A fishermen's agreement and co-op in Yaquina Bay roe herring

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1. INTRODUCTION

Private fishermen harvest agreements have demonstrated that fishermen are willing under certain circumstances to assume various tasks related to governing the fishery. Such agreements have generated interest because they provide an alternative to government-administered individual transferable quotas (ITQs). While they sometimes break down, such agreements have ended the race for fish and reduced excesses in fleet capacity in certain fisheries (e.g. Townsend, 2005). And since they are devised by the fishermen themselves, producer agreements can avoid some of the difficulties encountered when initial allocations of individual shares are carried out in the political arena (Sullivan, 2000).

A government authority can play a supportive role in the formation of such agreements. In single-sector fisheries, the government can facilitate an agreement by limiting the number of participants. In multiple-sector fisheries, the government can facilitate an agreement by determining each sector's share of the total allowable catch (e.g. Loy, 2000). But it is fishermen who formulate an agreement over how to allocate their sector's share of the total allowable catch among themselves. Like ITQs, these allocations are often specified in terms of percentages of the overall catch. Typically, all or part of these allocations are transferable, but certain restrictions on transfers may exist.

Because these arrangements are formed voluntarily and rely on cooperation, their emergence in a fishery depends on certain pre-existing conditions (Ostrom, 1990; Sullivan, 2000). The number of participants forming the cooperative must be relatively small and they must share a common interest. There must be an effective mechanism for preventing those not party to the agreement from entering the fishery. Otherwise, outsiders are "almost certain to be predators on the fishermen who rationalize the fishery" (Sullivan, 2000). There must be a clear indication to fishermen that forming and maintaining such an arrangement will yield economic benefits. Equally important, there must be a clear signal to fishermen that such an arrangement will not be overturned by government.

With the moratorium on new ITQs in US federal fisheries from 1996 to 2002, private harvesting agreements emerged in the late 1990s as an alternative approach to ending the race for fish. One agreement was formed in the Pacific whiting fishery off the Washington-Oregon coast (Sylvia, this volume) and others were formed in the North Pacific pollock fishery in the Bering Sea off the coast of Alaska (Richardson and Wilen, this volume; Paine, this volume). A much earlier fishermen's agreement – dating back to 1989 – was adopted by nine fishermen in Oregon's Yaquina Bay herring sac roe fishery, a fishery that occurs in state waters. This paper provides a historical account of the fishery, its management and performance under the associated agreement.

2. BACKGROUND

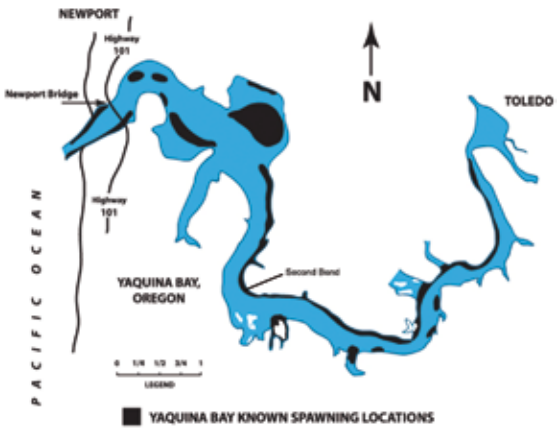
Located on the central Oregon coast, Yaquina Bay is the third largest estuary within the state, with just over 4 200 acres at high tide. The Bay's commercial herring roe fishery began in the late 1970s. It is a relatively small fishery by commercial fishing standards. Over the life of the fishery there have been only nine or ten vessel operators. Annual herring landings have ranged from 3 to 248 tonnes and combined annual ex-vessel revenues have ranged from as low as $2 463 to as high as $200 950 (Matteson, 2003b). In comparison, the San Francisco Bay herring roe fishery had over 132 vessel operators and an overall herring quota of 3 747 t for the 2001–2002 seasons (California Department of Fish and Game, 2002).

The target species, Pacific herring (*Clupea harengus pallasi*), range from Baja California to Alaska and across the Pacific Ocean to Russia, China and Japan. Pacific herring spend most of their lives at sea, but they migrate inshore to breed in sheltered inlets, sounds, bays and estuaries. Spawning can start as early as October in California and as late as July in Alaska. Off Oregon, the peak period of spawning occurs over the February–March time frame. Spawning appears to coincide with a period when plankton productivity increases. Sometime in late winter or early spring, large schools of herring enter shallow bays, estuaries, sounds, or sheltered inlets where they remain up to three weeks before spawning. Males and females school together and spawn simultaneously. Larger, older herring tend to spawn first. The fertilized eggs attach to various marine vegetations (e.g. eelgrass) in the inter-tidal and sub-tidal areas. Each large female can produce from 40 000 to 50 000 eggs in a year, which commonly hatch in ten days to two weeks. The eggs are vulnerable to predation by marine birds, other fishes and freezing during low tide cycles. Mortality is high (50 to 99 percent) at this stage. Those that survive migrate to the open ocean in summer or early fall, where they face other perils. It takes from two to five years for herring to reach maturity. Information on the life history of the Pacific herring in the open ocean is sparse.

Pacific herring have been exploited for centuries by fishermen for use as a fresh or salted food for humans and for bait in other fisheries. Herring are also important for other species, including salmon, sea lions and gulls. In the 1970s, herring from the waters off the West Coast began being marketed to Japan for their use as kazunoko (salted herring roe). These sales continue today.

The annual commercial harvest for herring in Yaquina Bay for its roe is timed to coincide with the annual spawning run in the Bay, which typically occurs sometime over the February-April period. During this time herring enter the Bay and congregate at various spawning locations (Figure 1). Commercial fishing for herring extends approximately five miles upriver from just below Newport Bridge.

FIGURE 1
Herring spawning locations in Yaquina Bay, Oregon



Over the years, Yaquina Bay herring fishermen have experienced wide fluctuations in run size. Such fluctuations have occurred despite state efforts to manage the fishery for sustainable harvests. The primary reason for this variation is that herring abundance is sensitive to habitat and other environmental conditions. Destruction of spawning habitat via man-made or natural causes can reduce herring production, as can unfavourable water temperatures and salinity (Lassuy and Moran, 1989). Survival at sea can be low during periods of warm ocean temperature. Because herring feed on plankton, which is

generally found in cold-water environments, an overall decrease in the herring population can occur when there is a substantial increase in ocean temperature. Such increases occur periodically in conjunction with El Niño events.

Historical data indicate that Yaquina Bay herring landings drop precipitously during or near each significant El Niño event (Table 1). Information on cold, normal and warm ocean episodes are provided by the National Weather Service Climate Prediction Center (NOAA n.d.). During the 1978–1981 period, annual landings ranged from 40 to 47 t. There was a sharp drop in landings to about 5 t in 1982. This decline coincided with the 1982/1983 El Niño. There was an increase in landings over the 1983–1986 period, with annual landings ranging from 57 to 72 t. A significant increase in landings occured over the 1987–1992 period, with landings ranging from 161 to 248 t. This period coincided with normal and cold ocean surface temperatures recorded during the 1988–1990 period, which was favourable to plankton production. Over the 1992–1993 period, ocean temperatures warmed and landings dropped by more than a half over the next few years. During the late 1990s, there was a significant decline in annual herring landings in the Bay, which coincided with the 1997/1998 El Niño. Because run numbers in the Bay were extremely low, no fishery occurred in 1999 and 2000. In 2001, a small total quota was fished with landings totalling 14 t. In 2001, an acoustic assessment in the Bay indicated the presence of a much larger spawning herring population, but the herring had already spawned and left the bay before fishing could commence. Failure to commence fishing in time appears to be due to the time taken to conduct a special herring survey in the Bay (Matteson, 2003a). A total quota of 126 t was set for the 2003 season by the Oregon Department of Fish & Wildlife. Herring landings totalled 93 t for the season. Poor ocean survival led to low numbers of herring returning to spawn in Yaquina Bay in 2004, 2005 and 2006 (Matteson, 2007). As a result, no commercial fishing for herring was conducted there during these years.

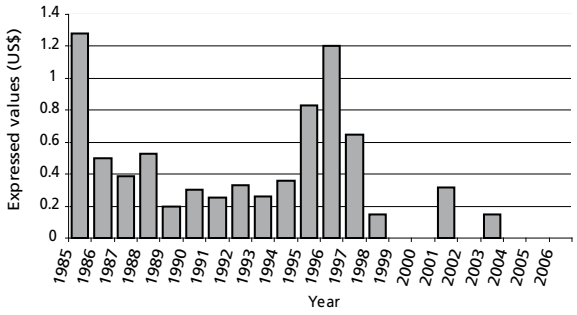
TABLE 1
Herring Landings in Yaquina Bay's Herring Roe Fishery, 1978–2006

Year	Landings (t)
1978	39.6
1979	45.3
1980	47.4
1981	41.3
1982	4.8
1983	55.0
1984	62.2
1985	71.4
1986	57.2
1987	222.4
1988	160.8
1989	247.5
1990	215.0
1991	191.5
1992	191.0
1993	74.1
1994	3.3
1995	48.7
1996	47.3
1997	49.9
1998	7.4
1999	(no fishery)
2000	(no fishery)
2001	13.9
2002	(no fishery)
2003	92.5
2004	(no fishery)
2005	(no fishery)
2006	(no fishery)

In addition to widely fluctuating herring abundance, Yaquina Bay fishermen have had to contend with dramatic price changes (Figure 2) for which there are a number of possible reasons. One is the Japanese economy, where most, if not all, of the demand for herring roe emanates. When the Japanese economy is growing and incomes are up, prices for herring tend to rise. When the economy performs poorly and incomes fall, prices for herring roe tend to fall. In addition, the final product, kazunoko, is a food that Japanese consumers consider a luxury and, as such, any change in income in either direction results in a greater change in its demand.

Another possible influence is the size of herring landings in the San Francisco Bay herring roe fishery. This fishery is located several hundred miles south of Yaquina Bay. Herring landings in this fishery total several thousand tonnes per year, compared to an average of nearly 90 t a year in Yaquina Bay. The San Francisco Bay fishery starts in December, two months earlier than the Yaquina Bay fishery and lasts through mid-March. Oregon herring fisherman Eugene Law (2003b) believes that when herring landings in San Francisco Bay are quite large, the price paid to Yaquina Bay fishermen tends to be lower due to a glut of herring on the market. In years with abnormally low landings in San Francisco Bay, the opposite effect on the Yaquina Bay herring price is believed to occur. While no statistical estimate of the extent of such an influence on the

FIGURE 2
Average price per pound of herring



Yaquina Bay herring price is available, this opinion seems plausible.

Another possibility is the roe content of the herring catch, the only factor under the control of Yaquina Bay fishermen. As an incentive, roe buyers pay a higher price if the roe content is above the target level. If roe content varies annually, then this may be another reason for fluctuating prices. Based on information that roe content was higher, on average, during the 1989–2006 period than during the 1978–1988 period (Law, 2003b), one might expect prices over the 1989–2006 period to be higher on average. But this is not the case (Figure 2). While roe content influences the ex-vessel price, it is not dominant enough to manifest such a trend.

3. HISTORY OF FISHING OPERATIONS

The Yaquina Bay herring roe fishery is affected by a number of state regulations. The fishery is the only commercial herring roe fishery allowed in Oregon's territorial waters. It appears that limiting the roe fishery to Yaquina Bay is a consequence of the state's limited resources for managing state fisheries (McCrae, 1994). Other herring fisheries in Oregon waters are allowed either for bait or for recreation, but their aggregate landings average less than 4 tonnes a year (McCrae, 1994). As it did from the start, the state sets the season's schedule and the total allowable catch in the Yaquina Bay herring roe fishery. In 2003, the season for commercial herring roe in Yaquina Bay ran from 1 February through 15 April, with the added restriction that roe herring could not be taken commercially from midnight Friday through midnight Sunday. The total allowable catch is set equal to twenty percent of the prior year's spawning biomass in Yaquina Bay. This biomass figure is estimated through a state-run survey of egg deposition in Yaquina Bay. In 2003, the state set the overall quota at 126 t based on estimated spawning biomass of 629 t in 2002 (Matteson, 2003b).

Fishermen are allowed to net herring until the conclusion of the season or until the total allowable catch in the fishery has been reached, whichever comes first. In contrast to the San Francisco herring roe fishery, which is limited to gill nets, gill nets are not allowed in the Yaquina Bay fishery. According to Eugene Law (Fisherman, Toledo, Oregon) a gillnet with a large mesh size has the advantage of being able to select only the largest herring, including large females with the highest roe content. But there is concern that the use of gill nets could restrict the gene pool of the herring population. In Oregon, the only legal gill net fishery is an indigenous one for salmon. Herring fishermen in Yaquina Bay are allowed to use hook and line or seines, but the gear of choice is either lampara or purse seines. Photo 1 depicts a lampara seine being used to net herring in the Bay. By state regulation, purse seines can be no larger than 50 fathoms (91 m) by 7 fathoms (13 m).

Fishing does not take place during the defined season until large schools of herring appear in the Bay and female herring in the schools have the desired roe content to meet buyer specifications. The rule of thumb is that roe content must be at least 10 percent of total fish weight (Matteson, 2003a). This determination is made through daily test fishing exercises. Each day, one or two fishermen net a small number of herring from various schools in the Bay and then weigh the females landed and their roe content to compute percent roe content. When test fishing indicates the target level is reached, actual fishing begins. In 2003, test fishing for roe content took place over the 3–10 February period and actual fishing began 10 February when the desired level was reached (Law, 2003a).

PHOTO 1
Fishing for herring using a lampara seine

KEITH MATTESON, ODFW AT-SEA RESEARCH/DEVELOPMENTAL FISHERIES

There is an incentive to land herring with the highest possible roe content. Buyers pay fishermen a bonus for herring with roe content above the target level. The industry standard is to pay fishermen a base price plus an additional ten percent of the base price for every percentage point that roe content is above ten percent. Thus, a roe buyer would pay herring fishermen $600 a tonne for landing herring with a roe content of 12 percent and a base price of $500 a tonne.

4. LIMITED ENTRY

In the early 1980s, there were ten Oregon fishermen participating in the Yaquina Bay fishery, an open access fishery at the time. The ten fishermen feared that leaving the fishery open access would eventually attract other fishermen and erode their profits (Law, 2003a). As a result, they urged the state to impose limited entry. The state did so in 1984 as part of a broader move to establish limited entry systems in several state-run fisheries during the 1980s. The state limited the number of permits in the Yaquina Bay herring roe fishery to ten and assigned them to the ten fishermen with catch history in the fishery. A permit is transferable from one vessel of the permit holder to another vessel of the holder. A permit holder can sell his permit to a fisherman outside the fishery, but the transfer requires state approval. No permit holder may hold more than one permit in the fishery, which prevents consolidation of permits on a vessel.

Before the start of the 1989 season, one fisherman decided to leave the fishery. He sold his permit to the other nine participants for an estimated $20 000 (Law, 2003b). The jointly held permit proved to be an important factor in the eventual formation of a private harvest agreement and co-op by the other nine fishermen.

5. THE AGREEMENT AND CO-OP

After several years under limited entry, the nine remaining participants decided that they wanted to go further in controlling fishing activity. Under limited entry and a total allowable catch, each participant tried to catch as many herring as quickly as possible before the total allowable catch was reached and the season closed. With this pattern, there was increasing pressure on the participants to invest in costly upgrades of vessel and gear. By one account, participants were under pressure to own both lampara and seine gear (National Marine Fisheries Service 1991). Given the modest and highly fluctuating run size of herring in Yaquina Bay and unstable prices, the participants believed that such costly investments were unacceptable.

Other factors also made the competitive fishery untenable. Preventing overfishing in the competitive fishery was becoming increasingly difficult. Greater gear sophistication and more vessels on the water at one time were already creating problems. In 1984 and 1985, when Yaquina Bay herring runs were slightly below average, landings exceeded the overall quota by 7 and 16 percent, respectively (Matteson, 2003b). With evidence

that the total allowable catch was being exceeded, the nine participants believed that the state would come under increasing pressure from other interests to close the small fishery (Law, 2003b). The hectic pace of fishing was also causing operational problems. It was not unusual for the season to end in a matter of hours because fishermen had harvested the season's total allowable catch (Law, 2003a). Under such a compressed season, an equipment breakdown on opening day spelled financial disaster and each of the nine fishermen had experienced such a disaster. Safety was also sacrificed; if a storm was forecast, a fisherman might lose his share of the season's catch if he stayed ashore while others ventured out. The race for fish meant that fish was of lower quality because fishermen landed every fish they netted, including immature ones with little roe. This lowered the value of the catch by as much as 20 to 25 percent (Law, 2003a).

In 1989, the nine fishermen agreed to individual shares in the total allowable catch for each of the next three years. Each fisherman agreed to try to catch one-tenth of the total allowable catch. To allow for a margin of error, landings that exceed the combined quota of the nine fishermen are allocated to the quota associated with the tenth permit that is jointly held by the nine fishermen. To facilitate administration of the private agreement, the nine fishermen formed a nonprofit, Chapter S Corporation called Yaquina Herring, Inc. (YHI), essentially a producer cooperative. According to Law (2003b), YHI serves the primary purpose of assuming joint ownership of the tenth permit and any overage that is allocated to the tenth permit. Earnings from the quota held by YHI are devoted to funding activities that contribute to fishery health, such as funding an assessment of the herring stock in the Bay.

6. RESULTS UNDER THE AGREEMENT

The agreement has alleviated the race for fish that plagued the fishery under the old regime. Seasons that lasted only a few hours have disappeared. Fishermen can now choose the most opportune time to fish, such as when roe content is higher. Law (2003b) estimates that roe percentage in herring landings has averaged between 12 and 13 percent since 1989, the inaugural year of the agreement. Prior to the agreement, Law estimates that roe percentage averaged slightly less than ten percent. When immature fish with low amounts of roe are netted, fishermen can now safely return them to the Bay to mature in approximately seven days and enhance the stock. Fishermen find it easier to balance the herring fishery with other fishing activities, such as crabbing and shrimping. Equipment breakdowns are no longer a catastrophe as they were before individual quotas.

On the cost-saving side, there is no need to invest in periodic gear and vessel upgrades because fishermen are no longer competing to catch the largest share of the total allowable catch. Savings have also resulted from economies of scale as fishermen have co-operated to catch their shares. For example, one of the fishermen who previously brought his larger vessel down the coast to fish no longer does so. Instead, he uses a skiff to net herring and has an agreement with another fisherman to off-load his catch. There are far fewer vessels, gear and labour than there were prior to the 1989 agreement. Prior to the agreement, Law (2003b) estimates that the hectic pace of fishing typically entailed the use of 8 to 10 catching boats to net herring and another four packing boats. Landings averaged about 81 t a season over the 1980–1988 period. After the agreement, Law (2003b) estimates that cooperative fishing typically entailed the use of three catching boats and another two packing boats (Law, 2003b; Matteson, 2003a). Landings averaged about 99 tonnes over the 1989–2003 period, above the average for pre-agreement period.

Harvest and stock management appear to be better as a result of fishermen cooperation. State fishery managers are pleased with the programme because it helps keep the actual catch in line with the total allowable catch. During years of poor runs in the Bay, the nine fishermen tend to be "quite conservative" and want managers to set the

total allowable catch carefully to protect the resource for the future (Matteson, 2003a). The agreement has also led to investments by fishermen in research on Yaquina Bay's herring stock. In 2002, for example, the nine fishermen used funds from the tenth permit to pay $6 500 to BioSonics, a research firm, to conduct an acoustic assessment of herring numbers in the Bay during spawning (Law, 2003b). The state of Oregon contributed another $1 000 for the assessment. For this effort, the fishermen also donated their time and vessels to help locate schools of herring. One of the fishermen donated the use of his vessel as a platform for BioSonics' measuring equipment. The resulting estimate of herring numbers assisted in developing the following year's overall herring quota (BioSonics, 2002). As the state of Oregon had insufficient for resources to manage state fisheries in recent years, investments such as this by the fishermen are good news for the future health of the herring stock.

7. DISCUSSION

An important question to ask is, what factor(s) contributed to the Yaquina Bay agreement? One factor is the small number of participants. A small group lowers the cost of reaching an agreement and lowers the cost of monitoring the agreement. Notably, there does not appear to be any enforcement concerns in the fishery under the agreement. There have been periodic individual overages, but they have not surpassed the amount allocated to the jointly-owned tenth permit. The absence of enforcement concerns appears related to the high level of cooperation among the nine fishermen in sharing fishing inputs. Given such cooperation, fishermen tend to know who catches what (Law, 2003b). Interestingly, when the nine fishermen made their initial agreement, they were able to come to terms despite differences in fishing ability. Prior to the 1989 start of the programme, two of the nine fishermen were catching 30 percent of the total catch while the others caught roughly ten percent each.

Apparently an agreement to share the catch equally was expected to produce enough benefits in terms of lower financial risks, more operational flexibility to fish and higher roe percentages to satisfy everyone. All members, including new recruits, possess one important trait, which contributes to maintaining the agreement. All participate in other state fisheries and have other sources of income. The herring roe fishery, while it is profitable, is not critical to the financial well being of the participants (Law, 2003b). Of course, financial well-being would be adversely affected if competition returned and costs escalated for the fishermen. As a result, the fishermen want the fishery to continue as a cooperative effort.

California's San Francisco Bay herring roe seine fishery, with 42 permit holders, provides an interesting contrast to the Yaquina Bay herring roe fishery. Beginning with the 1982–83 herring season, the 42 permit holders agreed to an individual quota programme to overcome the rising costs of competition and low roe recovery rates. With the support of the California Department of Fish and Game, they agreed to allocate shares of their overall quota among themselves. As in Oregon's Yaquina Bay herring roe fishery, the shares are divided equally among the forty-two participants, but there is not an extra permit to cover overages in landings. The permits can be bought and sold.

As with the Yaquina Bay fishery, the private agreement led to successes. It enabled fishermen to land fish with higher roe percentages. It also gave fishermen greater operational flexibility. For example, herring fishermen who also fished for squid did not have to be on the herring grounds at the opening. The pressure on Washington-based fishermen to reach the fishery on opening day, despite poor weather conditions, was reduced. Overall, fishermen were pleased with the benefits from the programme (Maxwell, 1992).

With the higher number of participants, enforcement was imperfect but state officials noted that violations were not serious. Cases of high-grading and fish smuggling by

some fishermen were reported by other fishermen in the early 1990s, but state managers thought they had more significant enforcement problems with the San Francisco Bay gill net herring fishery, which has an overall catch limit without individual quotas.

Unfortunately, despite its success, the private agreement among the 42 participants could not overcome governmental interference. The use of purse seine and lampara nets was outlawed by the state of California in the mid–1990s and all 42 permits were converted to permits in San Francisco Bay's gill net herring roe fishery (Ashcroft, 2002).

For the gill net herring fishery in San Francisco Bay, which had 430 permits in 2002, a private agreement over individual shares of the catch appears unlikely (California Department Fish and Game, 2002). Susan Ashcroft (2002), San Francisco Bay herring fishery manager for California Department of Fish and Game, states that there exist "huge ranges in catches between individual boats" and the fishermen "like to compete." But there are other factors. The gill nets used have a mesh size that snares only large mature females with high roe percentages. Compared to the Yaquina Bay seine fishery, which is less selective, the gain from timing their catches better without competition is not as great in the gill net fishery. Fishing is structured to extend over a long enough period to allow for the availability of mature females with high roe content. The fishery is divided into three platoons, each with a fleet quota set by state managers based on the previous year's biomass estimate. The "DH platoon," with 133 permits, fishes in December. In January, the "Odd" and "Even" platoons, with 150 and 147 permits respectively, are rotated into the fishery on a weekly basis. Once those fleets have reached their quotas, the DH platoon is allowed to return and can land any of its remaining quota until the end of the season.

Another critical difference is that, while the fishery is subject to the same low roe prices as the Yaquina Bay herring roe fishery experiences from poor economic conditions in Japan, its total landings are typically more than forty times larger than the Yaquina Bay fishery. This may help ameliorate the risks of investing in the San Francisco Bay fishery, although they certainly still exist.

The Yaquina Bay agreement has proven resilient to widely fluctuating resource and market conditions and to recently lower economic prospects. Despite fluctuating stocks and demands, the agreement has been renewed every three years since 1989. Two of the original 1989 participants sold their permits to two new fishermen, but these sales have not prevented the agreement from being renewed every three years. The new entrants signed onto the agreement and are members of the co-op. Neither weak roe demand nor a lower return in recent years has been grounds for ending the agreement. Law (2003b) estimates that a permit sale today would probably bring a lower price than the estimated $20 000 received for the permit sold just prior to the agreement in 1989. But he contends that everyone wants to continue the agreement. In fact, there is now discussion among fishermen to make the agreement permanent.

In economic terms, the benefits of continuing the agreement outweigh the costs. All nine fishermen participate in other fisheries, including more lucrative Oregon crab and shrimp fisheries. By not having to be on the herring grounds at the outset of the season, the fishermen have greater freedom to participate in these other fisheries. While not a dominant factor, the ability to time harvests to obtain a higher roe percentage is still important. Cost savings are also contributing to continuing the agreement. Given the uncertain conditions in the fishery, fishermen appreciate that they do not have to make costly upgrades to compete and can save on inputs by teaming up with one another on their catch. They also believe the fishery would not continue as a competitive fishery. Either it would be too costly, or it would be closed by the state because of the inability to prevent overfishing.

To be sure, there are challenges ahead. A stagnant Japanese economy and shifting tastes have dampened the demand for herring roe for the time being. And, improved

biological assessments of the Yaquina Bay herring stock are needed to enable the fishery to have a reliable total allowable catch. Fortunately, the agreement allows fishermen the flexibility and opportunity for collective investment to meet these challenges.

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