



Predicting trends in Irish Sea shellfish production

A bio-economic model based on aquaculture, fisheries, property rights, trophic efficiency and climate change

Dan Lee, Centre for Applied Marine Sciences

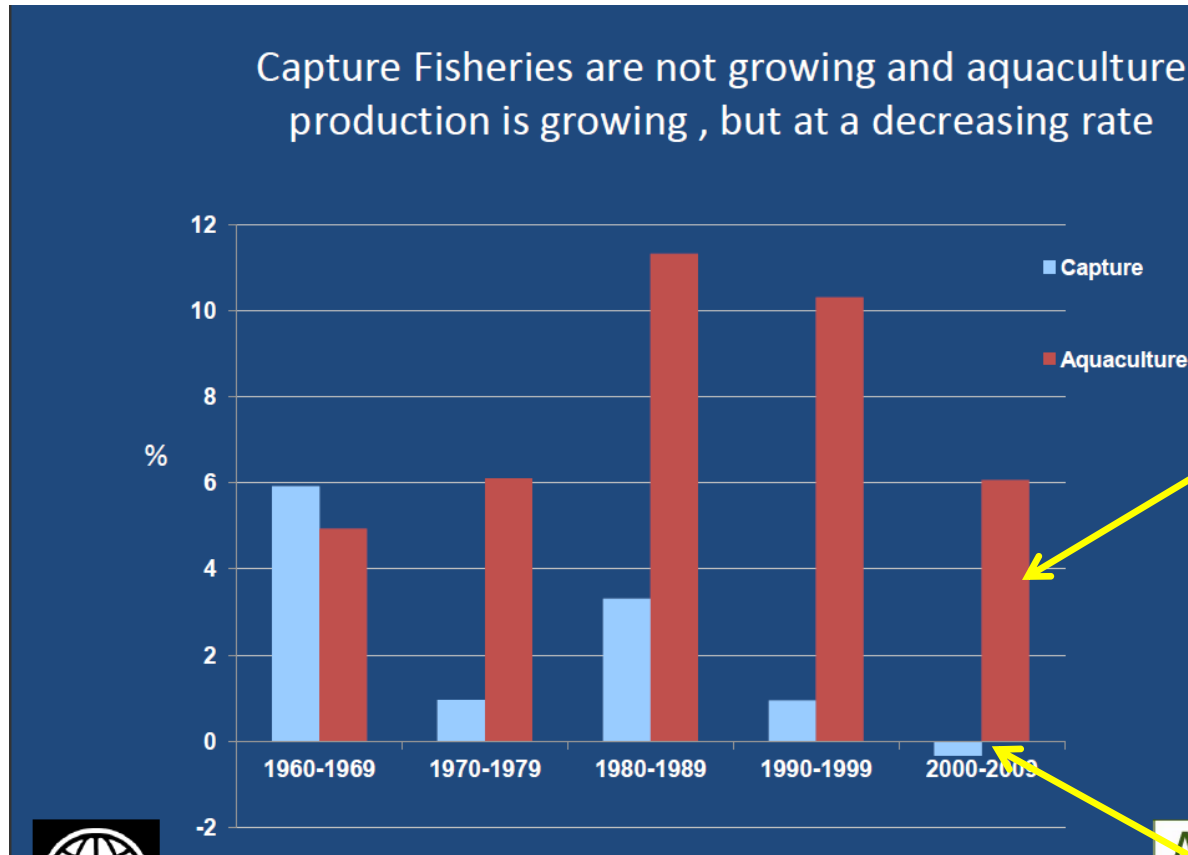


Ireland's EU Structural Funds Programmes 2007 - 2013

Co-funded by the Irish Government and the European Union



A global perspective: aquaculture and fisheries

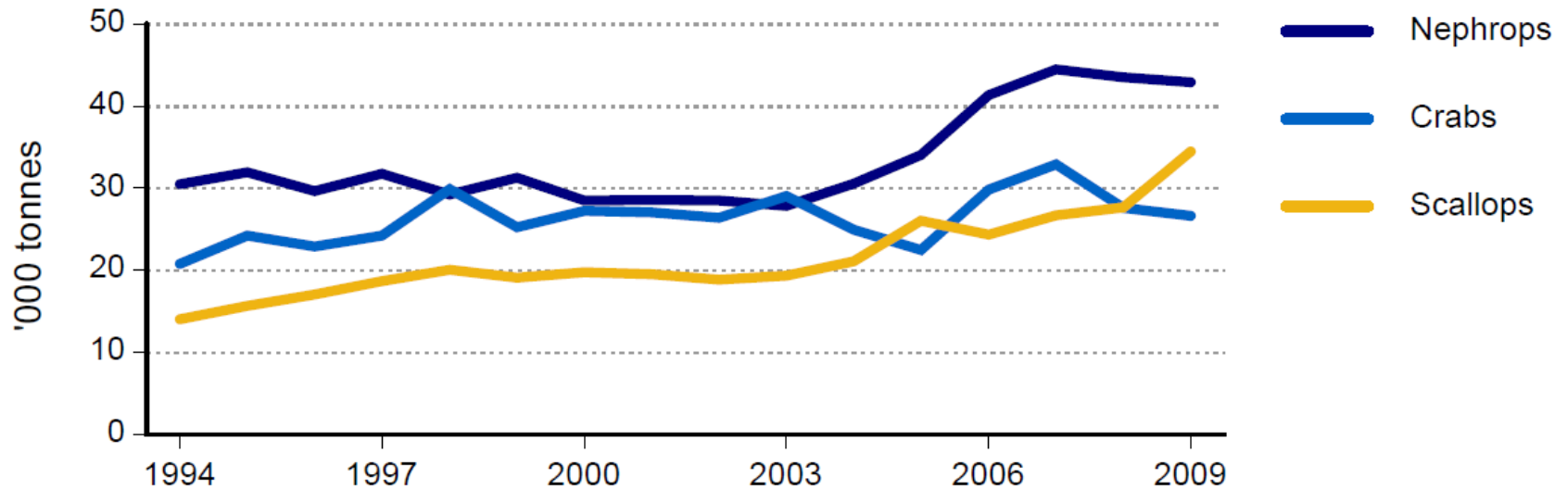


Max.
Aquaculture
growth = 6%
per year

Fisheries
growth = 0%
per year

Source: J Anderson, World Bank

But, shellfisheries have better growth potential than finfisheries: max. 3% per year



UK Landings of key shellfish species: 1994-2009

Assumptions

In general, aquaculture expands compared to fisheries because:

1. Property rights are more clearly defined for aquaculture
2. Aquaculture provides more control. It can:
 - adapt more readily
 - make better use of technological advances
 - make use of hatcheries and domesticated broodstock to make production more dependable and attractive to investors

The model

Increase in production = f (ARF, PR, TL, CCR)

ARF* = Aquaculture Fisheries Ranching index

PR* = Property Rights index

TL = Trophic Level index

CCR = Climate Change Resilience index

* Anderson J.L. (2010) Aquaculture and the future: why fisheries economists should care. *Marine Resource Economics*. 17 (2)133-151

Aquaculture Ranching Fisheries Index: five factors

1. Dependence on wild stock for broodstock and/or juveniles
2. Dependence on wild feed
3. Degree of confinement
4. Degree of control of the environment/ habitat
5. Degree of harvest and market management

Aquaculture Ranching Fisheries Index

Species	Dependence on Wild stock for broodstock and/or juveniles	Dependence on Wild feed	Degree of Confinement	Degree of control of the environment/habitat	Degree of Harvest and Market Management	ARF Index
Mussels	1	1	2.5	2	5	2.3
Pacific oysters	5	1.2	2.5	2	5	3.14
Lobsters	1	2	2	1	4	2
Crabs	1	2	2	1	4	2
Nephrops	1	1	1	1	1.5	1.1
Whelks	1	2	2	1	4	2
Scallops	1	1	1	1	1.5	1.1
Periwinkles	1	1	1	1	1.5	1.1
Shrimps	1	2	2	1	3	1.8

Property Rights Index: five factors

1. Transferability
2. Exclusivity
3. Security
4. Duration
5. Index of Economic Freedom*

* mean UK and Ireland, <http://www.heritage.org/index/>

Property Rights Index

Species	Transferability	Exclusivity	Security	Duration	Economic freedom	Property Rights Index
Mussels	4	4	4	5	4.02	4.2
Pacific Oysters	4	5	4.5	5	4.02	4.5
Lobsters	2.5	3.2	3.8	3.8	4.02	3.5
Crabs	2.5	3.2	3.8	3.8	4.02	3.5
Nephrops	1	1.4	2.6	2.2	4.02	2.2
Whelks	2.5	3.2	3.8	3.8	4.02	3.5
Scallops	1	1.4	2.6	2.2	4.02	2.2
Periwinkles	1	1.4	2.6	2.2	4.02	2.2
Shrimps	2.5	3.2	2.6	2.2	4.02	2.9

Trophic Level Index

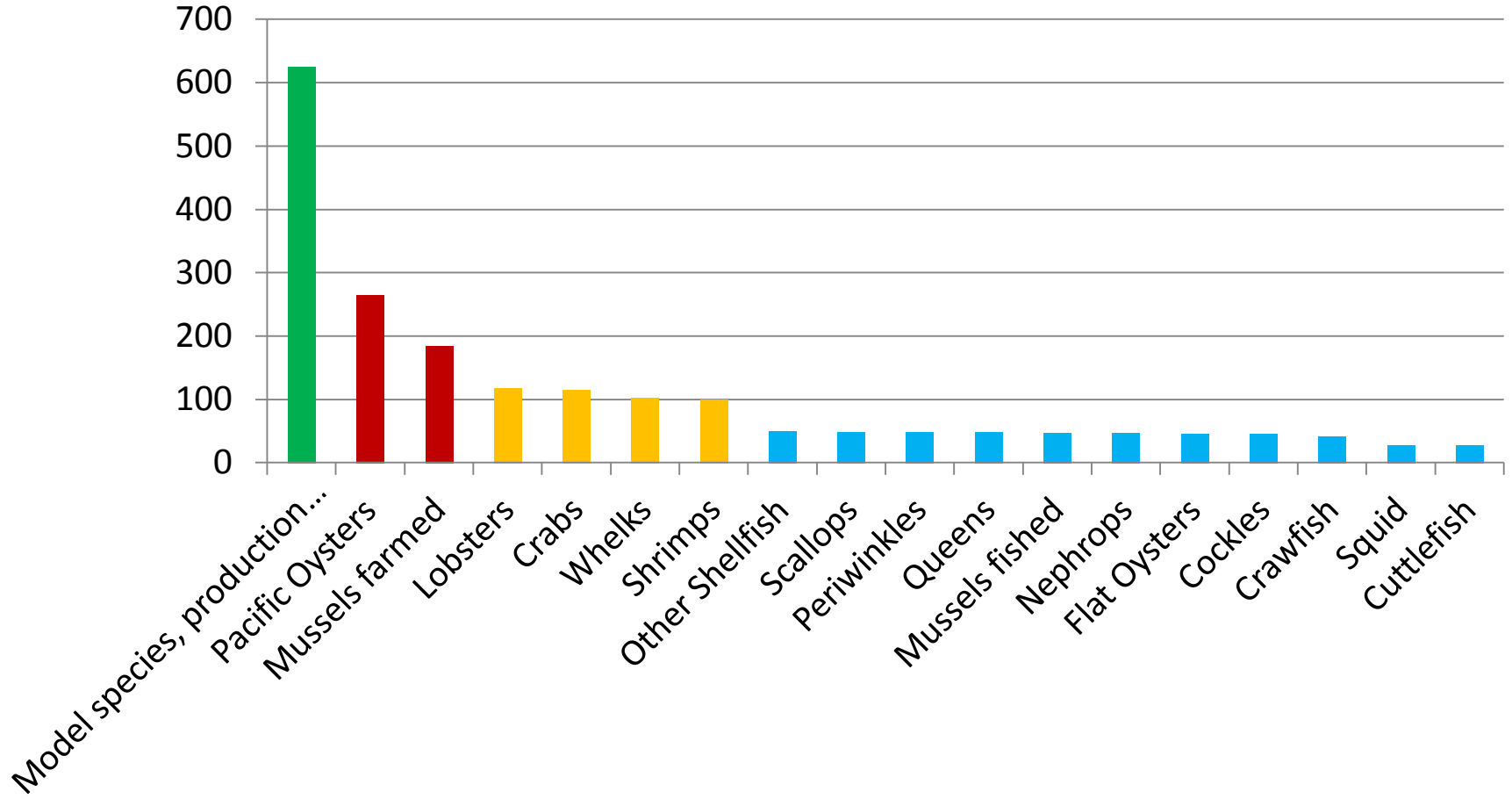
Species	Trophic Level*	Trophic Level Index
Mussels	2	4
Pacific Oysters	2	4
Lobsters	2.6	3.4
Crabs	2.6	3.4
Nephrops	2.2	3.8
Whelks	3	3
Scallops	2	4
Periwinkles	2	4
Shrimps	2.2	3.8
Other Shellfish	2	4
Crawfish	2.6	3.4
Queens	2	4
Cockles	2	4
Mussels fished	2	4
Squid	3.8	2.2
Flat Oysters	2	4
Cuttlefish	3.8	2.2

*Talberth *et al.* (2006) The Ecological Fishprint of Nations

Overall Scores

Species	Aquaculture Ranching Fisheries	Property Rights	Trophic Level	Climate Change Resilience	Overall Index
Mussels farmed	2.3	4.2	4	4.8	185
Pacific Oysters	3.14	4.5	4	4.7	264
Lobsters	2	3.5	3.4	5.0	118
Crabs	2	3.5	3.4	4.9	115
Nephrops	1.1	2.2	3.8	5.0	47
Whelks	2	3.5	3	4.9	102
Scallops	1.1	2.2	4	4.9	48
Periwinkles	1.1	2.2	4	4.9	48
Shrimps	1.8	2.9	3.8	5.0	99
Model species, production system, management and legislation	5	5	5	5	625

Overall Scores

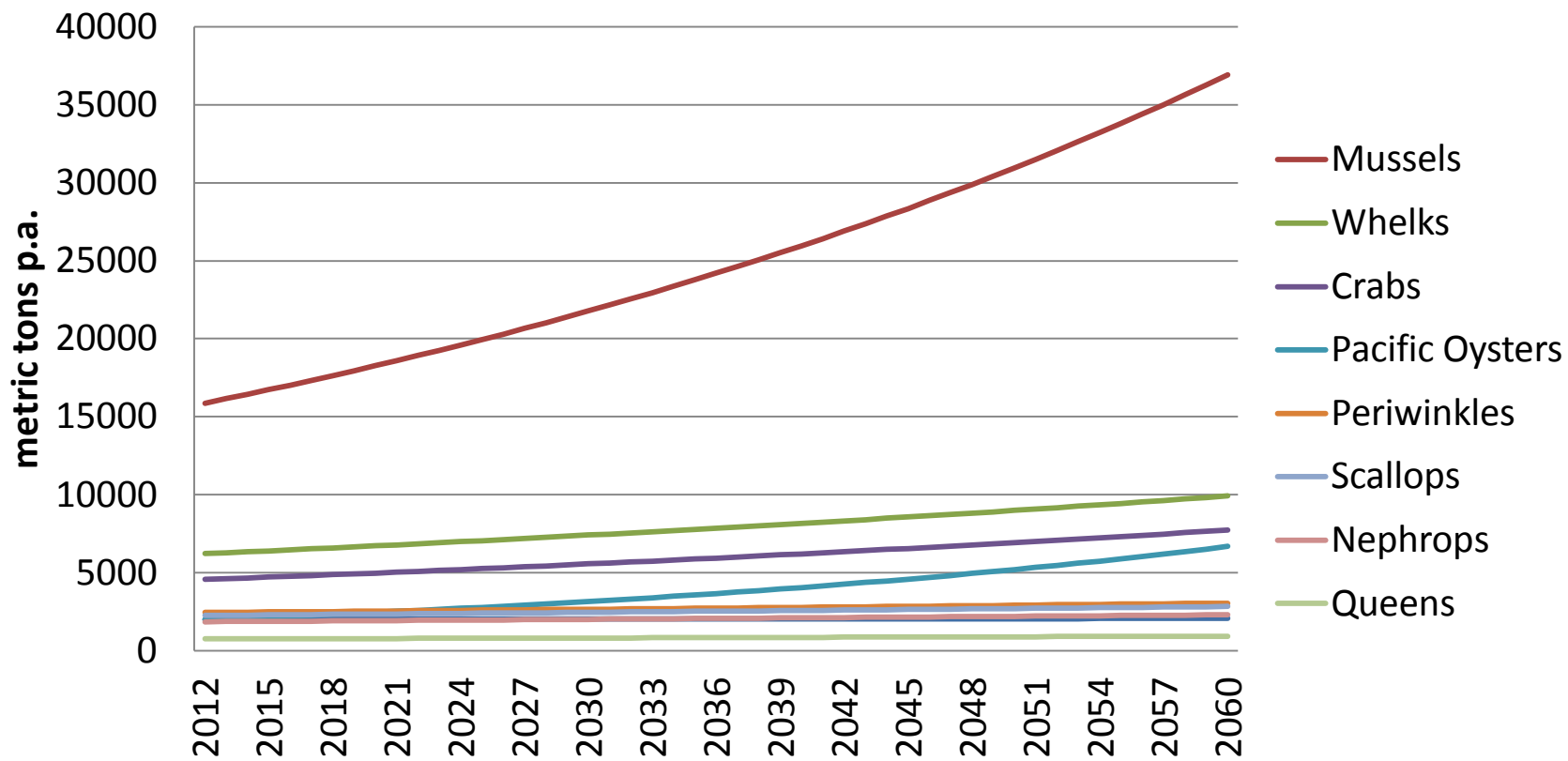


Basis for economic projections

- Maximum growth in annual production for model species, production system, management and legislation = 6%
- Predicted annual production growth
= 6% x Overall Score/625
- Gross value (€) in year n (at today's prices)
= production in year n (mt) x today's gross, landed price (€/mt)

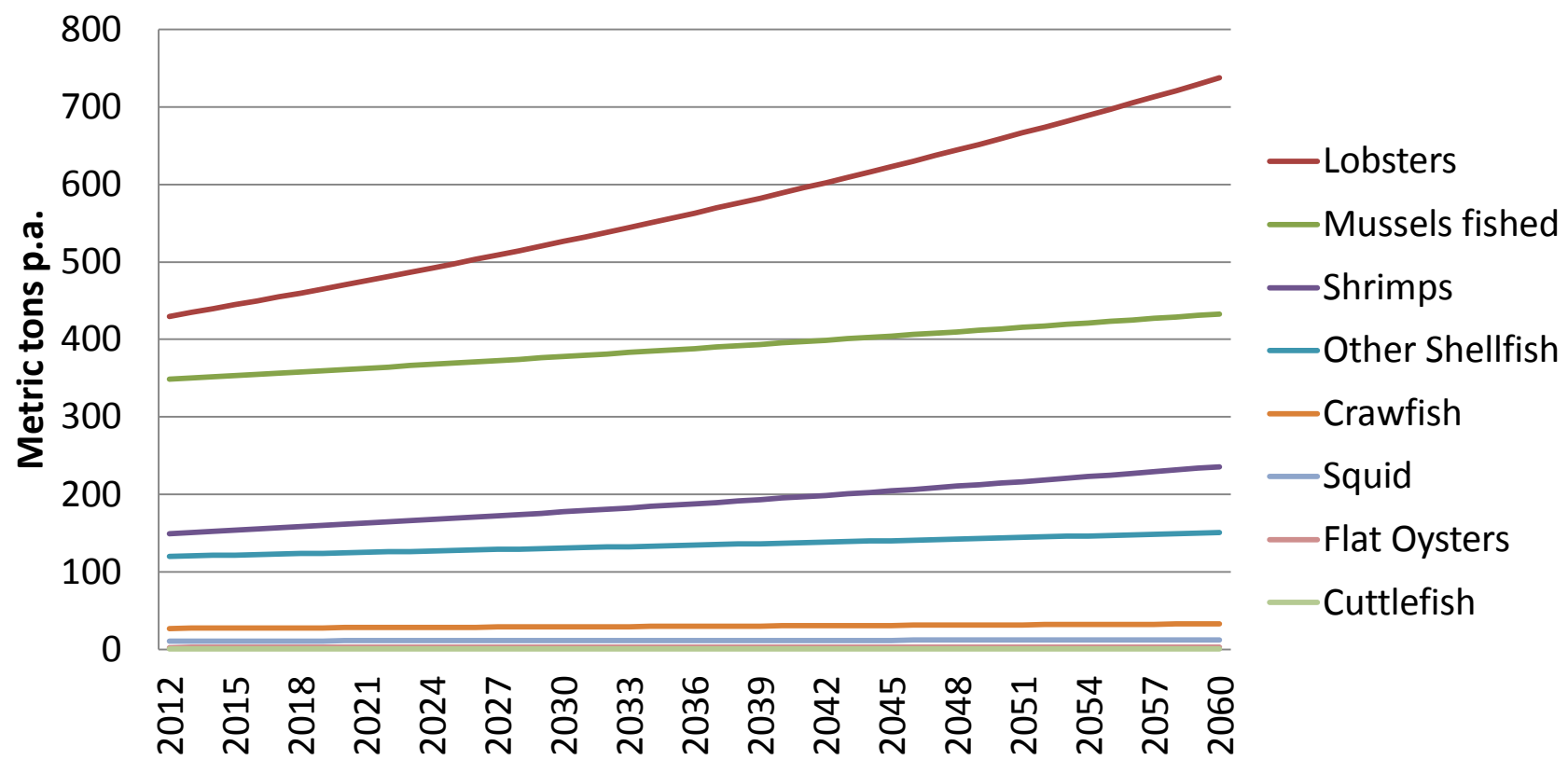
Model output

Irish Sea shellfish production volumes



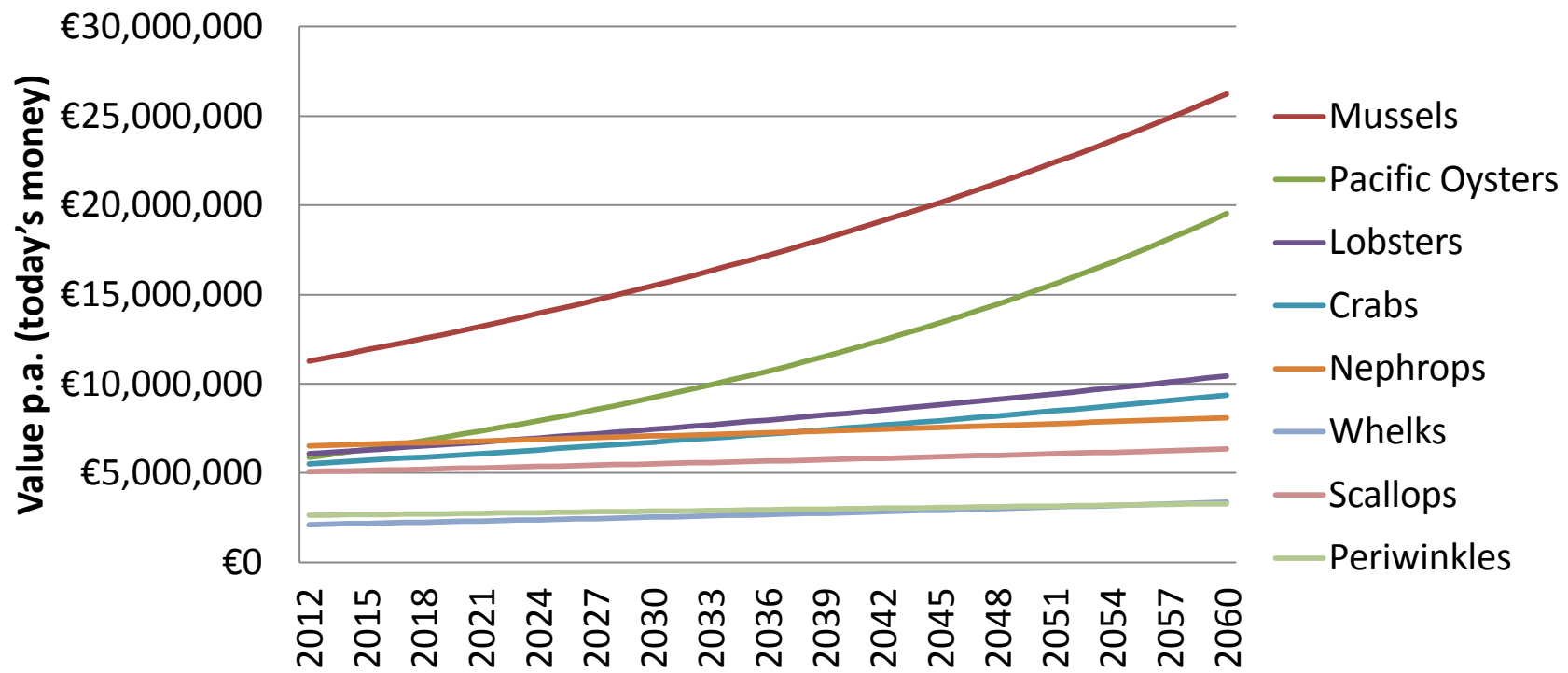
Model output

Irish Sea shellfish production volumes



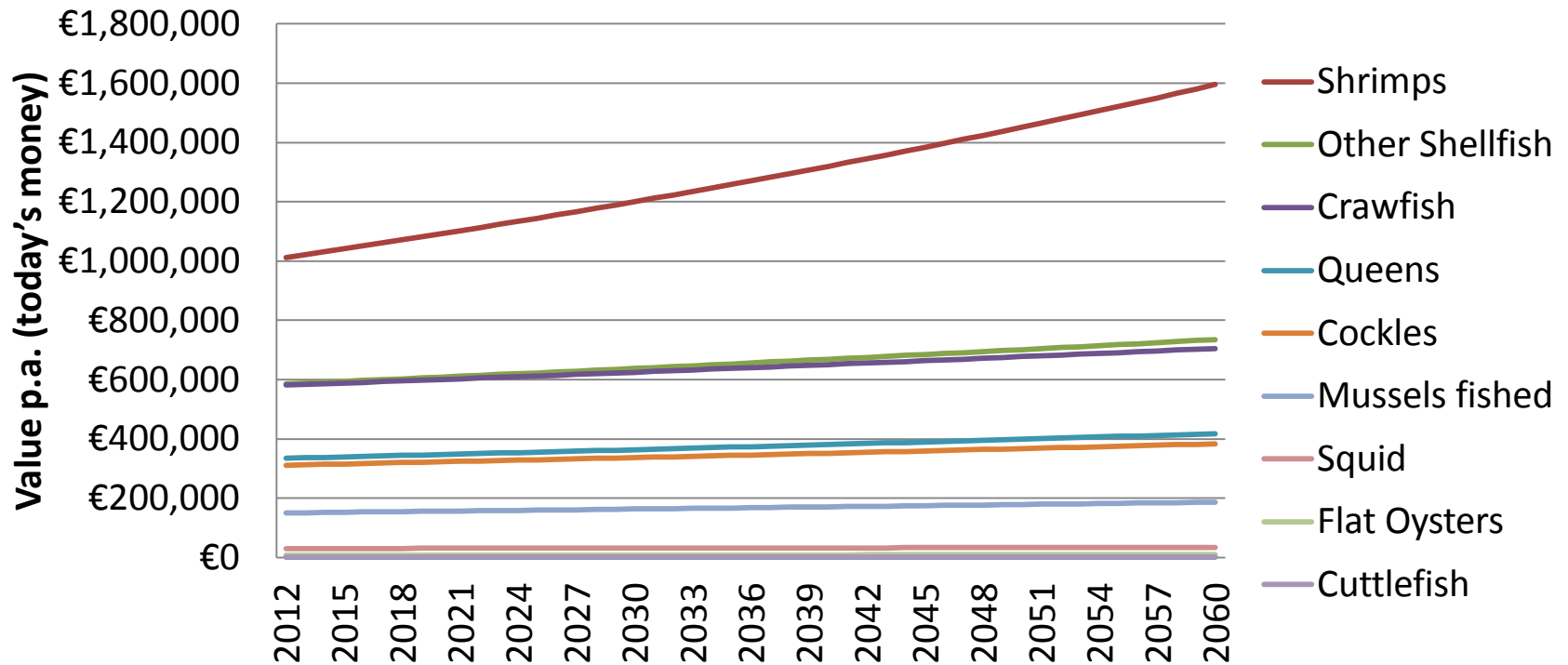
Model output

Irish Sea shellfish production value (gross, landed)



Model output

Irish Sea shellfish production values (gross, landed)



Conclusions

- Prospects are brightest for mussels, Pacific oysters, crabs, lobsters, and whelks. Species that are either farmed or potted in systems that provide better control (higher ARF Index) and have more clearly assigned property rights (higher PR index)
- All shellfish production, farmed and fished, would benefit from better assignment of property rights

Conclusions

- Climate impacts are of lesser importance but aquaculture systems are can adapt to climate changes by:
 - Moving offshore where water quality is more stable and climate change impacts are buffered
 - Making more use of hatcheries and selected/domesticated broodstock
- Model predicts that the aquaculture of a primary producer like seaweed has significant potential for growth