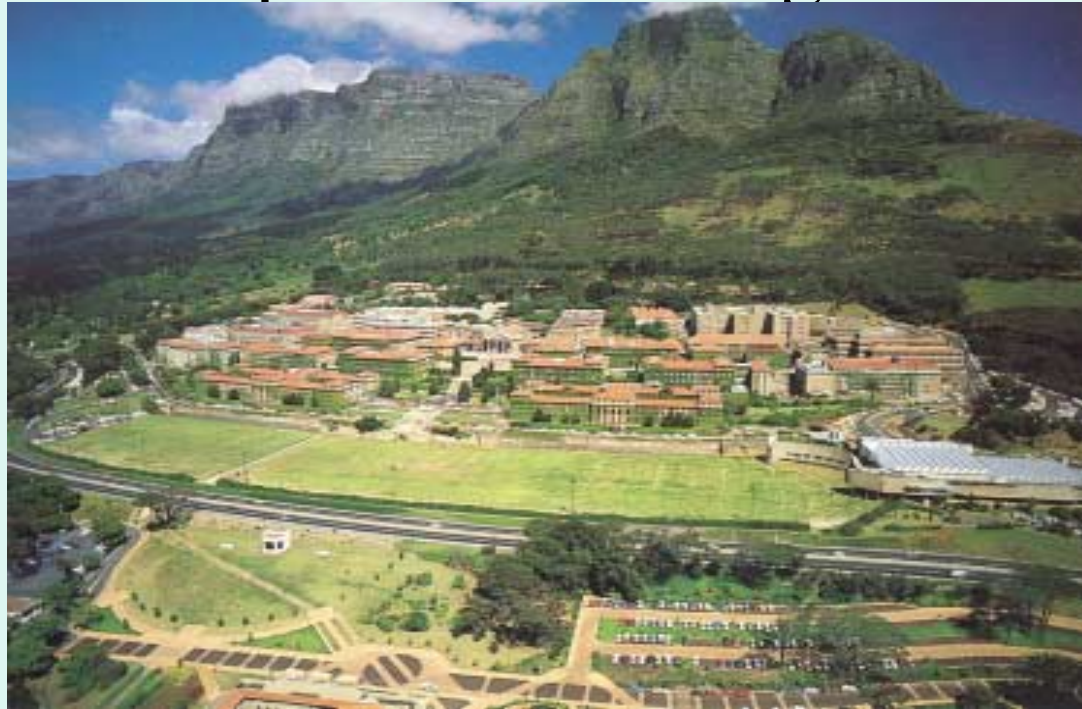




Aquatic invasive species in South Africa- impacts and management



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Presentation format:

1. Scope and definitions
2. Invasive freshwater plants
3. Invasive freshwater animals
4. Invasive marine species
5. Conclusions & future research



Marine: *Carcinus maenas*



FW plants: *Eichornia crassipes*



FW fish: *Oncorhynchus mykiss* Photo S Mills
2

Scope and definitions:

Presentation limited to:

1. Political boundaries South Africa

2. True alien invasive species

No domesticated and cryptogenic species.
Translocated species excluded (although many - like catfish & tilapia, important!)

3. Aquatic species

Terrestrial plants not considered, although impacts massive (reduce river runoff 7%, control costs \$100 million pa)



Sharptooth Catfish *Clarius gariepinus*



Acacia cyclops

Invasive freshwater plants in RSA:

Six significant species. All deliberately introduced. Ornamental or culture.

Species/ origin/date	Impacts
<i>Pistia stratiotes</i> Nile lettuce North Africa, ? date	Clog waterways; mosquito/snail habitat; de-oxygenation
<i>Azolla filiculoides</i> red water fern S. America, 1950's	Clog waterways; mosquito/snail habitat; prevent recreational use
<i>Myriophyllum aquaticum</i> parrot's feather, S. America, 1919	Clog waterways; mosquito/snail habitat; de-oxygenation
<i>Eichhornia crassipes</i> water hyacinth S. America, before 1910	Prevent boating, fishing; increase evaporation; block canals, pumps etc
<i>Salvinia molesta</i> 'water fern' tropical America, 1959	Choke waterways; prevent recreational use; increase evaporation;
Rorippa nastertium-aquaticum watercress, Europe and Asia, pre 1900	Clog waterways, increase evaporation, mosquito/snail habitat

Freshwater invasive plants : Control

1 - *Azolla filiculoides*

Biological control with *Stenopelmus rufinasus* (weevil) since 1997. Very successful, often 100% removal.



Before and after photos
by John Hoffman

Freshwater invasive plants : Control

2 - Myriophyllum aquaticum

Biological control with *Lysathia sp.* (Chrysomelid beetle) since 1994. Retards growth, but plants recover quickly. Control only partial.



Photo: John Hoffman

Freshwater invasive plants : Control

3 - *Eichhornia crassipes*

Biological control with two *Neochetina* weevils (and 3 other agents), 1974-1990s. Very successful in warmer regions and larger, deeper water bodies. Hampered by cold winters and episodic flooding in colder south. Mechanical control used in smaller systems.



Photo: John Hoffman



Photos:Black River - Cape Town

Freshwater invasive plants : Control

4 - *Salvinia molesta*

Biological control by weevil *Cyrtobagous salviniae* since 1985.
Very successful, but much slower in colder Cape region,
where mechanical and chemical control also used.



Manual clearance *Salvinia* W Cape

Invasive freshwater animals in RSA

Ca 30 confirmed species. Deliberate (or parasites). Sport or pet trade.

Source: De Moor and Bruton 1988

Taxon: No. spp	Important spp.	Main impacts
Protozoans: 2	<i>Ichthyophthirius</i> (whitespot) <i>Trichodina</i> (ciliate)	Fish parasite Fish parasite
Cnidaria: 1	<i>Craspedacusta sowerbyi</i> (hydroid - medusa)	Zooplankton predator
Platyhelminths: 1	<i>Bothriocephalus</i>	Fish tapeworm
Crustaceans: 2	<i>Argulus</i>	Fish louse (parasite)
Gastropods: 3	<i>Lymnaea, Physa, Helisoma</i>	Fluke host (<i>Physa</i>)
Bony fish: 23	<i>Parasalmo</i> (rainbow trout) <i>Salmo</i> (brown trout) <i>Cyprinus</i> (carp) <i>Micropterus</i> (bass, 2 spp) <i>Lepomis</i> (bluegill sunfish)	Predator /competitor Predator/ competitor Habitat alteration Predator/ competitor Predator/ competitor
Reptiles: 1	<i>Trachymys</i> (red-eared terrapin)	Competitor/ vector

Particular crisis of 'Cape' endemic freshwater fishes

- 16 endemic fish in Western Cape region (=Cape Floristic Kingdom)
- Dominated by cyprinids (15 spp.)
- 15 of these species threatened! Mainly by invasive alien fishes and habitat degradation



Redfin minnow



Cape Kurper

Distribution pattern endemic fish species in South Africa

(from Skelton et al. 1995 *S. Afr. J. Zool.*)

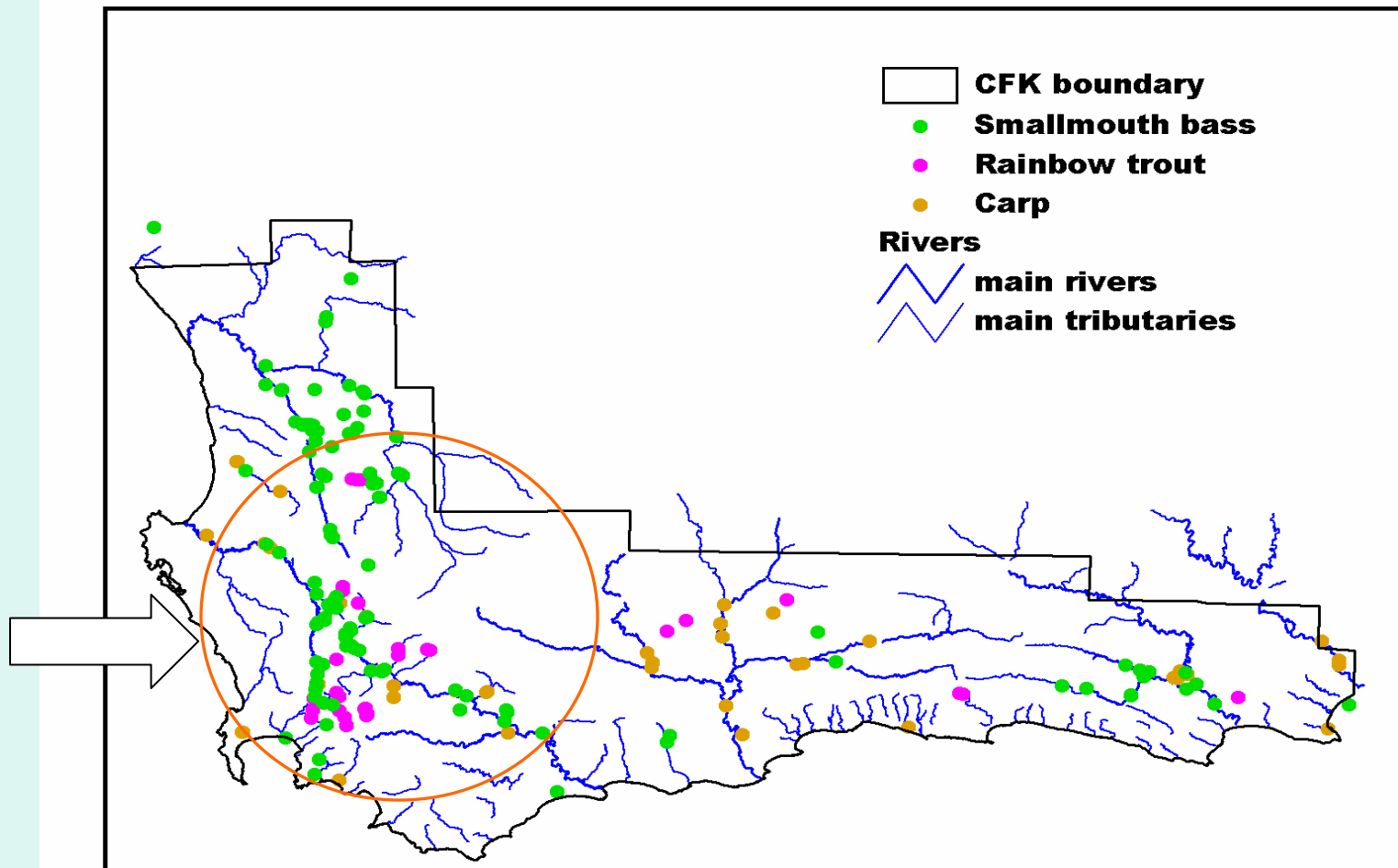


Shades indicate number of indigenous species per grid square. Note 'Hotspot' in SW Cape

Distributions of major alien invasive fish in W Cape

Note hotspots of indigenous species heavily infested!

(with thanks to D. Impson)



Example of conflict: Impact of alien small-mouth bass *Micropterus dolomieu* on indigenous fishes in the Hex River, SW Cape (Christie 2002)

Species	Density above causeway	Density below causeway
<i>Barbus andrewi</i> <i>whitefish (angling spp)</i>	345	5
<i>Pseudobarbus burchelli</i> <i>(redfin minnow-endangered)</i>	453	0
<i>Sandelia capensis</i> <i>(Cape Kurper)</i>	117	0
<i>Micropterus dolomieu</i> <i>(BASS)</i>	5 (first time recorded!!)	190



Photo: Dean Impson



But:

Bass, trout and other introduced sport fish:

- Important to recreational anglers
- Support valuable tourist industries

Solutions :

- Re-educate anglers to value indigenous species (eg Clanwilliam yellowfish)
- Clear key reaches of invasives to conserve critically endangered endemics



Smallmouth bass (S Mills)



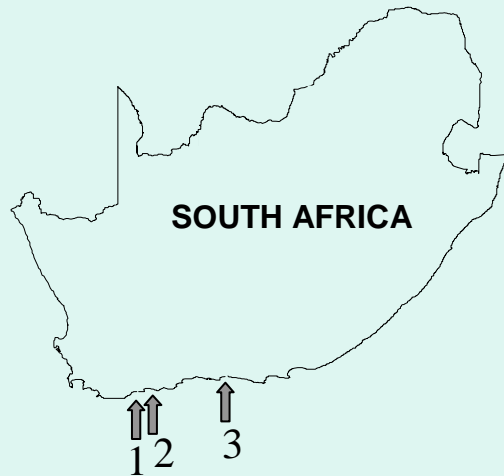
Clanwilliam yellowfish
(S Mills)

Invasive marine species in RSA

10 spp, 4 significant. All but one accidental (fouling or ballast water)

Species	Group	Location / Date detected	Status in 2004
<i>Carcinus maenas</i>	Crab	Cape Town, 1983	invasive in SW Cape
<i>Mytilus galloprovincialis</i>	Mussel	West coast, ca 1979	very invasive
<i>Crassostrea gigas</i>	Oyster	Knysna, 1970's	naturalised in 3 estuaries
<i>Ciona intestinalis</i>	Ascidian	whole coast, 1955	very abundant in harbours, lagoons
<i>Littorina saxatilis</i>	Periwinkle	Langebaan, 1974	Locally abundant 2 sheltered sites
<i>Sagartia ornata</i>	Anemone	Langebaan, 2002	Locally abundant One lagoon

Crassostrea gigas Japanese oyster



- 1 Breede River Estuary
- 2 Goukou River Estuary
- 3 Knysna River Estuary



Breede River

Origin: Asia

Site of introduction: Knysna

Current distribution: Three estuaries on South coast

Ecological impacts: Unknown

Economic impacts: Potential harvest



C. gigas

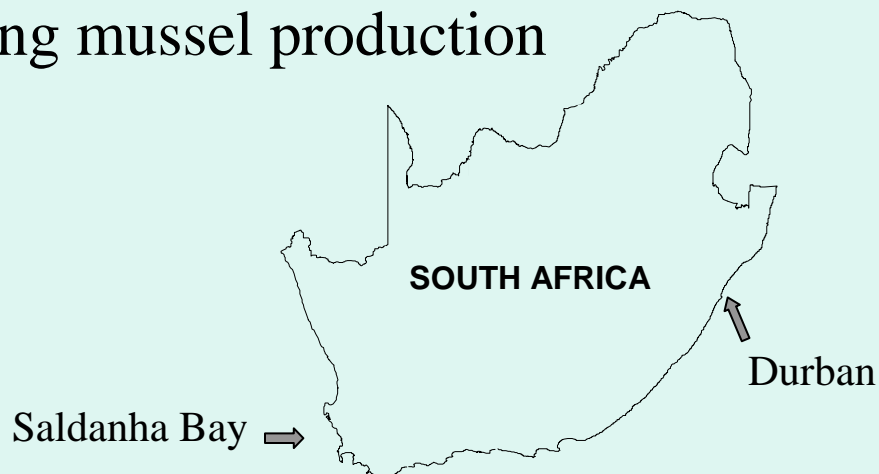
Ciona intestinalis

Transparent ascidian

Origin: North Atlantic

Location: Harbours & sheltered bays only, Saldanha Bay to Durban

Impacts: Important fouling organism. Prevalent on mussel rafts, where smothers mussels, significantly reducing mussel production



Ciona intestinalis



Mussel culture ropes

Carcinus maenas

European shore crab

Origin: Europe

Location: Cape Town docks
and vicinity (ca 100 km range).

Restricted to sheltered sites.

Impacts: Voracious predator.

- Eliminated most prey species from harbour area.
- Serious potential threat to mussel culture and indigenous invertebrates if spreads to aquaculture centres



Carcinus: Table Bay

Mytilus galloprovincialis

Mediterranean mussel

Origin: Europe 1979

Location: Entire west coast to Namibia, spreading along south coast beyond East London

Dominant intertidal organism along west coast. Local biomass can exceed 50 kg m^{-2} .

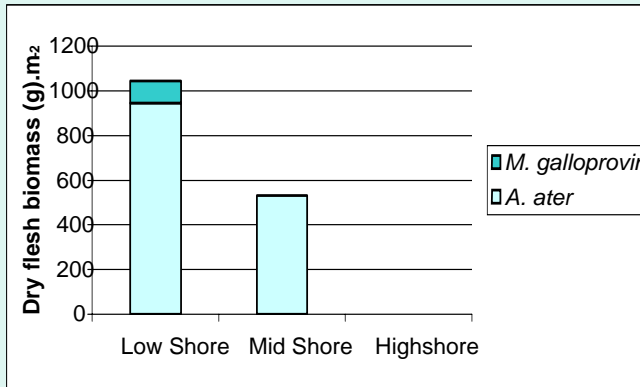
Significant ecological and economic impacts



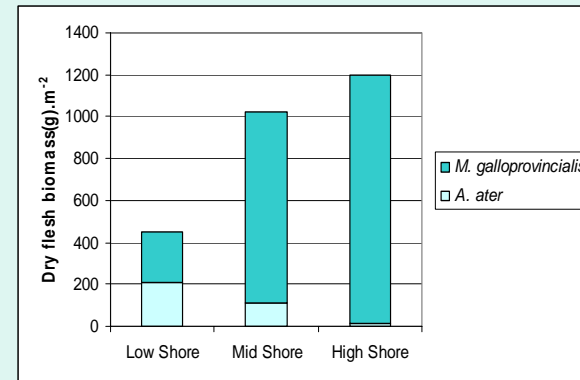
Mytilus on rocky shore, Table Bay

Mytilus: impacts:

1. Upward movement of centre of gravity of mussel beds



1979



1988

Dry flesh biomass.m⁻² on Marcus Island (Hockey & Van Erkom Shurink 1992)

2: Massive increase in mussel biomass

Biomass in wet tons for region

Species	W Coast	S Coast	E Coast	Total (%)
<i>M. galloprovincialis</i>	47 457	2 863	0	50 335 (44.2)
<i>A. ater</i>	10 609	535	0	11 144 (9.8)
<i>C. meridionalis</i>	6 542	697	0	7 239 (6.4)
<i>P. perna</i>	-	31 787	13 400	45 187 (39.6)

Mytilus: impacts:

3. Increased infaunal abundance

- via higher infaunal density m^{-2}

Mussel Species	Infaunal density per m^2
<i>M. galloprovincialis</i>	10 889
<i>C. meridionalis</i>	4 511
<i>P. perna</i>	6 411

(Hammond 2002)

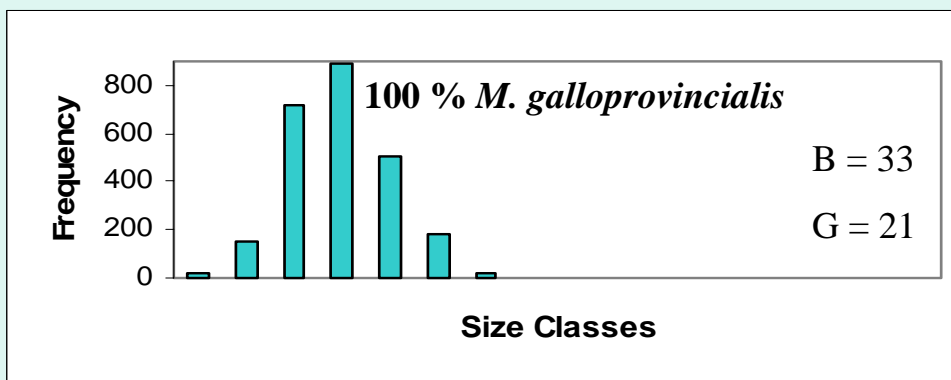
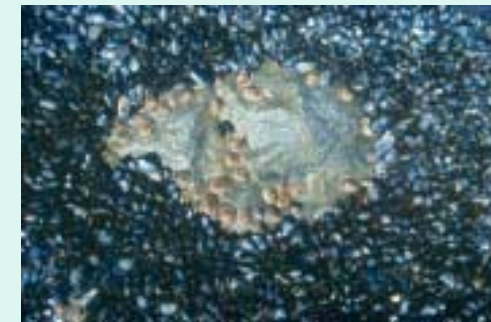
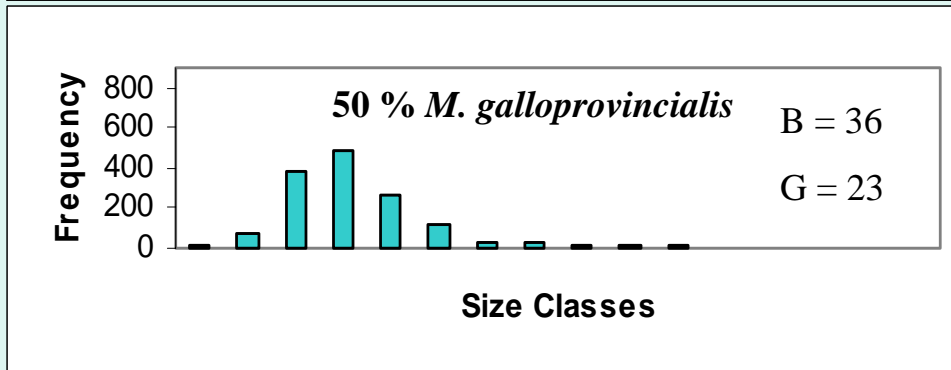
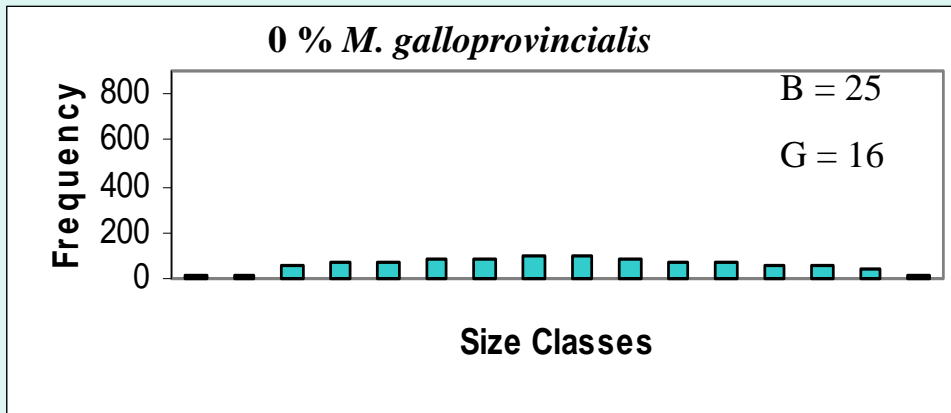


- plus vastly increased area of mussel cover!



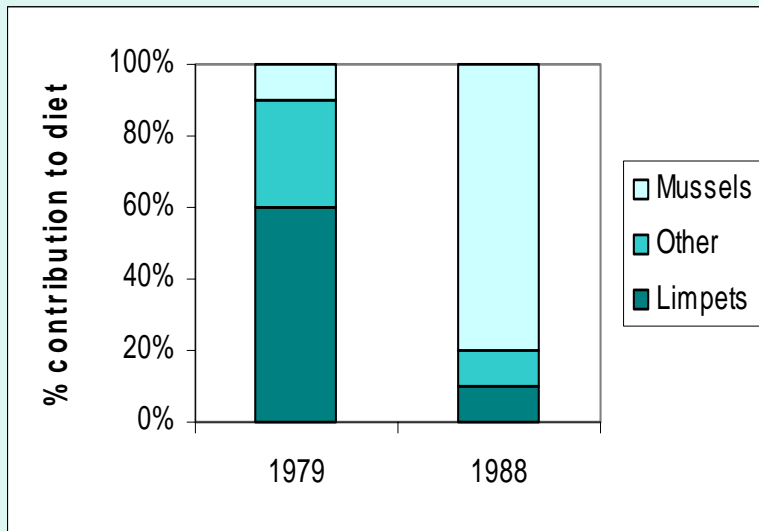
Mytilus: impacts:

4. Competitive interaction with limpets

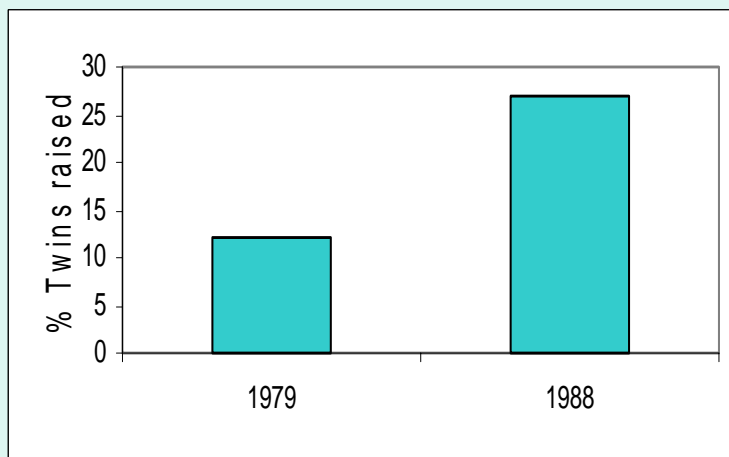


Mytilus impacts:

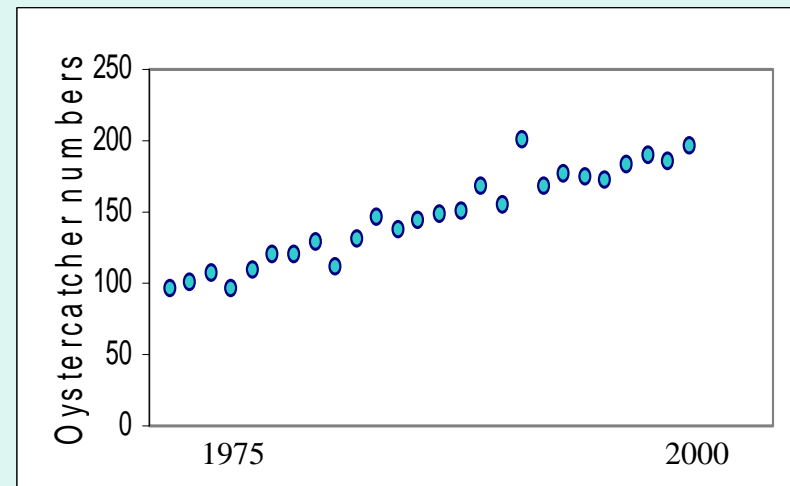
5: Increased resources for predators eg Oystercatchers



↑ Proportion black mussels in diet



↑ Proportion raising twins



↑ Population eg on Jutten Island



(Hockey & Van Erkom Shurink 1992)

Mytilus impacts:

6: Potential economic value for exploitation and culture



Commercial culture since 1980s, production ca 2500t

Small scale commercial exploitation of intertidal stocks (job creation) under development on west coast

Conclusions 1: Comparison between systems:

Variable	Freshwater plants	Freshwater animals	Marine
Dominant vector	Deliberate: ornamental or culture	Deliberate: sport or ornamental (plus parasites)	Accidental: fouling or ballast water, one aquaculture
Ecological impact	Severe ecosystem effects	Severe: predation, competition, disease	Moderate, ecosystem effects, competition
Negative economic impact	Severe	Moderate	Minimal,
Positive effects	Marginal to none	Very high (angling, tourism, food)	High (aquaculture, exploitation, food)
Biological control?	Yes - very successful	No - but physical control possible	No - and control appears unlikely

Conclusions 2: Future work

- CIB established 2004



Proposed aquatic research in 2005:

- **Plants:** Further development biological control and integrated pest management policies
- **Freshwater animals:** Experimental removal fish from critical reaches. Socio-economic studies of angler behaviour.
- **Marine:** Controlled exploitation mussels and oysters; control of ballast water discharges; monitoring aquaculture imports/translocations.

LAST WORD!

The Cape Floristic Kingdom - a place really worth saving!

- Terrestrial/ freshwater: >9600 plant species, 70 % endemic
- Marine environment: >11 100 species, 32% endemic



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