Gordon 1954 is the classic work describing what is nowadays referred to as open access. According to Gordon, when access to a fishery is free, fishing will increase to the point that economic overfishing will occur, that is, more inputs will be used to catch the fish than what would have been used at the optimal level. The optimal level is when the value of the marginal productivity is equal to the marginal cost of providing it. Because access is free, fishing will expand beyond the optimal level until the value of the average productivity is equal to the marginal cost. The rent that the fishery could yield is thus completely dissipated by the competition of too many fishermen.

The Danish economist Jens Warming (1911b) derived the same results in an article some forty years earlier, which is available in a translation by Peder Andersen (1983). Warming’s article, written in Danish, did not reach an international audience at the time. Also, he did not succeed in convincing Danish policy makers to consider his economic arguments for keeping the existing property rights when regulating Danish fisheries. Twenty
years after his 1911 article, Warming again weighed in on an open-access controversy. In 1931, Danish fishers demanded that the right to eel weir be abolished. In general, at the beginning of the fishing season, fishers would race for the most attractive fishing grounds and establish rights to the grounds by placing their nets and traps there. The right to eel weir interfered with that process. In the case of fishing grounds that historically were the site of eel catches, the right to eel weir allowed owners of coast lands to stake out an area extending from the shoreline that they alone could fish. It prevented a fisherman from claiming for the season a fishing ground that extended to the shoreline of coastal property he did not own. The right also permitted coast owners to charge a fee for the right to fish with eel weirs near their coast. Warming (1931) reconsidered the issue and wrote a second article as a response to the demand of the fishers. In that article he affirmed his support of the right to eel weir, hence opposing the position of the fishermen; in the process he further developed his 1911 analysis and provided additional insights. The debate in 1931 faded away, leaving the law unchanged, but when the debate was revived in 1955, the economic arguments were still ignored and the Danish parliament abolished the right in 1956 (Topp 2008).

As Warming himself explained, the 1911 article was an unexpected spin-off from a book he had written on wages and interest, and it and his 1931 article were the only pieces he wrote on fisheries economics; the general view has thus been that this area was of minor importance to Warming. However, in a diary entry not long before his death, he indicated his disappointment that his mentor Harald Westergaard, a leading professor of economics in Copenhagen at the time, had failed to recognize the importance of the 1911 article, and he suggested that Westergaard’s failure was one of the reasons he (Warming) was denied the chair in economics in 1911 (Davidsen 1999). Furthermore, Niels-Henrik Topp (2004) has called our attention to unpublished manuscripts from the 1920s in which Warming returns to and refines the analysis of fisheries; Topp reports that Warming actively tried to communicate his views on fisheries not only to other colleagues but also to leading marine biologists, politicians, and journalists. In short, fisheries economics was more important to Warming than has been traditionally thought.

This article deals with Warming’s contribution to fisheries economics, the historical context of fisheries management and externalities at the time, and why he failed to influence Danish policy makers and to reach a scientific and international audience. It concludes with a translation of his 1931 article “Aalegaardsretten” (“The Danish Right to Eel Weir”).
Fisheries Management and Market Failure in Late-Nineteenth- and Early-Twentieth-Century Research

In his inaugural address at the 1883 London fisheries exhibition, Professor Thomas Henry Huxley, famous for his defense of Darwin’s evolutionary ideas, dwelled upon whether fish are exhaustible and concluded the following:

I believe, then, that the cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery, and probably all the great sea fisheries, are inexhaustible; that is to say, that nothing we do seriously affects the number of the fish. And any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless. (Huxley [1883] 1998)

This view was gradually challenged. At the end of the nineteenth century, the leading fisheries biologists, at the time in Northern Europe, had started to worry about a decline in fish stocks in the Baltic Sea and in the North Atlantic, which led to the formation of the International Council for the Exploration of the Sea (ICES) in 1902, with headquarters in Copenhagen. The council’s objective was to work on practical fisheries problems and to serve as a multidisciplinary forum including all disciplines related to marine sciences (Rozwadowski 2002). The Danish marine biologist C. G. J. Petersen (1903) published a paper on the biological aspects of overfishing; according to Petersen, stocks could be depleted, as clearly demonstrated by the case of a marine mammal, the North Pacific fur seal. During the nineteenth century several million animals were harvested by Russians and later by Americans, which resulted in severely depleted stocks and led to the formation of the North Pacific Fur Seal Commission and a treaty that prohibited pelagic sealing in 1911 (Wilen 1976). Still, the scientific underpinning for regulations was poor, and the public pressure to continue fishing was strong, leading to only modest harvest regulations (Lackey 2005). The focus was still on biology, while the fishermen’s incentive to (over)fish was ignored. In 1930, Canada and the United States formed the International Pacific Halibut Commission, which adopted the scientific recommendations and became the first major experiment in the scientifically based management of a harvestable surplus (Wilen and Homans 1998). In the 1950s, which saw the birth of both modern fisheries economics (Gordon 1954; Scott 1955, [1955] 1983) as well as modern fisheries biology (Schaefer 1954; Beverton and Holt 1957), the social sciences started to slowly influence the field of fisheries management.
Turning back to the 1920s, the marginal revolution had completely permeated the field of economics. Arthur Pigou ([1920] 1932) is generally seen as the founder of the concept of external costs, but several important contributions were made by economists before Pigou. Steve Medema (2007) particularly stresses the role of John Stuart Mill and Henry Sidgwick in formulating a theory of market failure, with Sidgwick distinguishing two general categories in which private and social interests diverge: “those where laissez-faire’s wealth maximizing results are not in society’s best interest because there is more to life than wealth, and those where laissez-faire does not even generate the wealth-maximizing result” (346). The first category does not relate to Warming’s work on fisheries, but for the second the link is evident. Sidgwick ([1883] 1901, 410) explicitly referred to fisheries in his *Principles of Political Economy*:

Take, for instance, the case of certain fisheries, where it is clearly for the general interest that the fish should not be caught at certain times, or in certain places, or with certain instruments, because the increase of actual supply obtained by such captures is much overbalanced by the detriment it causes to the prospective supply.

This is part of a general concern that laissez-faire fails to meet the interests and needs of future generations due to self-interested agents’ not fully accounting for the social impact of their actions. In addition, Sidgwick also refers to fisheries regarding another concern of laissez-faire, the incentive to cheat (Medema 2007):

It would be palpably rash to trust to voluntary association for the observance of the required rules of abstinence; since the larger the number that thus voluntarily abstain, the stronger becomes the inducement offered to those who remain outside the association to pursue their fishing in the objectionable times, places, and ways, so long as they are not prevented by legal coercion. (Sidgwick [1883] 1901, 410)

In part 2 of *The Economics of Welfare* Pigou ([1920] 1932) introduces externalities with the example of uncompensated damage to forests by sparks from railway engines. He then provides what in principle remains the definition of an externality:

One person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons (not producers of like services), of such a sort that payment cannot be exacted from the benefited par-
ties or compensation enforced on behalf of the injured parties. (pt. 2, chap. 9, para. 10)

His core message was that if the private marginal net product deviated from the social marginal net product, then inefficiencies would ensue, and that the inefficiencies could be ameliorated by government intervention in the form of such devices as a tax. Pigou also wrote on fisheries:

This same slackness of desire towards the future is also responsible for a tendency to wasteful exploitation of Nature’s gifts. Sometimes people will win what they require by methods that destroy, as against the future, much more than they themselves obtain. . . . fishing operations so conducted as to disregard breeding seasons, thus [threaten] certain species of fish with extinction. (pt. 1, chap. 2, para. 5)

Both Pigou and Sidgwick are concerned about future generations and worry that self-interested agents may fail to give future benefits the appropriate weight, implicitly due to a higher private than social discount rate. However, Pigou and Sidgwick fail to recognize the fundamental problem in fisheries: because nobody owns the sea, there is no one to prevent too many fishermen from fishing in too small an area, and when that happens, the opportunity to earn an economic rent will be lost.

**Fisheries Economics according to Jens Warming**

In 1911 Warming wrote a book in Danish, *Wage and Interest*, that was part of an attempt to apply for a vacant chair in economics at the University of Copenhagen. The core idea, reflecting the marginal revolution, was that in a competitive economy a worker earns a wage equal to the value of his marginal product (Warming 1931). He also gave examples when this did not hold. Fisheries were one. If there were too many fishermen fishing in too small an area, the marginal product could be lower than the wage, due to the problems that occurred from, in Warming’s words, a “lack in the organization of society.” According to Warming these exceptions influenced only minor parts of the economy and did not undermine the theory of marginal productivity as the general wage determinant (Topp 2008). The fisheries exception led to the article “On Rent of Fishing Grounds,” a progression that initially seems to have been a coincidence, but responses both from the fishermen’s newspaper and from hydrological scientists convinced him that his ideas had practical relevance too (Warming 1931).
The contribution of the first article by Warming (1911b) can be summarized as follows:

- Under open access, the potential rent in a fishery is dissipated.
- Biological regulation, e.g., closed seasons, can prevent biological overexploitation but not economic overexploitation.
- Regulation of the fishery by use of fishing licenses in order to maximize total production (maximum sustainable yield, MSY) will not maximize total rents of the fishery.
- The economic optimal level of effort is at the point where marginal revenue is equal to marginal cost.
- A tax equal to the difference between average and marginal revenue at the level of optimal effort will lead to an optimal fishery.

Despite his effort, Warming did not attain the professorship in economics, due to what seems like a mixture of personal conflicts and his lack of formal training in economics resulting in an absence of references to the existing literature in his work.\(^1\) Warming tried to get tenure as an associate professor in 1903 and 1908, competing with the later well-known Danish economist L. V. Birch, but failed despite support from his mentor Harald Westergaard. Birch was awarded tenure in 1908, received a professorship in early 1911, and did not support his former competitor Warming later that year. Westergaard did not manage to get support for Warming, and another of his previous students, Axel Nielsen, got the professorship.

Warming wrote in his diary that Nielsen’s work, being full of references, seemed to be appreciated and later, in 1924, made a bitter remark implying that his 1911 failure was due to the paucity of references in his own work, a work that also was seen to have too much focus on real-world problems (Davidsen 1999). In 1919 he became professor of statistics at the University of Copenhagen, but he continued to focus on economics, and a couple of years later he started to write a textbook in economics. One chapter dealt with the “flaws of competition” and included a reference to the fisheries example but also provided a rather unique, almost comprehensive survey of classical welfare economics. The project met resistance among his economics colleagues, who believed that statisticians should not write textbooks, further fueling the bitter dispute with his colleagues. Warming finally completed a handwritten manuscript in 1924, but the book was never published (Topp 2002).

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1. Davidsen (1999, 2001) provides extensive treatments of Warming’s failure to get a professorship in economics.
In 1926 Warming submitted a 230-page essay to an international competition on the theory of wages. Again, he studied forces determining the wage level and cited the fisheries example as one exception to the general finding, and now provided a revised version of the 1911 article. He did not win but received an “honorable mention” from the committee. The recognition from his foreign colleagues may have been a further inspiration to reach an international audience for Warming, and in 1932 his work on the multiplier process appeared in the *Economic Journal*. Later on, Warming did publish a textbook on Danish statistics (1929) that applied an economic perspective and was used by students in economics all over the country for more than a decade. Teaching economic theory was not Warming’s task, but he partly disregarded that: he had several chapters that criticized mainstream economics, and he presented some of his own theoretical contributions including the fisheries example, which he also revised for the second edition (1938) that came out a year before he died (Topp 2008).

In 1931 Warming’s second article on fisheries was published in the *Journal of the Danish Economic Association*. He reinforced several of the points previously made, and as shown by Topp (2004) he clarified ambiguities that existed in previous texts in addition to introducing some additional features:

- The right of a coastal owner to charge a fee for fishing rights in the waters near the coast will have a regulatory effect, one that corresponds to the property right of land.²
- The right of the owner to regulate entry will prevent entry of excess fishers, and the owner’s goal of maximizing his own income will lead him to set a fee that will maximize the rent, which is earned when the optimal number of fishers is exploiting the fishing ground.
- Free access to the fishery can even lead to a negative marginal product, i.e., too many fishers catch too many young fish, leaving too few to grow and use the available feed.
- Even in times of high unemployment, it is better to keep superfluous fishers away from fishing.

Warming (1911b, 1931) provided early modern references to the problem of open access. He also preceded Pigou ([1920] 1932) in suggesting an optimal tax as a corrective measure—a Warming landing tax in fisheries,

² This is similar to what Coase (1960) said some decades later in “The Problem of Social Cost.”
The efficiency of the Warming landing tax was later proved by Gardner Brown (1974) and was recently revived in the context of uncertainty by Martin Weitzman (2002). What is missing in Warming’s description of the problem is the dynamic aspect and the fact that the economics of natural resources should be analyzed in a capital theoretic framework, which was later established by Anthony Scott (1955, [1955] 1983). The investment rule in modern fisheries economics stipulates investment in the resource until the marginal value of investment is equal to the social discount rate (SDR). Unlike Pigou and Sidgwick, Warming was not concerned about future generations, or the specific problem of achieving the social optimum of a fishery, which otherwise could have led him to consider also the dynamic aspects of fisheries.

The Great Depression hit Denmark in the last quarter of 1930 and unemployment was high. Still, Warming (1931) argued strongly against using fisheries as a recession employment opportunity for two reasons. First, extra fishers (those in addition to the optimal number) would impose an external cost on the “optimal” fishers and dissipate the potential rent. Second, there would be a negative dynamic effect due to inertia. When the upsurge in the economy came, some of those superfluous fishers would not move fast enough into more productive sectors, limiting the increase in wealth during the boom. These arguments seem alarmingly up to date at least in the context of the European Union (EU). The common fisheries policy (CFP) of the EU has as one objective to maintain employment while reducing fleet capacity. The direct effect of such a policy is that it imposes extra costs, but most likely it also prevents necessary changes, as any meaningful reformation of the CFP will lead to a reduction in employment. For example, reduced employment is an often-used argument in Europe against the introduction of the rights-based management approach called Individual Transferable Quotas.

Warming’s promotion of property rights is partly also a precursor to another seminal contribution in economics, “The Problem of Social Cost” (Coase 1960). Warming advocates the extension of land ownership into the sea as a means of solving the negative externality from too many fishers. He discusses an offshore extension of land ownership, but acknowl-

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3. For schooling fish like anchovy and herring, it implies that the growth rate of the stock should equal the SDR. Following Schaefer 1954, the modern textbook example also includes the stock effect for uniformly distributed fish like halibut and cod, stating that the growth rate plus the marginal cost saving from increasing the stock should equal the SDR (see Clark [1976] 1990 for details).
edges that property rights may not be maintained further out in the sea due to what Ronald Coase (1937, 1960) later called transaction costs:

If there is a single owner who can regulate the entry, the resource rent will be saved. . . .

. . . The option of regulation out at sea has so far been excluded, and it is quite likely that the costs would outweigh the benefits from enforcing and monitoring the regulation. (Warming 1931, 156)

Still, Warming (1931) is much more in line with Pigou than with Coase, as he implicitly thinks that a single regulation like a tax can serve the same function as a contract, and he is comfortable with the benevolent state that corrects market failures. Unlike Coase, Warming does not see the problem arising due to the absence of the right to contract. Warming’s view on distributional issues also clearly deviates from Coase:

You can complain about the fact that this value created by society, similarly as in the case of a land rent that accrues to the landowner, slips out of the hands of society. You have the same right to tax the value increase and maybe the value itself, just as you tax the land. Still, it is better that the value accrues to a private holder instead of being wasted, which follows if the fishing is free. You can also appreciate that this value can be saved by a minimum of administration, which is a consequence of the coast owner’s demanding the fee. (Warming 1931, 156)

To Warming it would be preferable if society collected the money, while Coase did not have any such preference. Indeed, Coase privatized the externality problem (Demsetz 1996) and would argue in favor of assigning property rights either to the coastal owner or to a fisherman.

Why Did Warming Fail?

The traditional view of Warming’s contribution to fisheries economics and the characterization of open access is that he failed to reach an international audience because the articles were written in Danish and that fisheries biologists were not aware of his findings (Andersen 1983). However, Warming was very active in communicating his results through a
wide distribution of offprints starting with the 1911 article and continuing with the 1931 article. The latter was sent to several leading Scandinavian marine biologists, but none of them saw the potential for developing the bioeconomics that later emerged during the 1950s (Topp 2008). Obviously, Warming was able to write in English, and in his 1926 essay on wage formation he included a revised version of the 1911 article, which suggests that the core of the 1931 article was already written in English. When “The Danish Right to Eel Weir” was published, he was working on the article that would appear in the *Economic Journal* the following year. Hence, he had an English draft of the 1931 article and he knew how to publish in an international journal. Still, despite his high regard for the fisheries model, he did not try to publish it internationally.5 Warming saw it as his duty to contribute to discussions of domestic economic policy rather than making a career as an internationally recognized economist (Davidsen 1999); a strict interpretation of this imperative would be that if the Danish right to eel weir was only of concern to Scandinavians, it made sense to publish for Scandinavians in the *Journal of the Danish Economic Association*. The articles on fisheries basically remained unknown to an international audience for fifty years until translations of the 1911 article were provided (Hannesson and Anderson 1981; Andersen 1983).6

Concerning the public debate about the Danish right to eel weir, Warming did not only participate with his 1931 article but also deliberately sent copies of the article to fisheries newspapers, high-ranking civil servants within the fishing agencies, and politicians, including the prime minister, who was previously the minister of fisheries, and to the minister of defense, who had been on the committee investigating the issue in 1919. From what we know, Warming did not receive any response. Scientists did not take into account Warming’s formal model or his concern that open access led to a wasteful use of scarce resources, neither in their research nor in their policy advice. The distance between the two disciplines was too great at the time (Topp 2008). One of the scientists to whom Warming sent an offprint of his 1931 article, H. M. Kyle, a biological secretary to the ICES, had stated his view on economics in an article written in 1905: “The prob-

5. As pointed out by an anonymous reviewer, one may ask if there was an outlet for such an article in 1931, before the era of subfields and applied economics (see, e.g., Backhouse and Biddle 2000).

6. Topp (2004) refers to a few exceptions, most notably the 1956 FAO meeting at which a former Icelandic student of Warming’s, Ólafur Björnsson, introduced Warming’s model to the participants, including Gordon and Scott.
lem of overfishing might ultimately be an economic one, at the mercy of the undeveloped discipline of economics” (Rozwadowski 2002, 51). The debate in 1931 ended without any change, but when the issue was revived in 1955 with another parliamentary committee report, it led to parliament’s deciding to abolish the right in 1956. The white papers of 1919 and 1955 hold in common a focus on legal and biological aspects while the economics is absent, reflecting the weak position of economics vis-à-vis all public administration in Denmark, even long after the active years of Warming (Topp 2004). Fisheries management in most of the Western European Union member states was for a long time mainly influenced by biologists, while the influence of economists was absent. The forty-one-page green paper on the common fisheries policy (European Commission 2001) did not use the phrase resource rent, long since a standard concept in fisheries economics for the “rent of fishing grounds” discussed by Warming some ninety years earlier. However, the “statistician against his will” (Davidsen 1999) got his revenge, albeit late. With the new millennium, priorities have changed, and Danish fisheries are now managed by the rights-based approach in line with Warming’s ideas that have long been advocated by most of his successors.

References


