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Tasmanian Aquaculture
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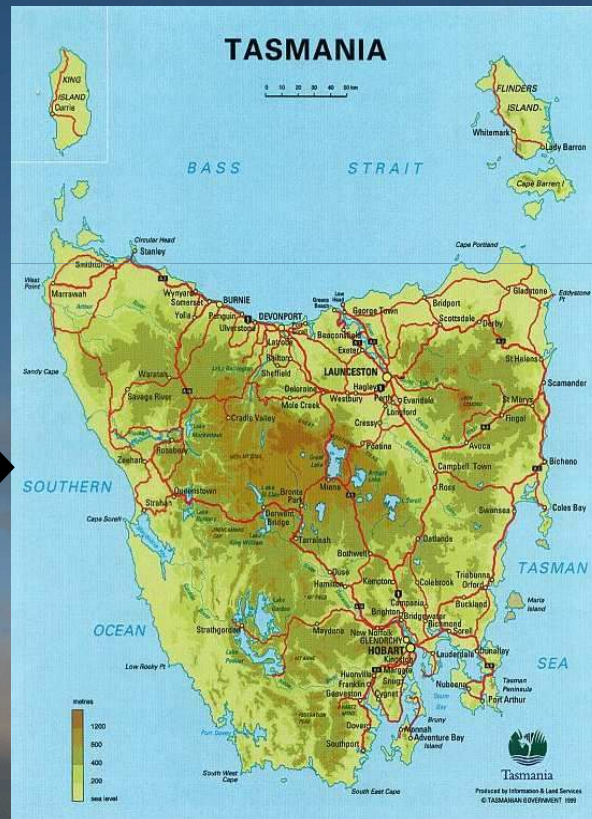
Modelling the fleet dynamics of a small-scale mixed fishery

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TAFI is a joint venture between the State Government and the University of Tasmania

Tasmanian scalefish fishery

Size of Tasmania equivalent to that of Republic of Ireland
and it also rains a lot on the west coast of Tasmania
but fisheries very different...



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Tasmanian scalefish fishery

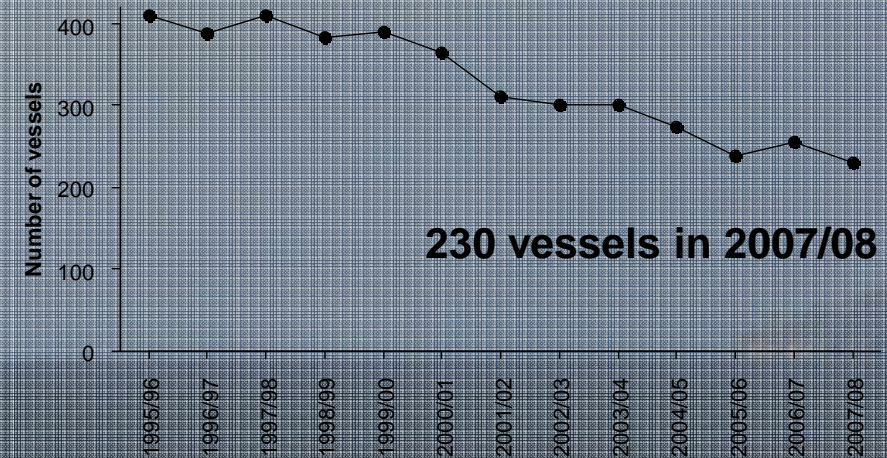
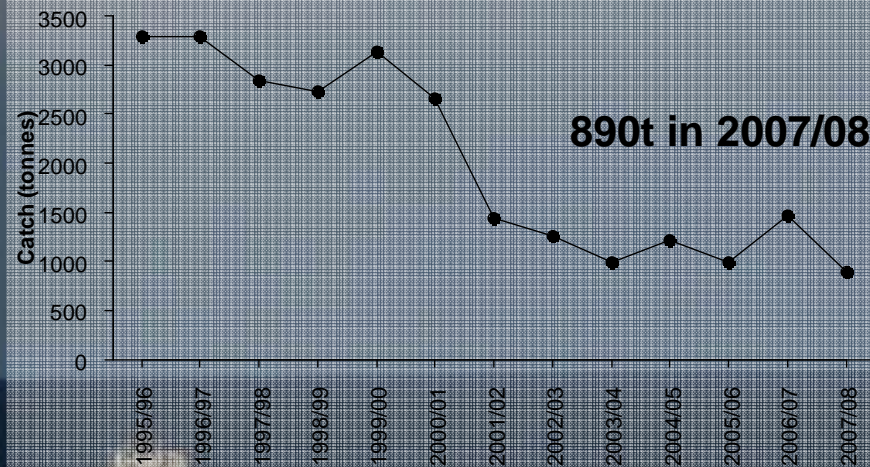
Tasmanian scalefish fishery is small (but important to local communities):

Total scalefish catch in Tasmanian logbooks: 890 tonnes in 2007/08

- Steep decline after 2000/01 due to changes in reporting scheme (Commonwealth/Australian government takes over the jurisdiction of sharks and a range of other deepwater species)

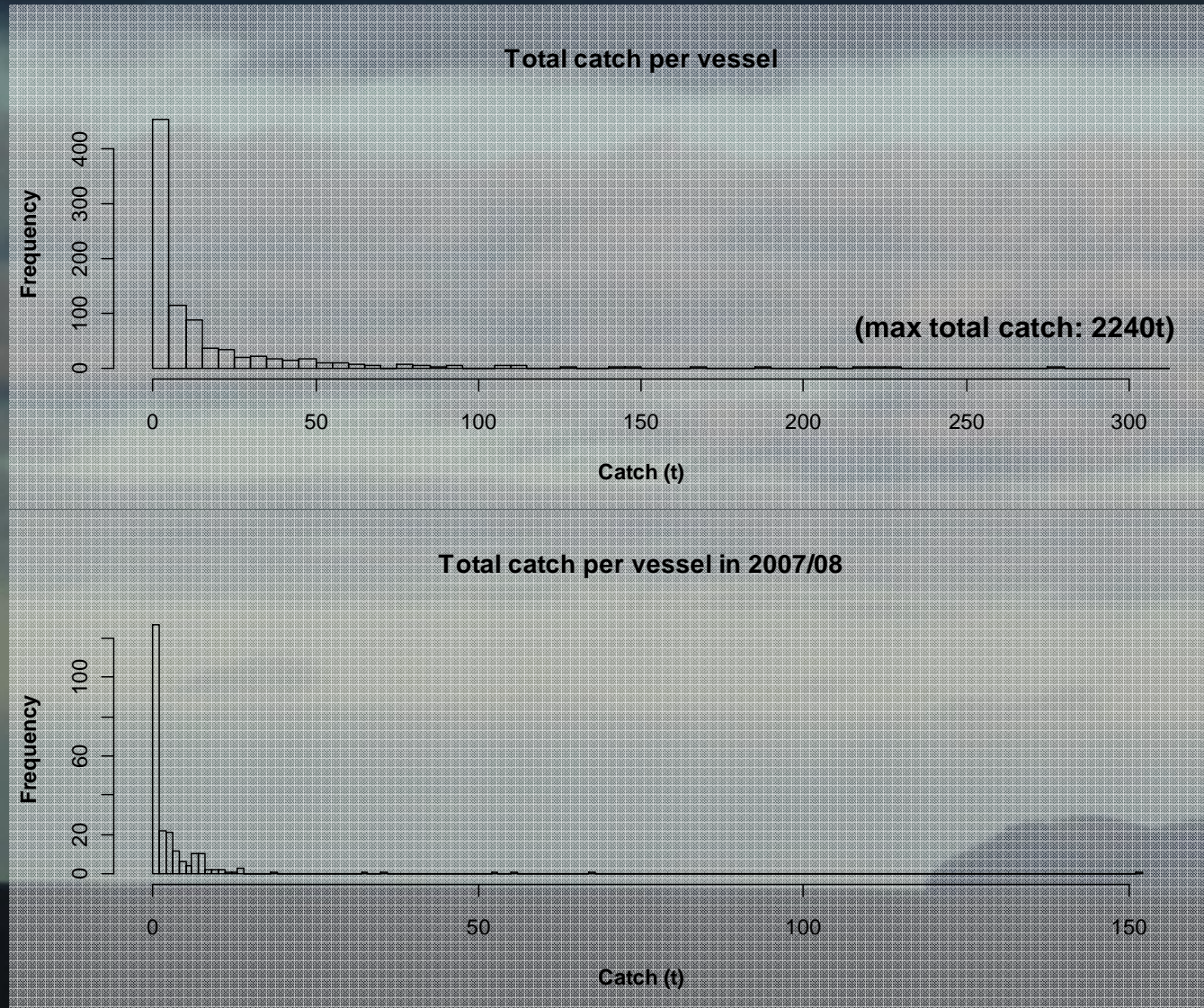
Vessels reporting catch:

- Number of vessels continuously declined from 410 to 230 vessels over 12 years
- Small number of vessels catching large quantities of fish



Structure of scalefish fishery

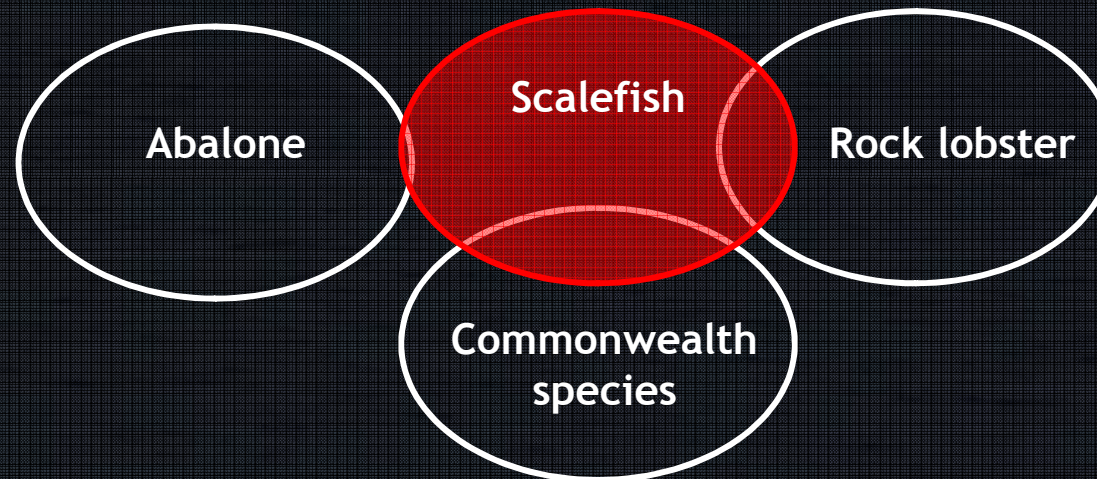
Most vessels catch only very small catches



Some of these vessels returned <100kg

Structure of scalefish fishery

'Scalefish fishery' includes all vessels that return scalefish catch in commercial logbooks (independent of method, mainly within State waters up to 3nm)
'Open' fishery with many interactions between other fisheries:



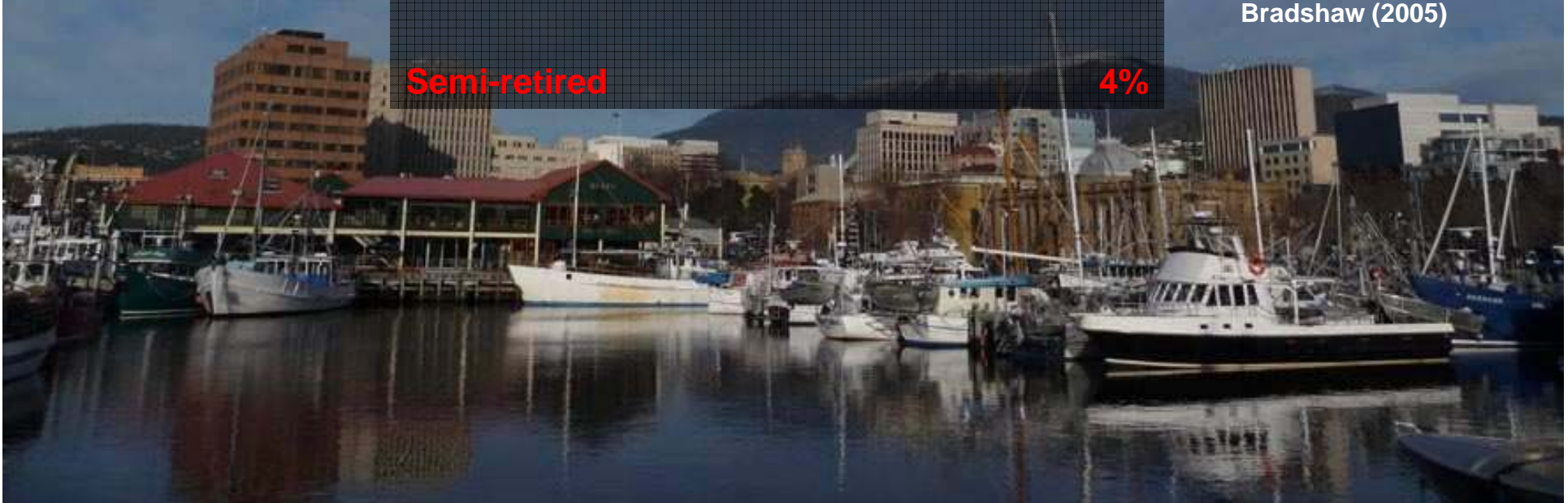
- Abalone: Little scalefish catch from abalone fishers (but some scalefish fishers work on abalone boats)
- Rock lobster: Many fishers catch lobster and scalefish (in lobster pots or with other gear, lobster fishery usually the main activity)
- Commonwealth species (3-200nm): Some fishers used to report their catch in Tasmanian logbooks (up to ~2000), still the case for minor shark species

Structure of scalefish fishery

Employment of scalefish fishers:

Full time fishers	58%
Scalefish only	22%
Scalefish and lobster	18%
Scalefish and other	18%
Part-time fishers	38%
Other occupation part-time	21%
Other occupation full-time	17%
Semi-retired	4%

Bradshaw (2005)



Structure of scalefish fishery

High diversity of fishery in terms of vessels:

- Many small vessels <6m, fishing inshore, unspecialised, 1-2 crew
- Majority of larger vessels (up to 20m) operate also in other fishery (rock lobster)
- Few larger vessels >20m usually specialised (BS, DS etc)



Structure of scalefish fishery

High diversity of fishery in terms of gear and species:

- 15 gear types (nets, seine, traps, line, troll, spear, hand collection)
- 32 species or functional species groups



Project goals

Traditionally the scalefish fishery has been assessed and managed by species or gear type

But commercial scalefish fishery is a **highly dynamic 'mixed' fishery**:

- Multiple fish species caught
- Multiple gear types used
- Spatially and seasonally diverse
- Fishers adapt and change their operations in response to species availability, market opportunities etc

Strong interactions between the different fishing practices:

- Simply summarising the catch is insufficient for full understanding of the overall dynamics
- Management decisions for one species affect fishing for other species

Project goals:

- Describe structure of fishery
- Determine fleet dynamics of a subset of fishery
- Develop a simulation model of a subset of the fishery using ISIS-Fish

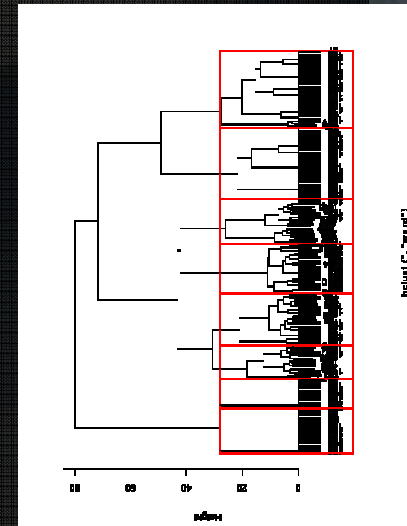
Fishery Structure

Logbook data:

- Catch and effort records by day
(not trip, pooled by month for analysis since daily data very noisy)
- Relatively large spatial scale given the fishing operations
- Unverified

Multivariate analysis (clustering and correspondence analyses) to determine:

- Target species by gear
- Fishing tactics (métiers)
Summarising fishing activity into main characteristics of target species, fishing gear, location, time of year (month)
(e.g. target banded morwong with gillnets on east coast from May-Feb)
- Vessel groups with similar fishing tactics (fleets)
Vessels rather than fisher, all vessels
(e.g. group of 12 vessels targeting mainly banded morwong with gillnets on east coast from May-Feb)



Target species

Gear type	N	Target species
Graball net	14524	Blue warehou, banded morwong, bastard trumpeter, striped trumpeter, miscellaneous reef fish, flounder, flathead, Australian salmon, mullet, trevally, barracouta, octopus, shark, mixed group
Dip net	1699	Garfish, calamari, mixed group
Shark net	7671	Shark
Beach seine	2209	Garfish, Australian salmon, mullet, jack mackerel, anchovy, mixed group
Purse seine	501	Garfish, calamari, Australian salmon, mullet, jack mackerel, anchovy
Danish seine	567	Flathead, whiting
Fish trap	4403	(all assumed) Wrasse
Octopus trap	597	Octopus
Hand collection	353	Octopus
Spear	1838	Flounder, flathead, calamari, octopus
Squid jig	3569	Calamari, Gould's squid
Hand line	7773	Wrasse, striped trumpeter, flathead, Australian salmon, barracouta, shark, mixed group
Bottom line	2118	Shark, flathead , mixed (shark and flathead), striped trumpeter, deepwater fish
Drop line	2317	Striped trumpeter, blue-eye trevalla, barracouta, shark, mixed group
Troll	2605	Barracouta, pike, Australian salmon, tuna, mixed group
Total	52744	

Target species are determined from catch composition by principal component and cluster analyses
 N is records per gear, vessel, year, month and fishing block

Fishing tactics

51 fishing tactics of variable sample size defined
Up to 13 tactics per gear (mostly species-specific)
Top 15 tactics represented almost 80% of records

Some Graball net tactics as example:

Tactic	Region	Season	Years 95/96 – 07/08	Species caught (weight %)
Banded morwong	E, SE	All year except Mar-Apr	All years	Banded morwong (72%)
Flounder	N, SW (SE)	All year	Decreasing	Flounder (61%)
Mixed	E, SE (N, SW)	All year	Decreasing	Morwong (26%), bastard trumpeter (17%), striped trumpeter (14%)
Mixed (NW & Flinders)	NW, Flinders	All year	All years	Australian salmon (23%), bastard trumpeter (14%), banded morwong (11%), reef fish species (10%)

Vessel groups

20 vessel groups / fleets categorised into:

Categories	N of vessel groups	Description
Specialists	7	Dominance (>60%) of one or two particular fishing tactics and/or species caught. Often 'niche' gear types (AJ, DS, BS, DN, OP, HC, SP) or species
Specialists of Commonwealth species	3	Dominated by fish species (blue-eye trevalla, deepwater species & sharks) that now fall under Commonwealth jurisdiction
Intermediate	5	Intermediate level of dominant fishing tactics and species caught (generally 40-60%; GN, FP, HL)
Generalists with dominant gear type	4	Dominant gear type hand line and graball nets (23% of all records; GN and HL)
Generalists	1	Mixed vessel group (16% of all records). Highly polyvalent vessels. Group included all fishing tactics, with graball net (23%) and handline (19%) and squid jig (12%) accounting for most records

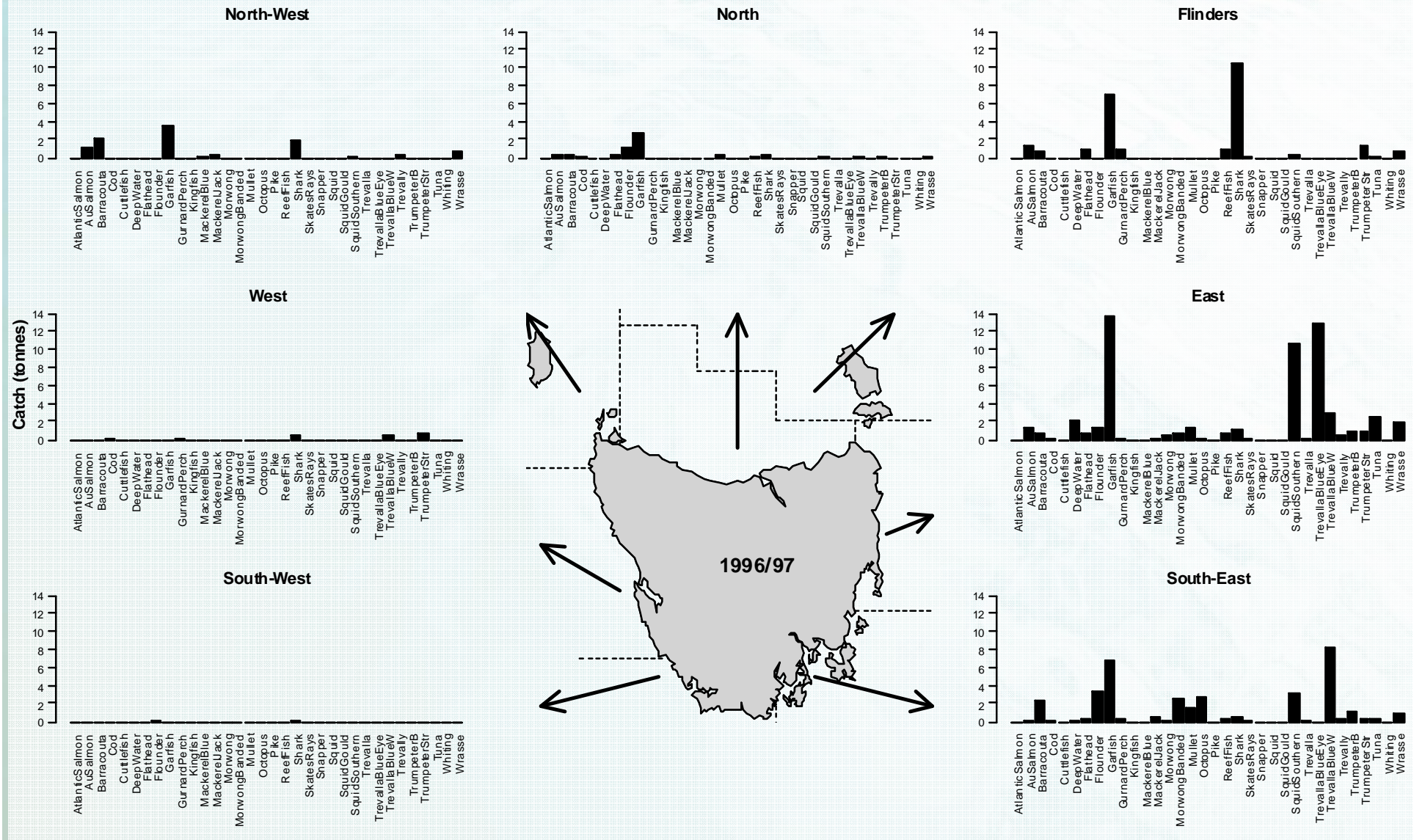
Specialist

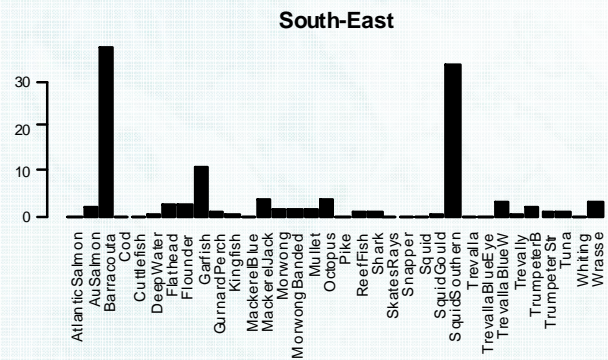
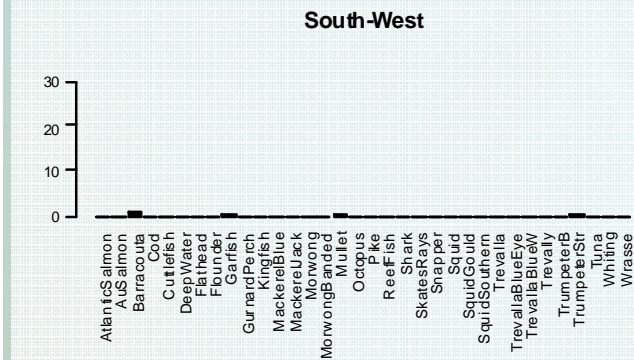
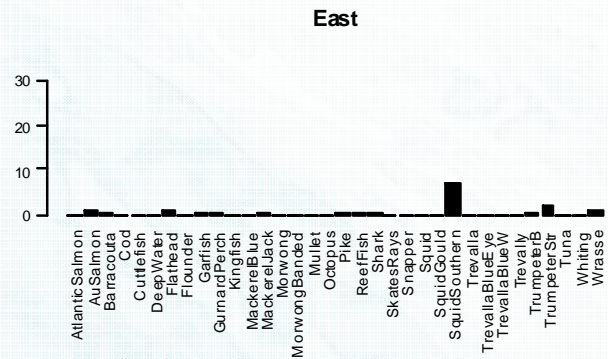
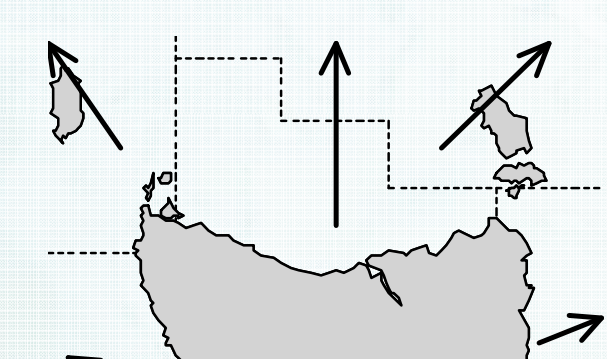
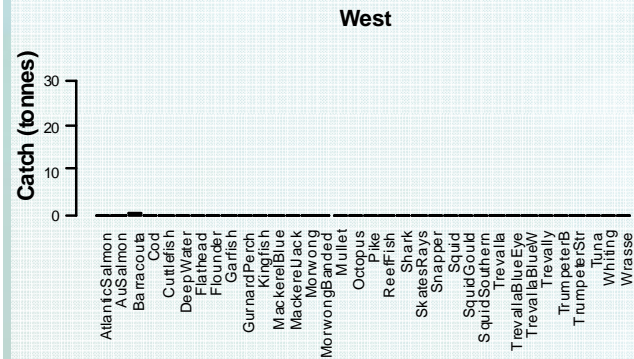
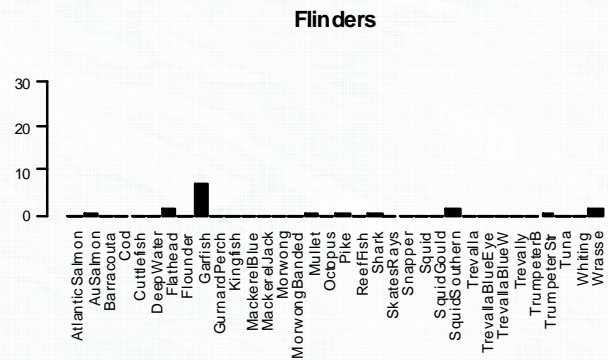
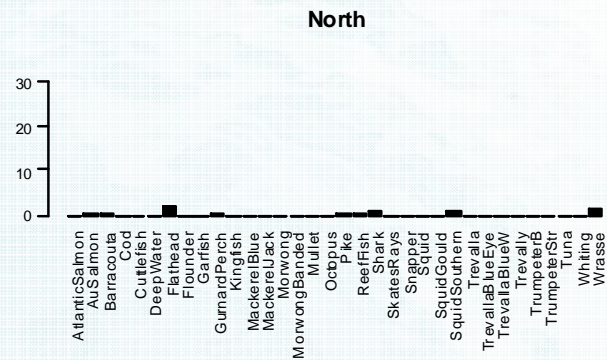
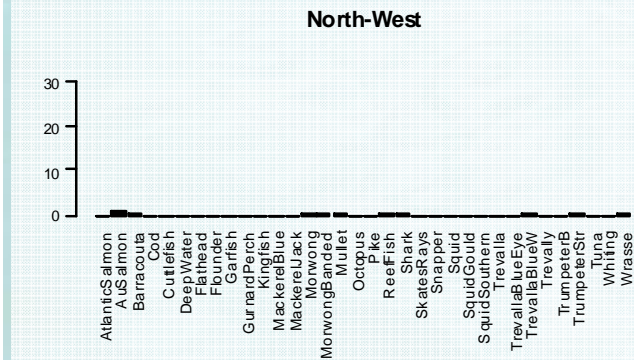
Generalist

Some VG dominated by vessels with lobster licences

Vessel groups determined from proportion of records that a vessel fished a particular fishing tactic
By multiple correspondence and cluster analyses

Spatial and temporal patterns of mixed vessel group





Fleet dynamics (work in progress)

‘Fleet dynamics’ analysing fisher’s behaviour

Subset of fishery in South-East and East (489 fishers) have reported catches of 4 key inshore species:



Banded morwong (~45t)



Calamari (~100t)



Wrasse (~50t)



Garfish (~40t)

Fleet dynamics

Different types of fishing operations reflected in catches (part-time vs full-time, targeted vs bycatch only):

→ **Fleet stratification** necessary for better prediction?

(1) Catches only for 1 year: 113 fishers (23%)

(2.3% of total catch of key species)

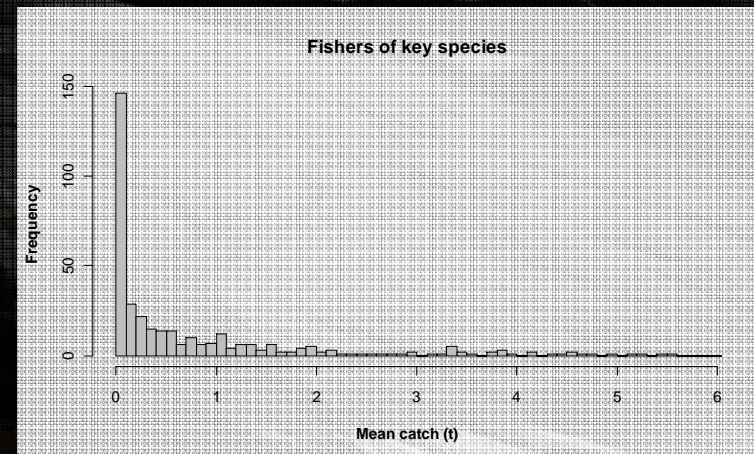
(2) Median catches <200kg per year: 175 fishers (36%)

(1.7% of total catch of key species)

(3) Remaining 201 fishers (41%)

Most fishers specialise only on 1 species (62%) or 2 species (30%)

Heterogeneous group (part-time versus full-time, different vessel size etc)



Fleet dynamics: RUM

Random utility model (RUM) for fishers of key species in regards to metier by fishing block:

(1) **Small industry survey:**

- Highlighted the diversity of approaches in the industry
- Informed about possible variable choices

(2) **Variables for model:**

- Some variables such as knowledge, habits, information flow etc can be modelled, however other variable more difficult, eg:
- Economic profitability is important only for some fishers, many others are 'life stylers' other activities 'subsidise' fishing
- Extreme variability in annual income for some fishers
- Fish price is highly variable depending on market (e.g. \$16/kg paid local, but \$26/kg paid interstate)
- Relatively large spatial scale of reporting (for dinghies):
 - May hide differences in risk taking
 - Distance to port/steaming time not determinable

Concluding remarks

- Small-scale fisheries are often **complex and highly diverse**:
Many fishers, gear types, species, tactics and fleets
Many links to other fisheries and activities
Large range from specialists to generalists
- Modelling the fleet dynamics may require stratification / selection of appropriate vessel or fisher groups
- Not all fishing choices follow economic rational (e.g. life style choices)
- Finally, fleet dynamics and fishers' choices will be used in multi-species & multi-gear ISIS-Fish model to **simulate the scalefish fishery**
→ Predict future developments in the fishery

Project funded and supported by:



Australian Government

**Fisheries Research and
Development Corporation**



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IAN POTTER
FOUNDATION**