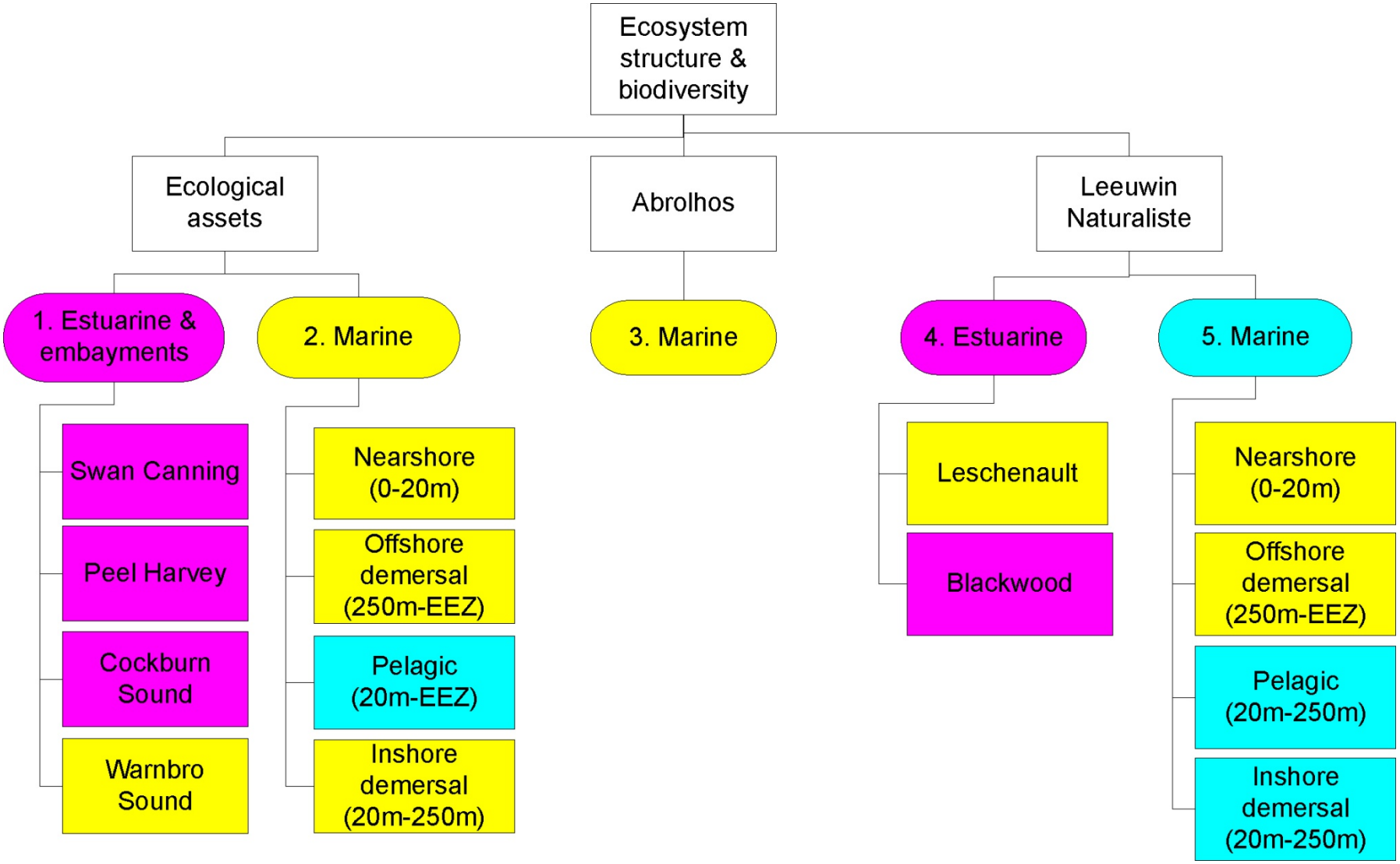
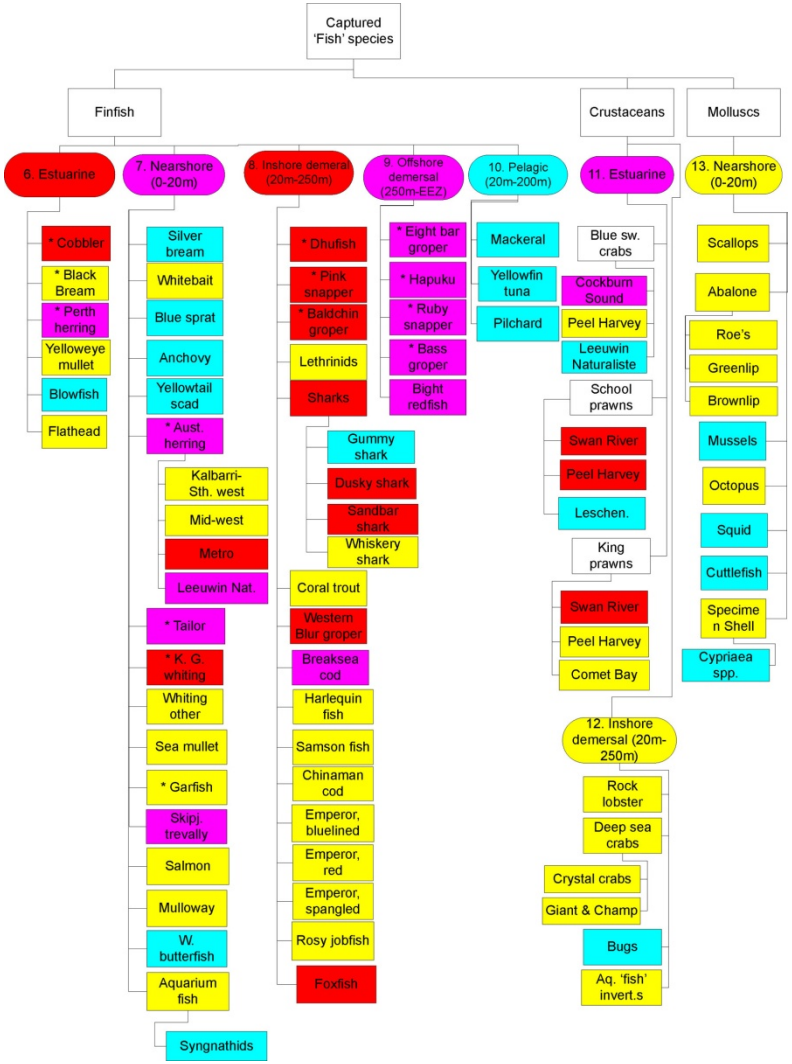
4.3.2 (Quantitative) Ecosystem Modelling

Norm Hall

Focus is Peel Harvey



More precisely, estuarine finfish and crustaceans in Peel-Harvey



Quantitative modelling

- A PhD study by Sarah Fretzer
- Individual plant and animal species are combined into functional groups
  - Similar size, prey and predators
- Ecopath model uses estimates of biomass, rates of production and consumption per unit of biomass, and dietary composition for each group
- Ecosim predicts trends in biomasses that will result (directly or indirectly) when fishing effort or other forcing variable is modified

Findings – with emphasis on issues constraining utility of model for EBFM

- There were sufficient data to develop an Ecopath/Ecosim model with reasonable pedigree
- Data gaps
  - Biomass estimates of fish, birds, macroalgae, etc., are poor – studies directed towards research not absolute population biomass
  - Diets of most fish species in Peel-Harvey are poorly known
  - Recreational catches known only through infrequent surveys
- Limitations of data and model structure
  - CPUE data driven largely by environment, in particular nutrients entering estuary, but model tracks biomass (energy flow) not nutrients
  - Interchange of marine species between estuary and ocean poorly/inadequately handled
  - Ecopath/Ecosim model does not address key issues for estuary
    - nutrient load and impact on trophic structure
    - impacts of climate change

After reviewing study, decision made to determine future model structure

- A scientific workshop will be held later in 2010
- Aim: to determine the type of model for the Peel-Harvey Estuary that needs to be developed to:
  - assess the impacts on the ecosystem of the continued high level of nutrients entering the estuary, and
  - assess the implications of climate change
- Possible recommendation? A biogeochemical ecosystem model integrating:
  - a catchment model
  - a hydrologic and sediment transport model of estuarine/oceanic waters
  - a biogeochemical model that traces the flow of nutrients through the estuary and biota, and
  - an ecosystem model of the food web.

Issues for fish research – reliability of predictions depends on quality of data

- Need improved biomass estimates of fish species in estuary
  - Tagging study, depletion study, estimation of fishing mortality from age composition data?
- Need dietary data for fish species in Peel-Harvey estuary
  - Gut content, stable isotope analysis
- Need trends in abundance of fish species
  - Regular surveys to obtain fishery independent index of abundance and age composition data inside and outside estuary
- Need data on interchange of marine species between estuary and ocean
  - Tagging (conventional or acoustic) inside and outside estuary, micro-chemistry of otoliths from fish inside & outside estuary
- Explore empirical statistical relationships between nutrient load and chlorophyll a and macroalgae

Issues for management/research

- Currently no reference points have been established for the Peel-Harvey ecosystem (or other WA estuarine ecosystems)
- Need a precise statement of the management objectives. What do managers want the ecosystem to look like? What indicators are appropriate to assess performance in achieving objectives?
- Minimum is probably that single species reference points should be established and used, but environmental change also needs to be considered (e.g. Estuary Cobbler in Fig 6) as it will affect some species more than others.
- Likely to require exploration with ecosystem model of the likelihood of change in average trophic level, using reference points for key indicator species

Issues for management (cont.)

- Environmental change due to nutrient load has potential to make currently sustainable levels of exploitation unsustainable
- Although primary management issue is one of managing catchment, fisheries managers will also need to manage the consequences