

Institutional Analysis of Port Phillip Bay Scallop Fishery, Victoria, Australia

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1. Part I: System Structure - Collective Action

Port Phillip Bay is a large bay in southern Victoria, Australia. The bay covers about 1,930 square kilometers and has a maximum depth of 24 meters, with half the bay being shallower than 8 meters deep. The original case, published in 1982, catalogues the management of both Port Phillip Bay and nearby Lake's Entrance fisheries following a decline in scallop stocks in the early 1970s. The action situation involves approximately 79 fishermen; scallops are the resource unit.

This case study is part of the original Common-Pool Resource (CPR) database. A summary of the original CPR coding conducted in the 1980s by Edella Schlager and Shui Yan Tang at Indiana University may be found [here](#).

1.1 The Commons Dilemma

The Port Phillip Bay scallop fishery was overfished less than a decade after resource extraction began in 1963 due to a lack of regulation. This original decimation of the scallop population, combined with dredging of the ocean floor that destroyed vital scallop habitat, contributed to later stresses on the resource. The scallop has become an increasingly scarce resource with high extractability.

The state government responded to this initial overharvesting by implementing a number of new management strategies to limit scallop fishing efforts in the bay, including the exclusion of non-licensed fishermen from the fishing grounds. However, there are likely too many fishing licenses allocated for Port Phillip Bay, and the government is unwilling to implement direct limitations on the number of licenses, instead relying on fishermen to voluntarily withdraw their licenses or lose them due to inactivity. This reluctance on behalf of the government to limit fishing licenses represents a potential under-provisioning of soft public infrastructure in managing the scallop fishery.

Additionally, some fishermen received licenses for Port Phillip Bay only, while others were licensed to fish in all Victorian waters, including both Port Phillip Bay and Lakes Entrance. This means that the potential overharvesting of scallops will impact the Port Phillip Bay-only license group more than the group that could fish in all Victorian waters. This allows license holders with access to all Victorian waters to free ride to some extent, because they do not have as much incentive to adhere to the rules as fishermen with access only to Port Phillip Bay.

1.2 Biophysical Context (IAD)

The **natural infrastructure** in Port Phillip Bay includes the bay itself and the resource unit, scallops. The bay includes 1,930 square kilometers of coastal marine habitat for scallops. The well-defined boundaries of the bay makes the fishery a closed population, which should lend itself well to resource monitoring. The commercial scallop, *Pecten alba*, can be found below depths of about 7.5 meters in the bay. The scallops live on seabeds ranging from fine silt to coarse grain sand, but are not found on reefs or weed beds. Their life span is about 12 years, and spawning occurs in the second year of life between August and November, induced by rising sea temperatures. Their only known predator, aside from humans, is the spiny starfish (*Conscirasteria calameraia*).

The **hard human-made infrastructure** includes equipment used for fishing, primarily boats and dredging equipment. A dredge is a chain mesh net that is dragged along the seafloor to collect scallops.

1.3 Attributes of the Community (IAD)

There are 79 fishermen licensed to fish in Port Phillip Bay, 23 with licenses exclusively for the bay and 56 with licenses for all Victorian waters. The division of license holders into three groups was intended to address the management goals of sustainable yield and satisfactory income for fishermen. The Fisheries & Wildlife Division (FWD), who issues the licenses, believed that having only two groups of fishermen, each with access to only one fishery, could potentially hurt both the fishery and the fishermen. Having a third group, with access to both fisheries, meant that some fishermen could move between the two locations depending on scallop abundance, which would ease pressure on overexploited areas and ensure that all of the fishermen could catch enough to support their livelihoods. This licensing system has created close ties between the Port Phillip Bay and Lakes Entrance fisheries, because those 56 fishermen with licenses for all Victorian waters may use either fishery. This means that conditions in one fishing area will affect the other fishing area, with the 56 fully-licensed fishermen seeking the best spots and moving between Lakes Entrance and Port Phillip Bay.

Restrictions on licenses has led to a number of social developments within the fishing community. Fishermen may not formally sell their licenses, although they often transfer licenses when selling their boats, which has created an informal de facto market for fishing licenses. Additionally, the government requires that a fisher who has not been “actively, regularly and substantially engaged” in her fishery must formally defend herself or lose her license. This could have the perverse effect of encouraging fishermen to increase their fishing efforts in order to defend their licenses, adding unnecessary additional strain to the fishery.

1.4 Rules in Use (IAD)

Position Rules:

- The *Fisheries & Wildlife Division (FWD) Ministry for Conservation* has jurisdiction over marine fisheries in Victoria.
- The *Fisheries Management Committee*, comprised of representatives of fishermen in the various fisheries and the FWD, advises the Minister and Director of the FWD on management matters.
- *Individuals* who can afford the licensing fees to fish for scallops are permitted entry to the Port Phillip Bay scallop fishery.

Boundary Rules:

- There are 3 types of scallop fishing licenses in Victorian waters: Port Phillip Bay only, Lakes Entrance only, and all Victorian waters. Fishermen must possess the appropriate license to extract scallops from Port Phillip Bay.
- Fishermen who are not considered actively and substantially involved in their fishery are required to “show cause” for why their licenses should not be cancelled.
- No formal market for license exchange exists, but fishermen have created an informal market wherein licenses are transferred along with sales of boats.

Choice Rules:

- Fishermen with licenses may choose to:
 - Actively use their right to fish
 - Defend their right to fish if challenged by the government for being inactive
 - Voluntarily withdraw their licenses
 - Transfer their licenses with sale of their boats

- During closures of the Port Phillip Bay fishery, fishermen may choose to either: a) take up other occupations during the closure, or b) retire from fishing completely, since their occupation cannot be supported year-round.

Aggregation Rules:

- No available information on aggregation rules.

Scope Rules:

- The maximum allowable dredge size is 3.36 meters.
- Fishermen may catch up to 10 bags per day in Port Phillip Bay.
- There is no limit on the size of scallop that can be caught.
- Fishermen may only fish between 5am-5pm.
- The fishery is closed from mid-December to early April, with other closures implemented as necessary.

Information Rules:

- No available information on information rules.

Payoff Rules:

- The FWB may take away licenses if fishermen cannot prove that they are actively involved in the fishery.
- Fishermen must pay a license fee of \$8.00 per every 10 centimeters of dredge width.

1.5 Summary

The Australian government implemented a number of management strategies to address the overexploitation of scallops in Port Phillip Bay in the early 1970s. These strategies include license allocations, limits on seasons and times that fishermen can harvest scallops, limits on the size of dredges used in the bay, and limits on the number of bags a fisherman can harvest daily. However, the total number of licenses still potentially allows too many fishermen to extract scallops from the bay, which would make all additional management strategies less effective as well. The government needs to implement rules that more directly limit the number of fishing licenses, rather than waiting for current license holders to voluntarily give up their licenses.

Port Phillip Bay is more heavily regulated than the nearby Lakes Entrance scallop fishery. The Lakes Entrance fishery has no limitations on scallop size, fishing season, or fishing hours, and has a daily catch limit five times higher than that of Port Phillip Bay. Both fisheries are managed by the Fisheries & Wildlife Division, but the differences in regulation are likely a result of Port Phillip's Bay historical over-extraction of scallops and its smaller size and stricter boundaries.

2. Part II. Dynamic Analysis – Robustness

This update to the Port Phillip Bay scallop fishery case was made in 2015 by Danielle Chipman at Arizona State University. In-text parentheses indicate corresponding links in the system representation on the SES library.

2.1 Update on the Commons Dilemma

The Port Phillip Bay scallop fishery has been closed to commercial fishermen since 1997, but is still open to recreational fishermen. The fishery collapsed again in 1990, after years of wildly fluctuating and

eventually decreasing abundances of scallops. Abundances in all three Victorian scallop fisheries – Port Phillip Bay, Lakes Entrance, and Bass Strait – declined between 1987 and 1991, increased until 1994, and then dropped again dramatically. After the closure of Port Phillip Bay, the other two fisheries were combined into one fishery, “Ocean Scallop”, and a quota management system was introduced in 1998.

At the time of closure, the management strategies had changed since the situation detailed in the original case study in 1982. The number of licenses had increased slightly, from 79 to 84 licensed boats, despite concerns voiced by the original case author that there were already too many licenses for the bay. The maximum allowed dredge size increased from 3.36 meters to 4.4 meters. Fishing was permitted only 4 days a week, from Monday through Thursday between 5 a.m. and 5 p.m. during the fishing season. The fishing season still generally ran from April through December, but was adjusted according to the scallop population as necessary. Fishermen had daily catch rates, and all boats were given the same limit. These catch rates were variable, and tended to be set higher in July-October, during times of peak abundance. This differs from the management strategy in 1982, where fishermen had a fixed catch rate rather than a variable one. On-board monitors were now assigned to boats, and they had the power to close the fishery if more than 20% of dredged scallops were discarded or if the average number of meats per kilogram exceeded 120. Lastly, measurements of scallop abundance were made by independent dredge and diver surveys, rather than using commercial scallop dredges.

2.2 Shocks, Capacities, Vulnerabilities...

... to and of the Resource (link 7 to R)

A number of factors have changed environmental conditions in Port Phillip Bay, making it potentially unfavorable to scallops. Dredging has disturbed the seafloor, causing a loss of habitat for scallops and other creatures, and leading to changes in the types and abundances of fauna in the ecosystem. Overfishing has led to the decline of numerous other fish species as well, including abalone, rock lobster, calamari, anchovy, flathead, and pilchard. At the same time, several new alien species have been introduced, including the Northern Pacific Seastar in 1995 and the European Fanworm in 1992. Increased sediment, nutrient, and pollutant discharge from nearby Melbourne has changed the composition of bay waters. All of these rapidly changing environmental factors may have had an impact on the health of the scallop population.

... to and of the Public Infrastructure (link 7 to PI)

Insufficient information to determine shocks to public infrastructure.

... to and of the Public Infrastructure Providers (link 8 to PIP)

The population of the Victoria region has been steadily increasing since 1982, which has likely increased pollution to the bay and thus created unforeseen environmental stresses for the fisheries managers to contend with.

... to and of the Resource Users (link 8 to RU)

Insufficient information to determine shocks to public infrastructure.

2.3 Robustness Summary

Despite several changes to the public infrastructure governing the extraction of scallops in Port Phillip Bay, the scallop fishery collapsed in 1990 and was subsequently closed to commercial fishermen, suggesting that the system was not very robust. The reasons for this decline in scallop abundance are

unclear, but may include an over-allocation of fishing licenses, environmental degradation of the bay, or insufficient soft public infrastructure to guide resource extraction behavior.

The fishery's closure is surprising given the seemingly positive changes made to the management system after 1982. There were already many positive aspects of the original pre-1982 management system, such as clearly defined boundaries (the licensing system) and collective-choice arrangements allowing for fishermen participation in management decisions (the Fisheries Management Committee). After 1982, monitoring improved, with on-board monitors now assigned to boats. This means that there would likely be more accurate counts of scallop hauls. Additionally, the fact that the fishermen and monitors worked in close contact would likely improve trust and accountability towards one another. Another big change was the switch from a fixed catch rate to a variable one, which would ideally create a feedback mechanism to make the fishermen more aware of the current state of the fishery. For example, if the catch rate decreased suddenly, fishermen would be alerted to a potential population decline, which might influence their behavior.

The effect of the switch from commercial scallop dredges measuring scallop abundance to independent contractors doing so is difficult to determine. On one hand, the independent contractors would be more unbiased in their assessments of scallop populations, because they have no vested interest in the health of the fishery. On the other hand, having commercial scallop fishermen perform the assessments might have increased the accountability of those fishermen and the trust other fishermen placed in the population estimations. Thus, the effect of employing independent contractors for monitoring may have had a positive or negative impact on the fishery.

The Ocean Scallop fishery (which includes the former Lakes Entrance fishery) is still open to fishermen, which provides an interesting comparison to Port Phillip Bay. Both fisheries were managed by the same public infrastructure providers, the Fisheries & Wildlife Division, and had similar rules and interconnected actors, although the regulations governing Port Phillip Bay were much stricter. Both sites fished the same resource, scallops, so many of the resource characteristics were the same, and the few that differed suggested that Port Phillip Bay would be more easily managed. For example, Port Phillip Bay had more clearly defined boundaries and a smaller scallop population than Lakes Entrance, making the resource easier to monitor.

The most likely explanation is that Port Phillip Bay was never allowed to recover from the original overextraction of scallops in the 1960s. Although the licensing system restricted the number of fishermen allowed to participate, the number of licenses was likely too high. Additionally, the environmental damages from dredging and pollution destroyed the scallops' habitat. All of these factors combined to make an unfavorable environment for the scallops. Although the FWD attempted to change the rules in response to fluctuating scallop populations, they were unable to implement an effective set of regulations before the fishery collapsed.

3. Case Contributors

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