Beds: Rockpoint Oyster Company grounds. Site of oldest and first successful planting of the japanese oyster. Drills present -- Tritonalia, small native drill Neptunia, and Urosalpynx. CW had a poisoned grease painted box in which was to be natural mortality and outside to be total mortality. In this manner he expected to check drill damage. The experiment consisted of a very few, less than ten, clusters of 1 year old oysters or a total of 20 both inside and out. The poisoned grease contained mercurous chloride. Tritonalia lays eggs in March april and May and again in the fall. They are not hermaphrodutic. Extreme salinities are lethal.

Thais lamellosa neptunea

60 - 70% of Washington's oyster industry is in Willapa.

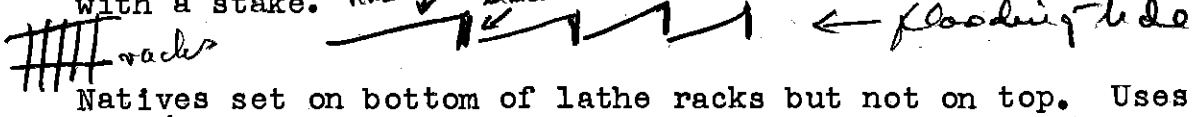
Across Bay from first st Rockpoint Oyster Co at Lauren Howard's beds, was the next stop. West side had firm sand. East side ankle deep mud. Drills appear to demand a certain amount of food in an area. Areas of heavy oyster concentration ideal. If the area has not been planted for a while the drills seem to "starve" out. Drills can move across deep mud by extruding a slime "road" or "film. Chuck has some growth figures on Tritonalia. Believes they have to be 2 years old before t they can spawn. Have to be controlled in first year of life then.

September 2, 1952 - Paulsbo Bay with Chuck: Formerly and potentially excellent fattening and growing ground but heavily infested with Tritonalia.

Chuck stated that in Discovery Bay 20,000 Polynices collected on clam grounds in one area in 1951. Apparently a clam pest, not particularly an oyster pest.

Liberty Bay: Coast Oyster Co. - Verne Hayes: Silt type flats ankle deep to deeper hardened with oyster and clam shell. A minus 0.5 to a minus 1.5 feet height of flats. Oyster ground has been hardened with gravel. Off hardened area very soft, over knee deep. CW ways about 200 acres under cultivation here. Trucking of oysters from Willapa for fattening resulted in heavy mortality. Blame put on rough handling by conveyor belts. Area downbay, as well as first stop, were old dyked areas formerly used for native oyster culture. Some live natives still around observed. Observed Tritonalia drilling a native oyster. Saw some jap oysters with more than one hole in them. Evidence of native oyster setting -- probably last year.

North Bay -- State Reserves. Took samples of Ostrea edulis, Kumomoto O. lurida, O. rivularis. Saw state dykes which are about at 4.0 feet made of concrete. Chuck has growth studies going from jap seed obtained from the various growing areas in Japan.
O. edulis brought in May 15, 1951 To Wu.
Saw Clem Sargent's native oyster beds (dykes) in North Bay(Allyn, Wn.) in which his largest dyke was 150 ft by 900 fet and of the self flushing type. Elevated about 2-3 feet above surrounding ground. Chuck says a layer of plank plus several layers of tarpaper and then a layer of shiplap or plywood, then gravel on top. Lathe racks approximately 4 X 4 feet the lath being about 4 inches apart. These racks are cement coated and then laid like shingles or shakes on bottom of dyked area. The forepart or part facing the flooding tide is raised several inches with a stake.



Natives set on bottom of lathe racks but not on top. Uses about 1/4 to 1/3 of this area for harvesting each year. Harvests about 300 sacks per year worth between 20 and 30 dollars per sack. Harvests three year oysters. Has no drill problem -- no drills.

Other operator (not seen) has drill problem and has to collect spat on floating cultch. This is done with clair trays (egg dividers) dipped in cement. Differential set between other types of cultch is great. Cement coat stuff is a lot better.

Clem can move about 25 sacks per ~~130/X/130/p16~~ man tide. Harvests 300 sacks per 150 X 130 ft plot. Can cull about 1 sack per hour. Harvests in three years. (Disregard former figures on yield.)

Preservation of bivalve larvae by Karriker.

$HgCl_2$ 0.08 grams
Sugar 100 grams
20 - 30 o/oo sea water to make 1000 cc.
Alkalize to pH of 10

formalin 10 cc
commercial sugar 100 grams
filtered sea water 20-30 o/oo to make 1000 cc.
alkalize to pH of 10.

Plankton nets used for collection of oyster larvae in Washington waters
20 -- Pacifics
12 Natives

Native oyster larvae count : Maximum of 12,000 per 20 gallon sample. 500 spat per 100 shells or 5 spat per shell commercial set. Prefer shell to glass for collecting experimental spat.

Setting Index: Take 12 seasoned oyster shell free from bottom. Don't dount bottom or top. Count 10 shells to get average.

$$\frac{\text{Aver no. spat X 100}}{\text{no. days in}} = \text{When 500 then commercial}$$

Theoretically when shell group becomes numerous and also a good back log of larvae then setting will be commercial.

Vance Tarter has figured out native setting by air temperatures.

Check oyster bulletins for Vance's temp method.

Concrete dipping critical. Lathe should be soaked before dipping. One application. Kept wet while curing and put out 3-5 days after concrete has set.

Condition factor of oysters:

$$\frac{\text{Total vol minus shell vol}}{\text{volume of meats}}$$

This method gives the relationship between the meat vol & the cavity in the shell.

Chuck is worried about the future polution of Willapa Bay. Gene Haydu is working on this. Chuck is very critical of the intake height (plus 8.0 feet) of Haydu's water forexperiments with polution. Believes the figure Gene will get will be maximum due to height of intake. Experiments

Experimental seed in 1947 shipment to Oregon from Japan thru Wash. Kumamoto -- 10 cases numbered 6,7,8,9,10,14,15,18,19.20.

According to notes by Glud the 1948 shipment to Oregon included 10 more cases of Kumamoto, came aboard the S. S. Oregon Mail.
Five cases of broken regular seed were given OFC in 1947.
Look up 1950 plantings of Kumamoto for Ore growers to find evidence of O. rivularis.

General survey form used by the Washington Shellfish Lab.

Oyster Survey

General Area _____ Date _____
Sub Area _____ Time of Day _____
Exact Loc. _____ Tide _____

Inspection notes:
(1) General character of land
(2) Purpose of Experiment
(3) Expeiment
(4) Conclusitions

Oyster Bay September 3 with Chuck:

Saw Mrs. Bowman's native oyster dykes. Water in dykes upon arrival was around 71°F. Other Co.'s in this bay are Olympia Oyster Company and Northcraft Oyster Co. The dykes were constructed of creosoted 1 inch ~~boat~~ by 12 inch by 2-4 ft boards. Mrs. Bowman has been thinking of fresh water flushing of dykes as a control of the drills. Mrs. Bowman uses shell for collecting her own seed. She has 10 acres of dyked land. Has harvested 1200 sacks per year at top production. Last year 500. Costs $1000 (old figure) to dyke one acre of ground. Has been hand picking drills off area. Has both Trit and Uro but Trit is the pest. 75°F upon leaving.

Conversation regarding with Cedric
September 4, 1952 ~~with Chuck~~. Paulsbo Bay. Algae (Ulva) 1-4" deep. Cedric believes the mortality to be from shifty sand and drills rather than from algae. Could not see oysters through algae. This is not the place Cedric was telling about where moartality due to algae took place.

Cedric has survey of clam beds on State Reserve ground made in 1942 by L. R. Donaldosn.