Management of New Zealand mixed fisheries: a bio-economic modeling approach

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EU-funded TRANZEF project

1. **IFREMER (Boulogne s/mer, France)**
2. **Seafood Industry Council Ltd (Wellington, New Zealand)**
3. **NIWA (Wellington, New Zealand)**
4. **IFREMER (Nantes, France)**
5. **Agrocampus (Rennes, France)**

The issue

- In New Zealand, enforcement of TAC is meant to be achieved by economic incentives
  - Discards are prohibited for most stocks, so
  - It is legal to exceed the TAC, but
  - A charge applies to landings above quota: the deemed value

- Efficiency of deemed value depends on its level
  - If set high, powerful incentive for not targeting stock
  - If set low, fishers may prefer to pay the charge rather than to buy quotas
  - Currently, no clear science or policy in setting deemed values
  - What is the appropriate deemed value level?

ISIS-Fish: fisheries modeling tool

- ISIS-Fish: spatial bio-economic model simulating the dynamics of regulated mixed fisheries (www.ifremer.fr/isis-fish)
  - Open source
  - Spatially explicit
- Populations dynamics
  - Length/age, seasonal and spatial distribution, large scale migrations
  - No trophic relationship
- Fishing activities dynamics
  - Fleets, métiers (gear, areas, target species), strategies
  - Short and middle term economic parameters (costs)
  - Dynamic allocation of fishing effort
- Management dynamics
  - Scenario (area- and seasonal closures, TAC, mesh size, effort limits)

Case study: hoki mixed fishery

- Difficulty to integrate the dynamics of all stocks in the model:
  - Hoki is the only NZ species to be assessed annually
  - Some by-catch species (hake, ling) are assessed from time to time
  - Most species are not assessed at all (squids, barracouta, warehous)
  - Hake caught in lower quantity than hoki, but its

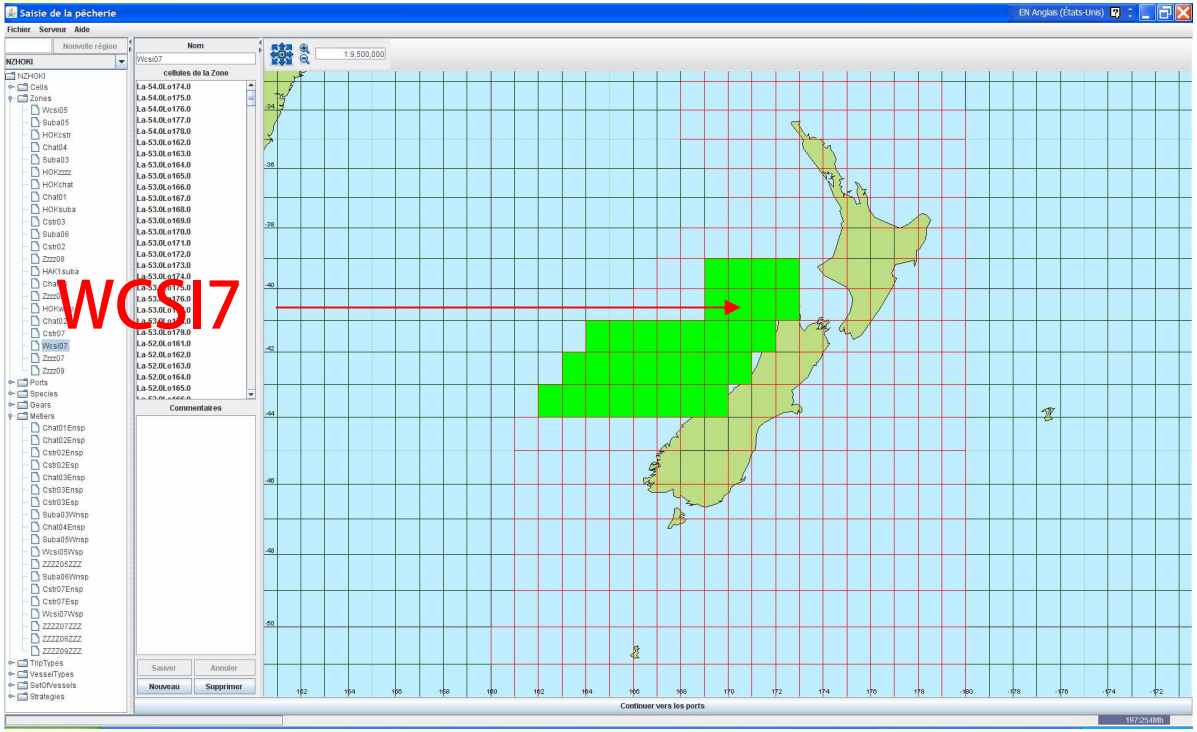
- Species/stocks selected in our modeling approach
  - 1 target spp: hoki; assessed as two stocks (eastern and western)
  - 1 by-catch: hake; assessed & managed as 3 stocks (Sub-antarctic, Chatham Rise, West Coast South Island)
  - Neglect the value and dynamics of the other species

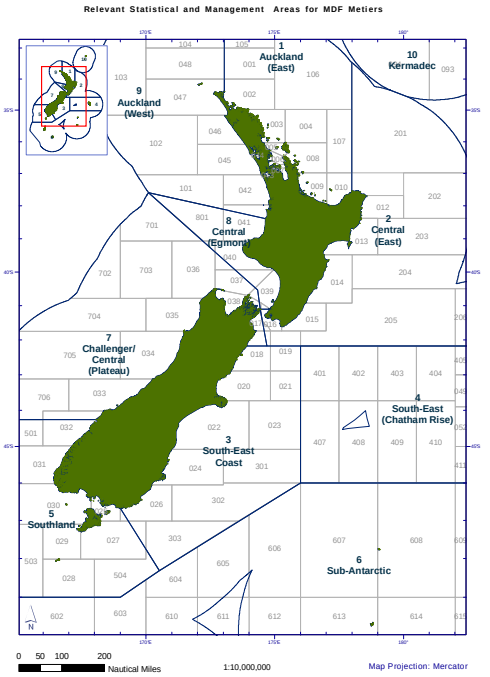
Parameterisation: fleets

	Fleet FL1	Fleet FL2	Fleet FL3	Fleet FL4
Main gear	trawl	trawl	trawl	trawl
Length range	12-45 m	12-45 m	46-110 m	46-110 m
Mean trip duration	4 days	4 days	>28 days	>28 days
Number of vessels	133	16	22	28
Strategy	S1	S2	S3	S4

Parameterisation: métiers

Fishing area	Management areas	Season	No. métiers
Chatham Rise; east coasts North and South Islands	1 - 4	Oct – Sep (non sp.)	4
Cook strait; Pegasus	2, 3, 7	Oct – Mar (non sp.)	3
		Jun – Sep (sp.)	3
Sub-antarctic	3, 5, 6	Oct – Sep (non sp.)	3
West coast South Island	5, 7	Oct – Sep (sp.)	2
Others	5, 7, 8, 9	Oct – Sep (non sp.)	4
TOTAL			19





Biological & exploitation parameters

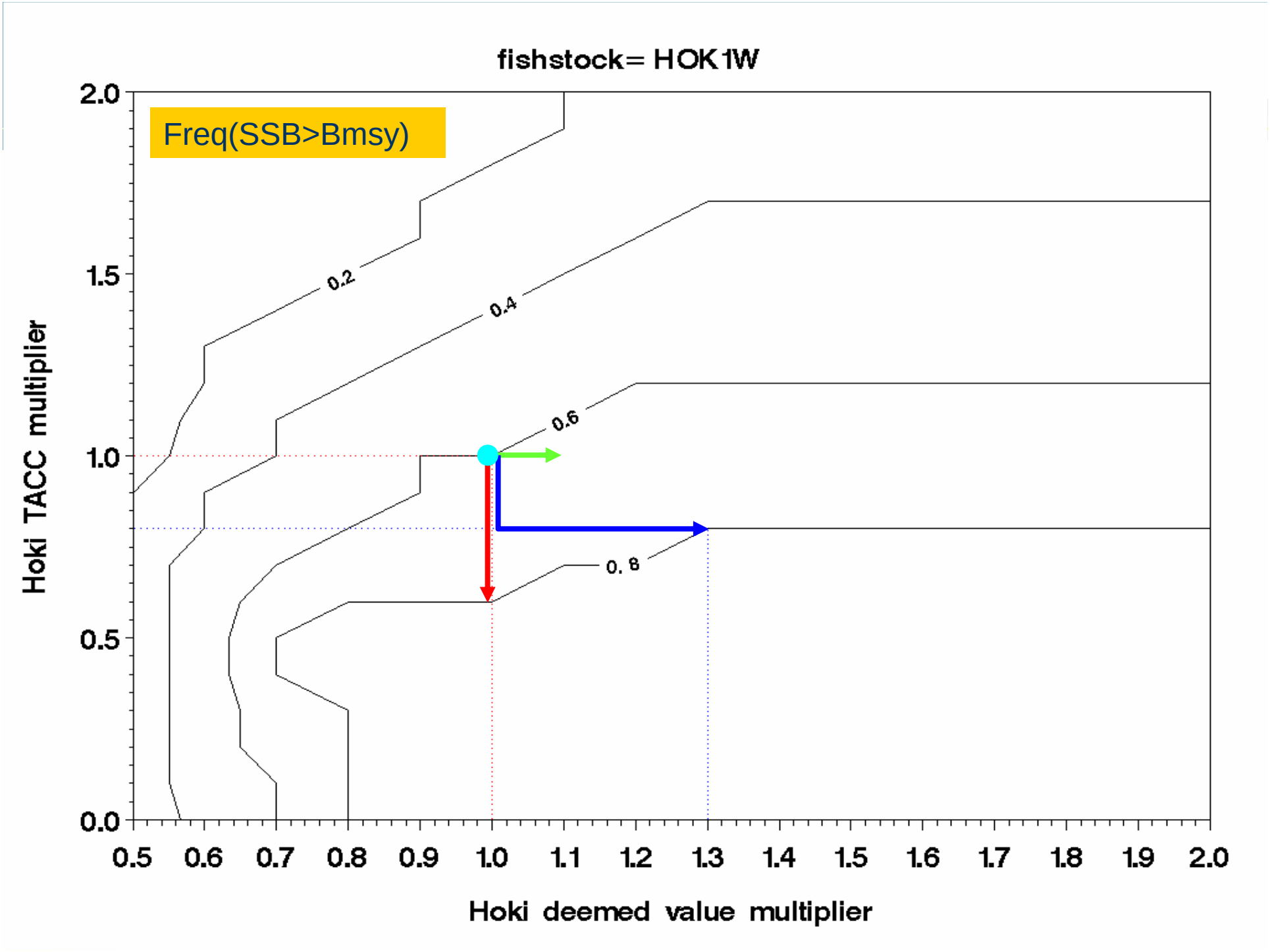
- Direct estimations
  - 2007 assessment (eastern and western hoki); combined-sex assessment
  - 2004 assessment (3 hake stocks)
  - Growth, migration and selectivity ogives, natural mortality
  - Constant recruitment (geometric mean, no S/R)

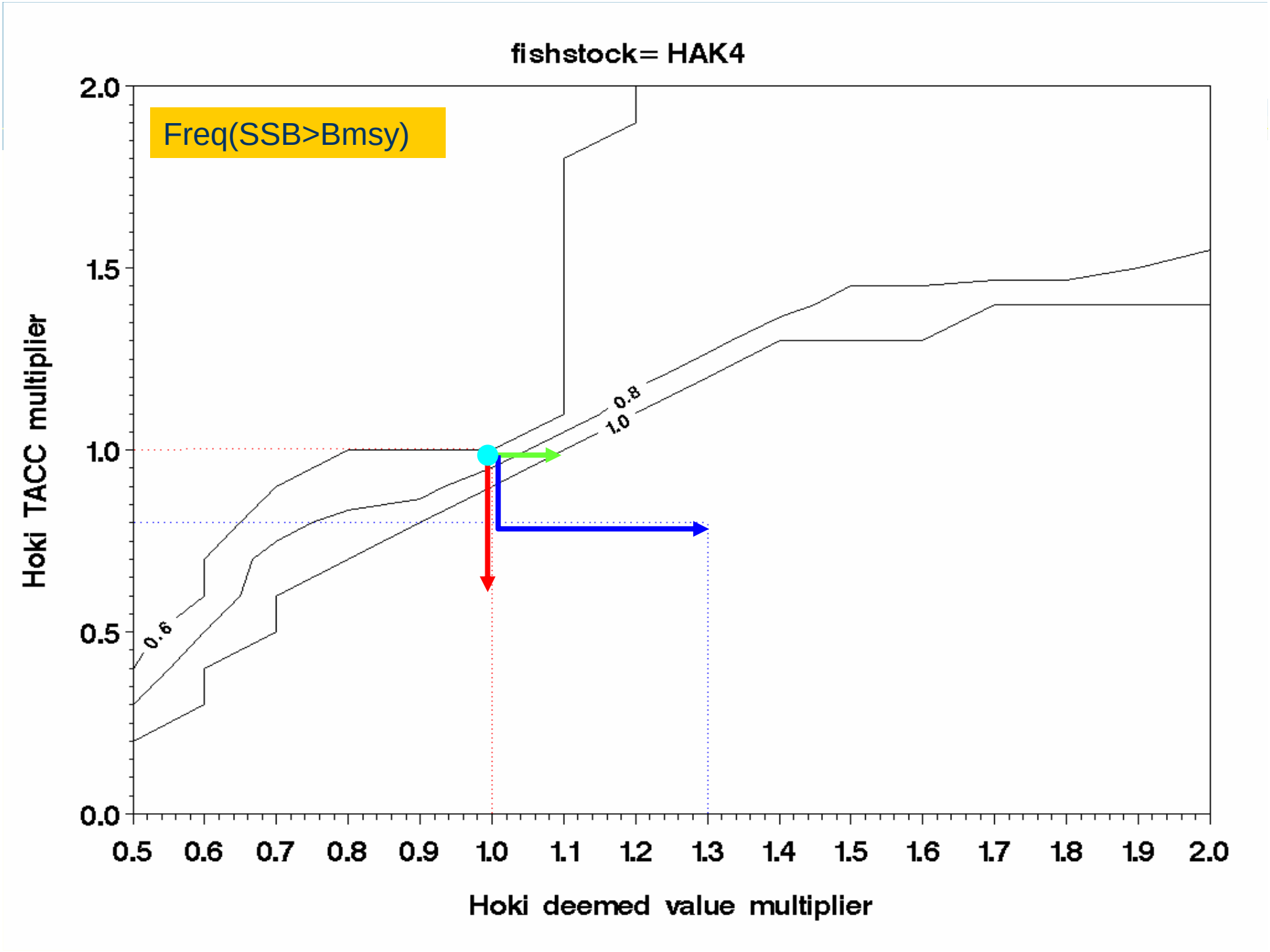
- Indirect estimations
  - Target factor associated to each métier estimated by GLM
  - Accessibility = F_{SQ} / (Selectivity X TargetFactor X StdEffort)

- Effort allocation
  - Assumed that main driver is VPUE (Value Per Unit of Effort)
  - VPUE = *landing* X {*fish price* – (*ACE rental* OR *deemed value*)} / *days fished*
  - Then allocates fishing effort towards the highest VPUE or stop fishing if highest VPUE < 0

Management scenarios

Run	TACC hake	TACC hoki	DV hake	DV hoki	Total effort
0	*SQ*	*SQ*	*SQ*	*SQ*	*SQ*
1	0.5 * SQ	*SQ*	*SQ*	*SQ*	*SQ*
2	1.5 * SQ	*SQ*	*SQ*	*SQ*	*SQ*
3	*SQ*	0.5 * SQ	*SQ*	*SQ*	*SQ*
4	*SQ*	1.5 * SQ	*SQ*	*SQ*	*SQ*
5	*SQ*	*SQ*	0.5 * SQ	*SQ*	*SQ*
6	*SQ*	*SQ*	1.5 * SQ	*SQ*	*SQ*
7	*SQ*	*SQ*	*SQ*	0.5 * SQ	*SQ*
8	*SQ*	*SQ*	*SQ*	1.5 * SQ	*SQ*
9	*SQ*	*SQ*	*SQ*	*SQ*	0.5 * SQ
10	*SQ*	*SQ*	*SQ*	*SQ*	1.5 * SQ
11.x.y	*SQ*	x * SQ	*SQ*	y * SQ	*SQ*


fishstock= HOK1W
Freq(SSB>Bmsy)
0.2
0.4
0.6
0.8
Hoki TACC multiplier
Hoki deemed value multiplier
2.0
1.5
1.0
0.5
0.0
0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0


fishstock= HAK4
Freq(SSB>Bmsy)
Hoki TACC multiplier
Hoki deemed value multiplier
0.6
0.8
1.0
2.0
1.5
1.0
0.5
0.0
0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0

Conclusions

- There are indications that economic management could efficiently support TAC implementation if set at appropriate levels
- In mixed fisheries, the deemed value may inflate management degrees of freedom
- Increasing hoki deemed value does not have adverse effects on the hake and hoki stocks (but could have on other stocks (e.g. squids) not included here
- These results are still preliminary. Future work will include:
  - Development of the effort allocation model (traditions, catch portfolios)
  - Splitting TACC among the fleets and allowing quota exchanges
  - Refining assumptions on the other species dynamics
  - Introducing the usual ingredient of the fishery system (uncertainty)