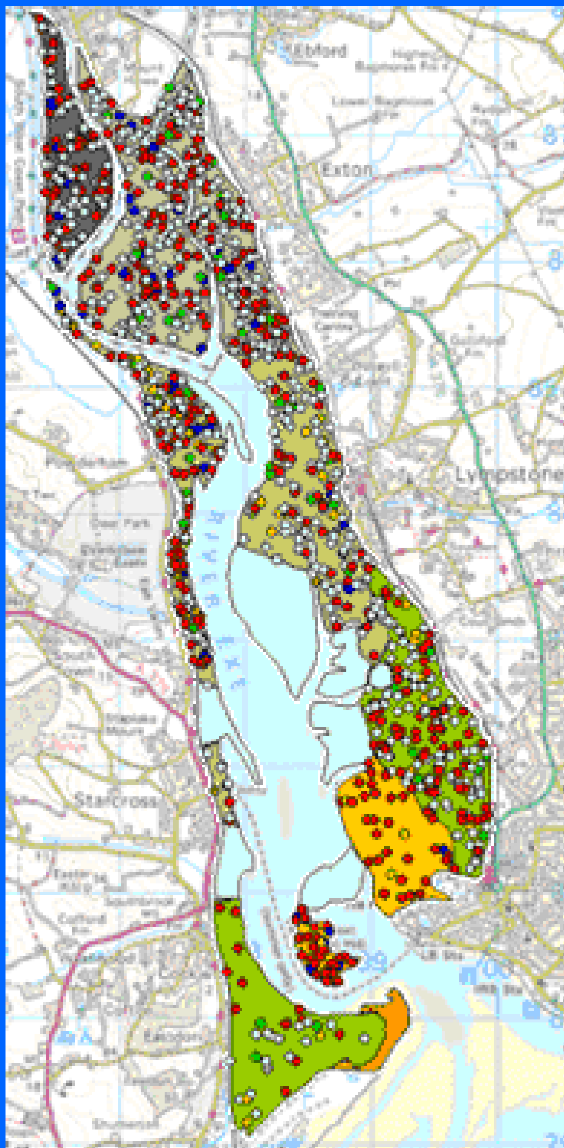
Assessing the effects of coastal engineering on non-breeding shorebirds in estuaries and inlets

Casey Lott- American Bird Conservancy



Most of the ideas in this presentation come from…

Peer-reviewed literature, online resources

Bird monitoring methods

Wetland bird survey, UK… BTO, RSPB, WWT

http://www.bto.org/survey/webs/index.htm

The Shorebird Model

Centre for Coastal Ecology and Hydrology, UK

http://www.ceh.ac.uk/birds/Default.asp

Photos

Previous workshops: Walker Golder, Brian Harrington, Sidney Maddock

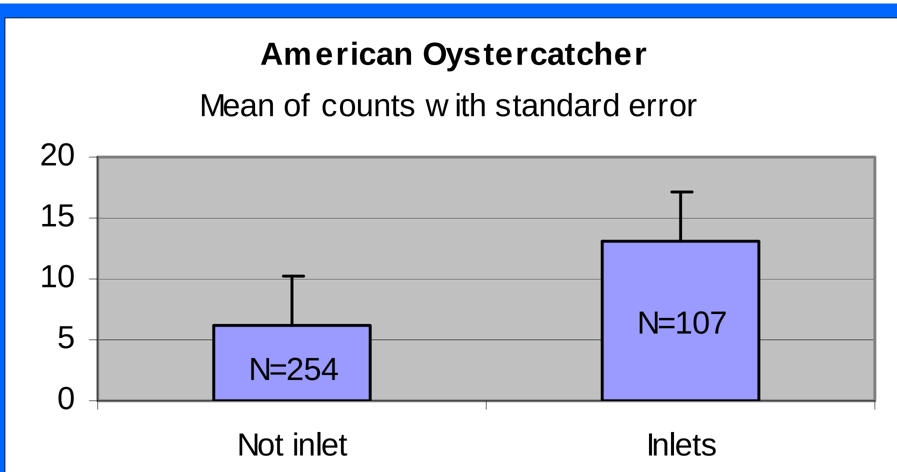
If you haven't been acknowledged, please forgive me

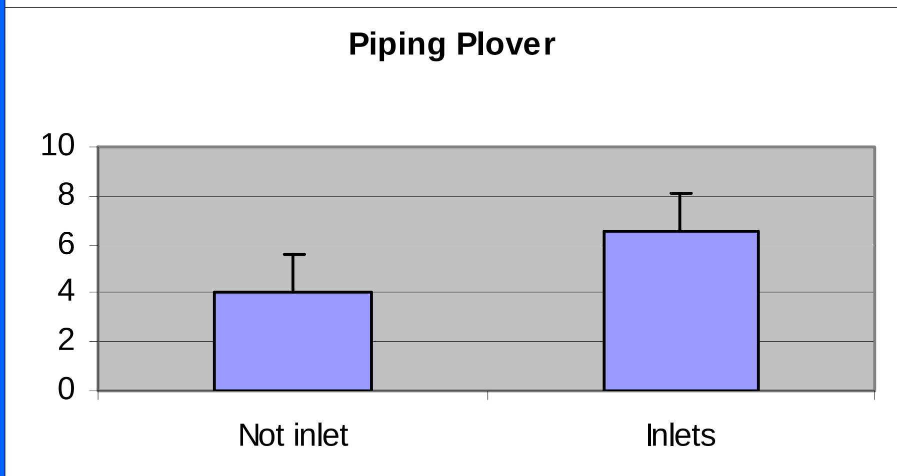
Inlets and estuaries are very important for birds

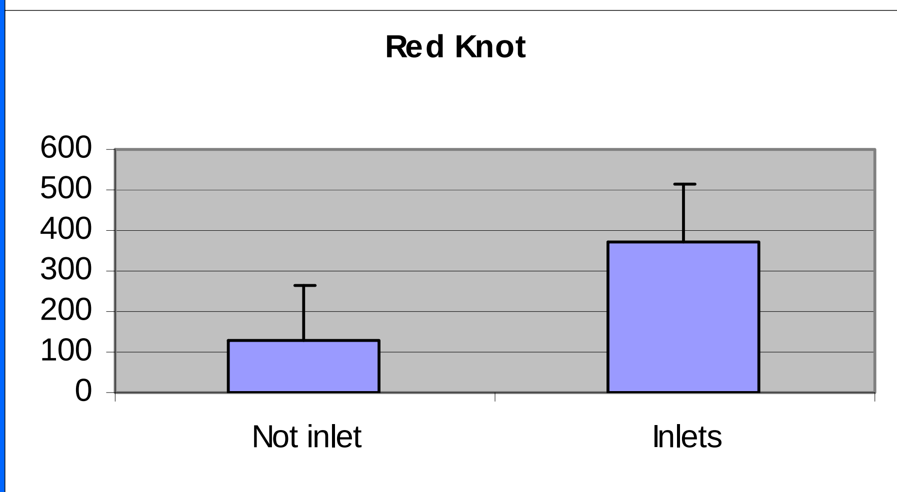
Inlet-o-philic species

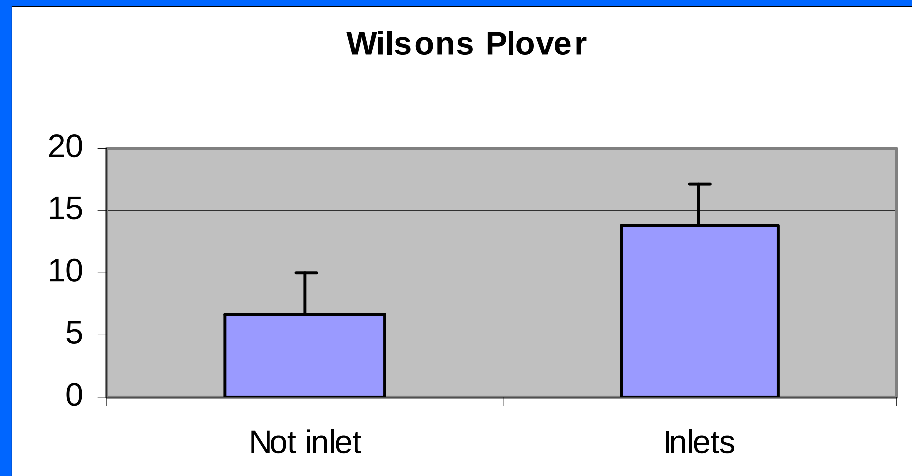
Highly imperiled

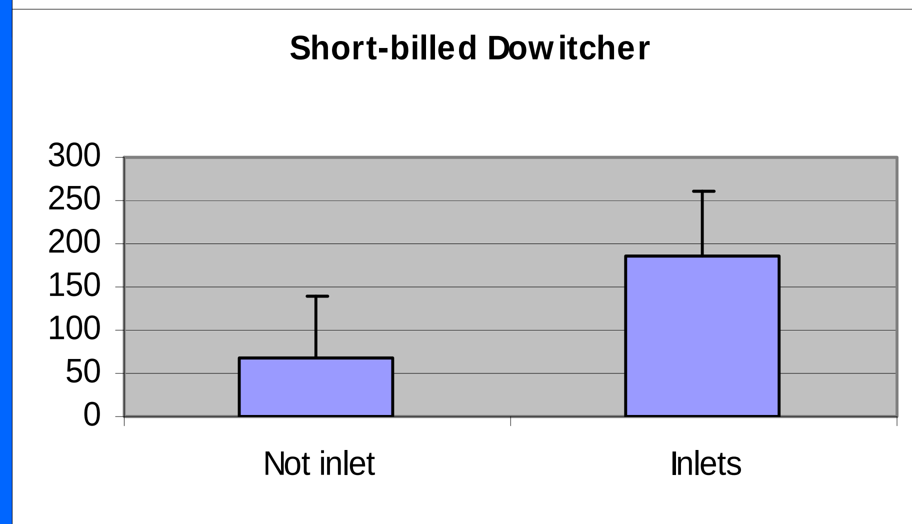
High concern











Non-breeding shorebirds alternate between roosting at high tide and foraging at lower tides

Individual birds use habitats in predictable way

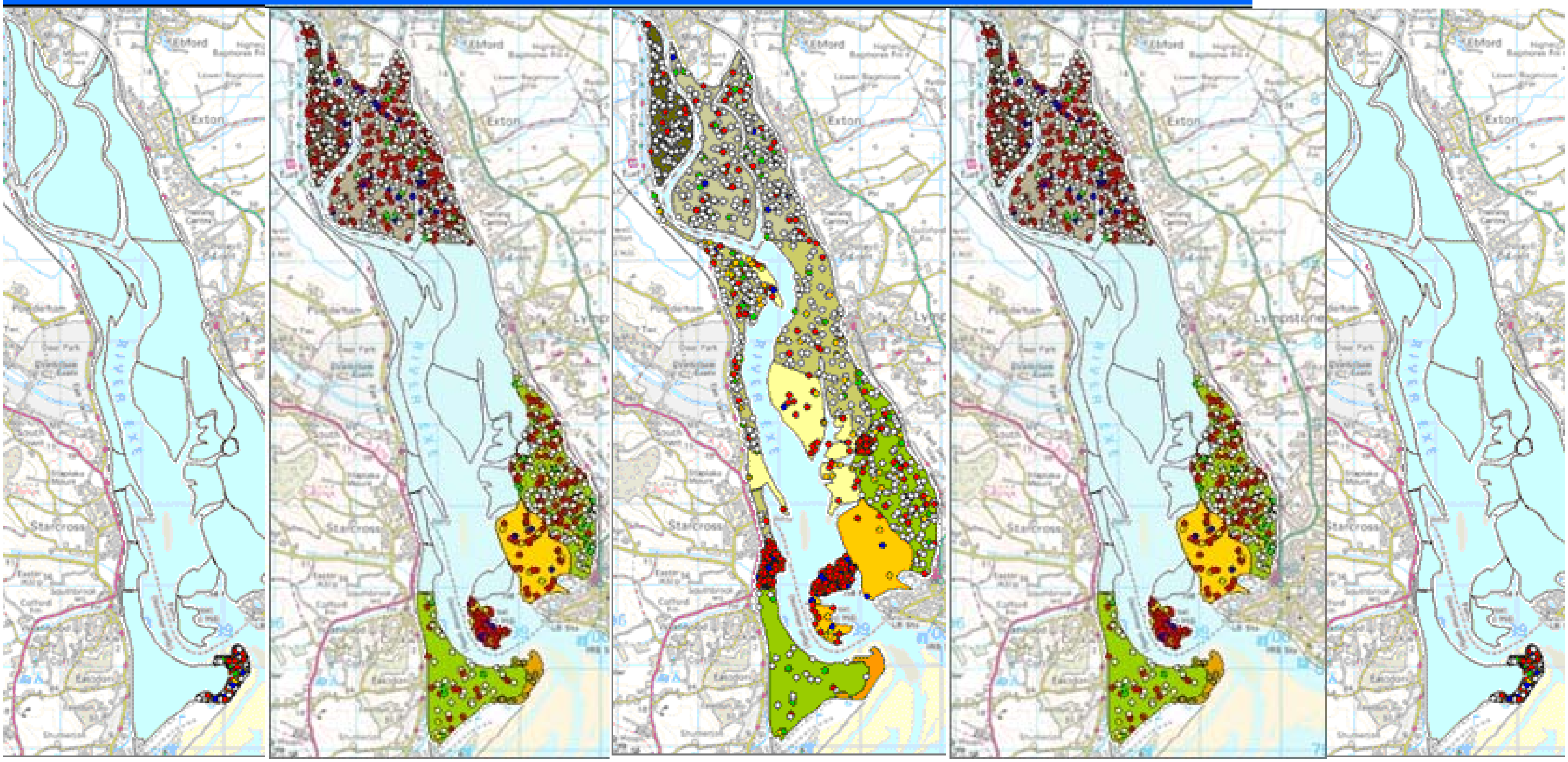
Forage in most profitable habitat for species

Unless excluded by dominant individual

Then… move to next best habitat patch

If no habitat available, roost

- Dunlin
- Grey Plover
- Black-tailed Godwit
- Bar-tailed Godwit
- Oystercatcher
- Curlew



Bird monitoring protocols for inlets or estuaries

Identify major foraging and roosting areas

Count birds at roosts at high tide for population size

Divide areas into count sectors if necessary

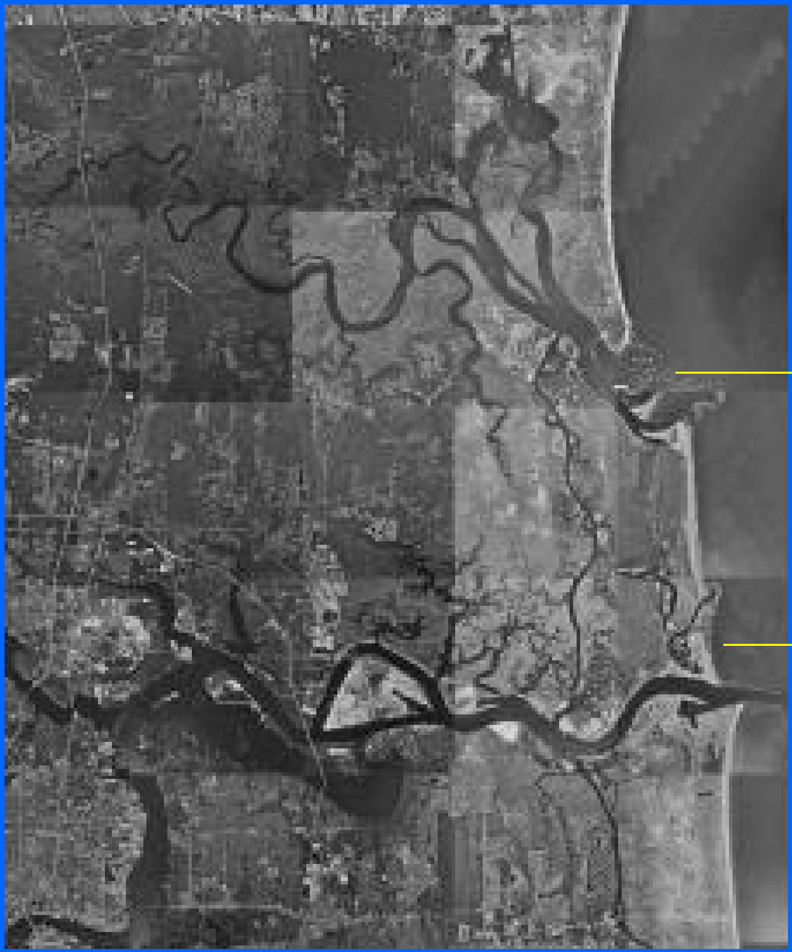
Count birds at low tide to document foraging areas

Frequency and scheduling of counts

Repeat counts once a month to track seasonal changes

Schedule counts 1hr from high (or low) tide- plus/minus

Schedule counts on same date at adjacent sites



Regional high tide count dates

- September 18
- October 16
- November 6
- December 4
- January 15
- February 12
- March 12

Sunday closest to spring or neap tides (high/low counts)

What do numbers tell us?

Site counts can be compared with global, hemispheric, or regional population estimates for species

Sites with >1% of population considered "important"

Sites with >20,000 individuals considered "important"

Low tide counts: track changes in habitat use over time

High tide counts: site-based population trends

How do we interpret changes in numbers over time?

- May be related to quality of site
- May be related to changes in breeding populations
- May be related to use of other wintering sites

Counts are not unambiguous indicators of site quality

How can monitoring help to meet conservation goals?

Use monitoring data to inform management that will…

Maintain quality sites to improve conservation status

Ultimate objective is to increase population size

Do this by improving over-winter survival rates

Evaluate effects of actions and site-based management on survival, not just numbers

How do we monitor over-winter survival?

Long-term, intensive banding-resighting studies

Expensive, many years to produce results

Alternative- model survival probabilities

Individual-based, behavior-based models

Centre for Coastal Ecology and Hydrology, UK

http://www.ceh.ac.uk/birds/Default.asp

The Shorebird Model

Ridiculously complex, many papers

Solid theory, empirical data, validated and tested

Requires minimal field data collection

Intertidal food supply (2-3 weeks, one time event)

Bird abundance, habitat mapping, human disturbance data collected by 2-3 person field crew (Sep.- Mar.)

Time-frame of environmental assessment (modeling)

Can be used to predict effects of actions on survival

- Loss of habitat from dredging
- Effectiveness of potential mitigation projects
- Different scenarios of disturbance management

How does the model work?

Most over-winter mortality is due to starvation

Individuals must eat enough to meet energy demands

Individuals forage in patches that will maximize intake

Individuals vary in foraging efficiency and dominance

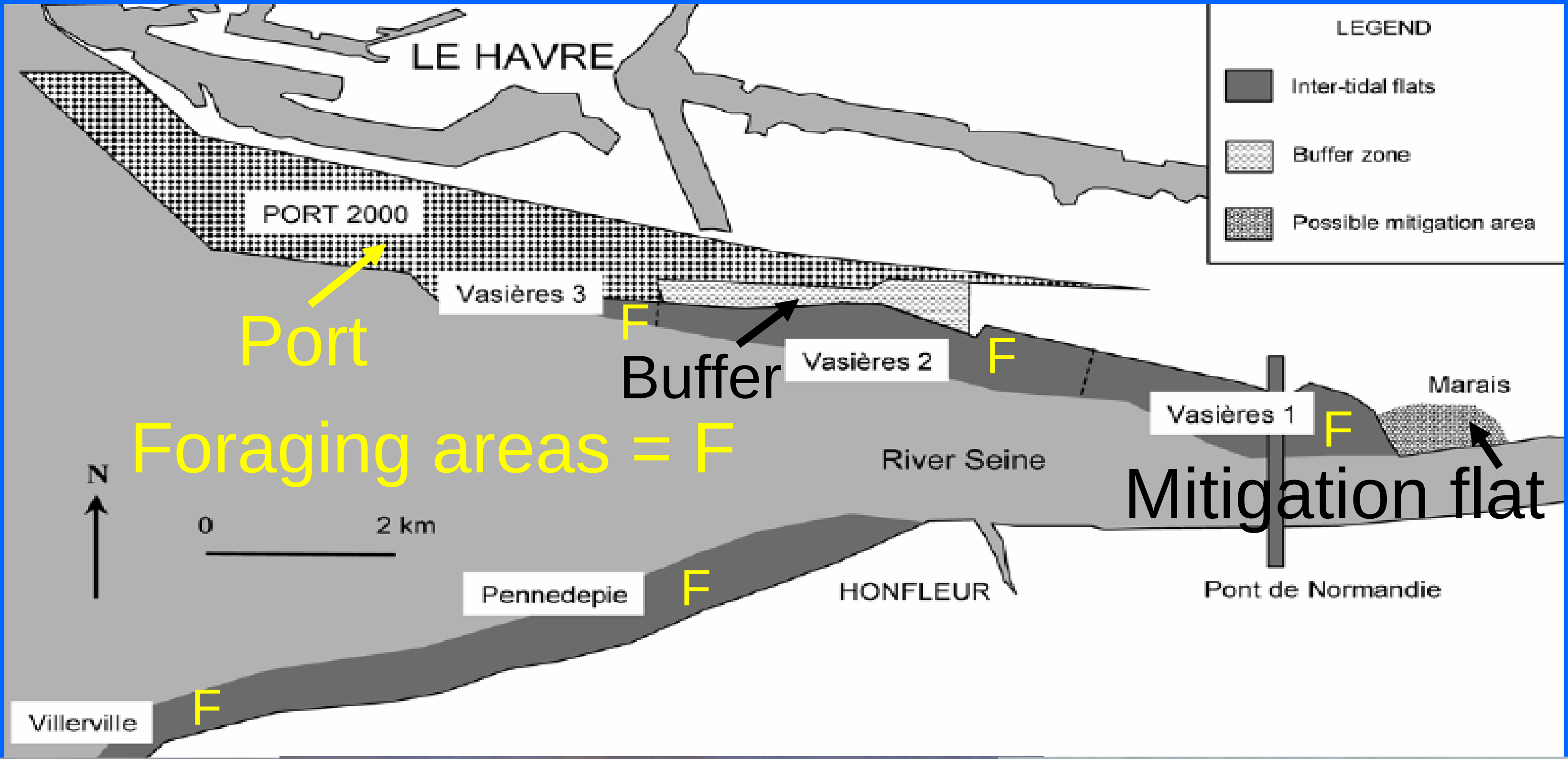
Foraging patches vary in quality and competitor density

Model simulates foraging locations, intake rates, body condition, and ultimate fate of each individual for each day of winter across each tidal cycle

If individual meets daily energy demands, it stores fat

If not, it uses energy reserves until these = 0 and it dies

Effects of port expansion and proposed mitigation



Invertebrate diet varied by bird species

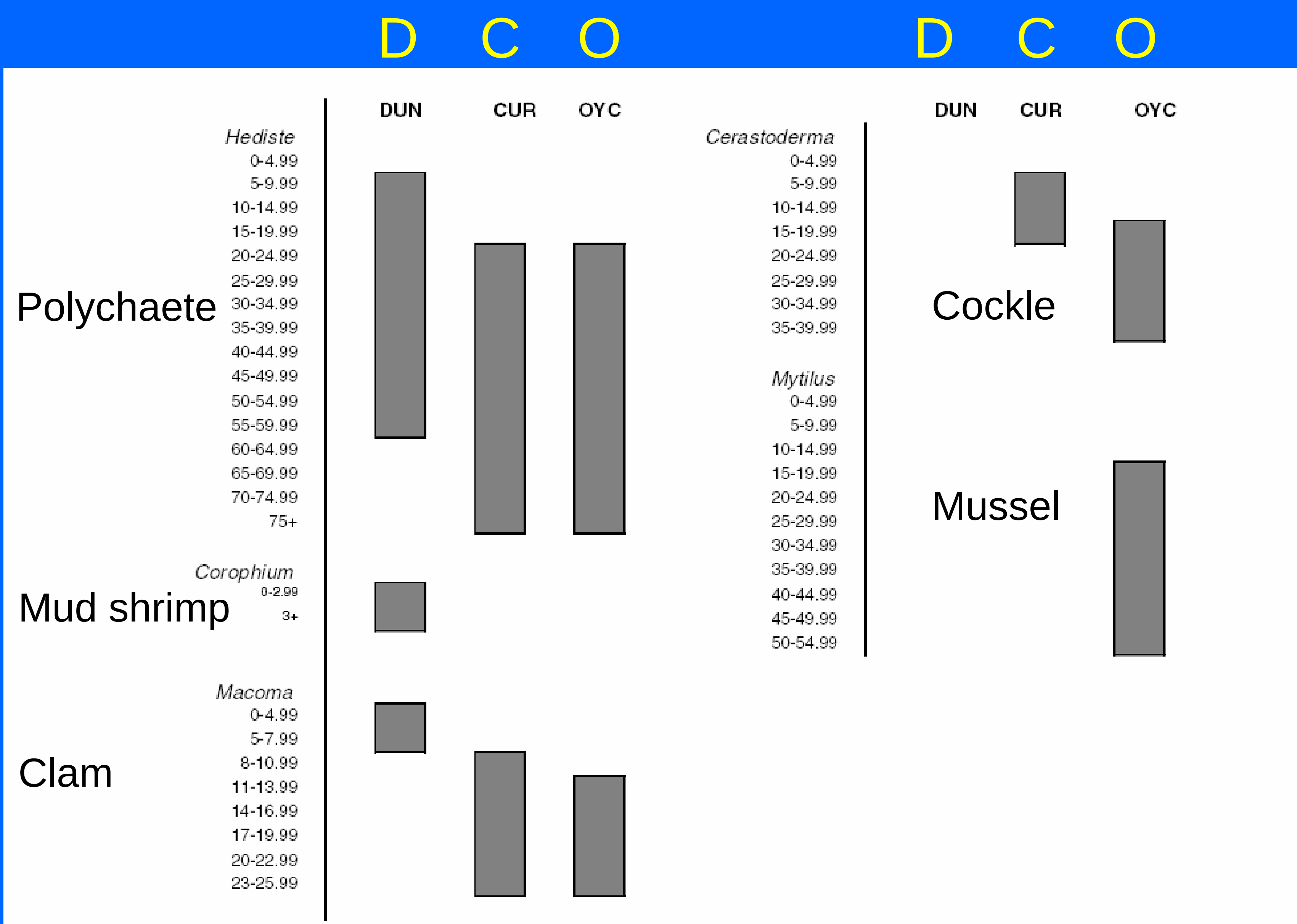


Fig. 2. The size range (mm) of prey taken by each bird species in the model. DUN = dunlin, CUR = curlew, OYC = oystercatcher.

Sampling to characterize different foraging patches

Patch name	Area (ha)	Mean exposure time (h)	Description	Prey species	Disturbance ($n\ d^{-1}$)	
					Weekdays	Weekends
Vasières 1	206.5	8.09	Mudflat	*Hediste diversicolor*, *Corophium volutator*	0.016	0.125
Vasières 2	214	6.41	Mudflat	*Hediste diversicolor*, *Macoma balthica*	0.016	0.125
Vasières 3	21	3.24	Mudflat	*Hediste diversicolor*, *Macoma balthica*	0.016	0.125
Pennedepie	388	2.99	Cockle bed	*Cerastoderma edule*, *Macoma balthica*, *Nephtys hombergii*	0.09	0.20
Villerville	218	2.24	Mussel bed	*Mytilus edulis*	0.13	0.64

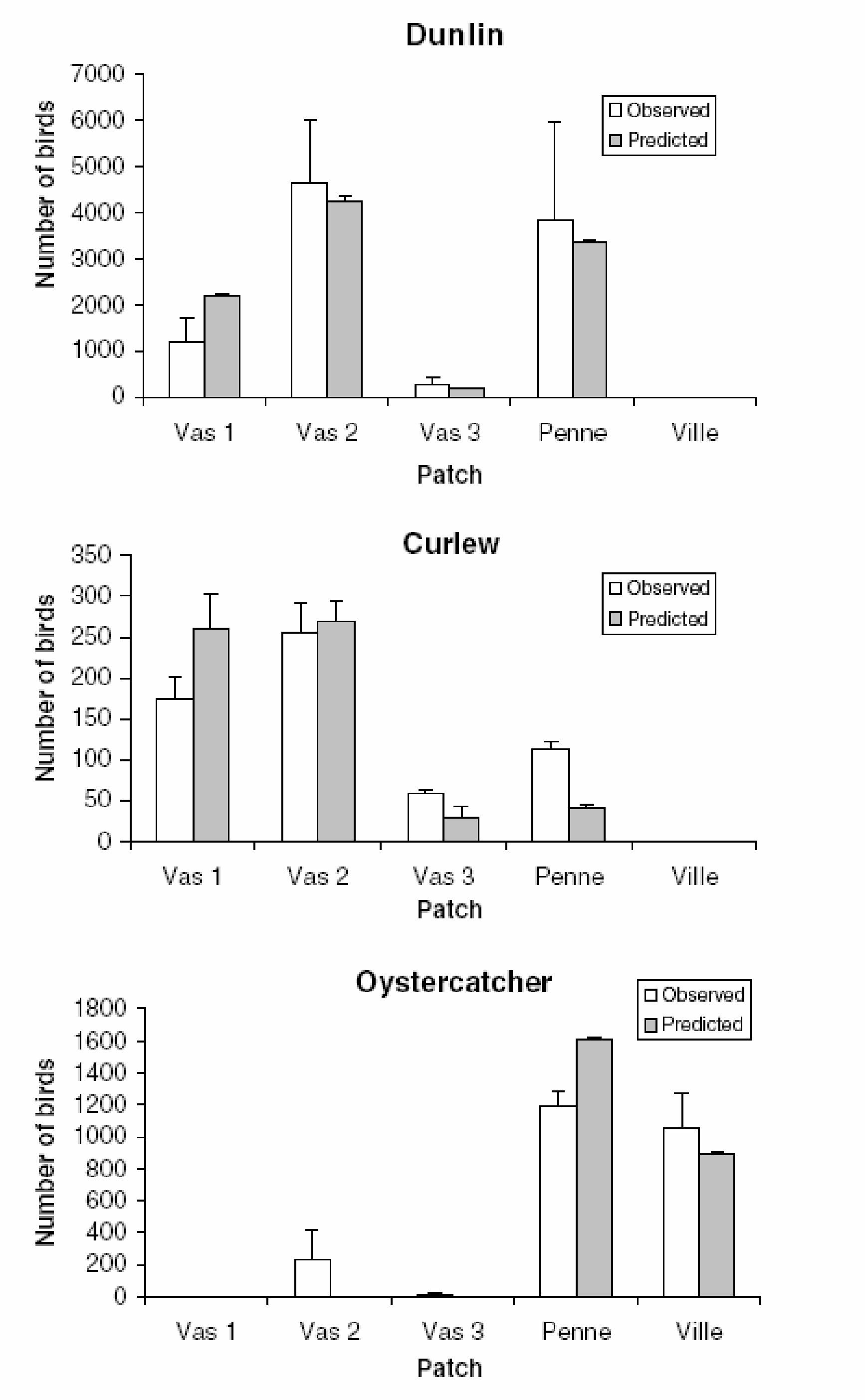
Patches varied by size and exposure length

Patches varied by invertebrate composition and biomass

Patches varied in disturbance rates

Patches had different value for different species!!

Effects of action spatially explicit and will vary by species



Partial model validation

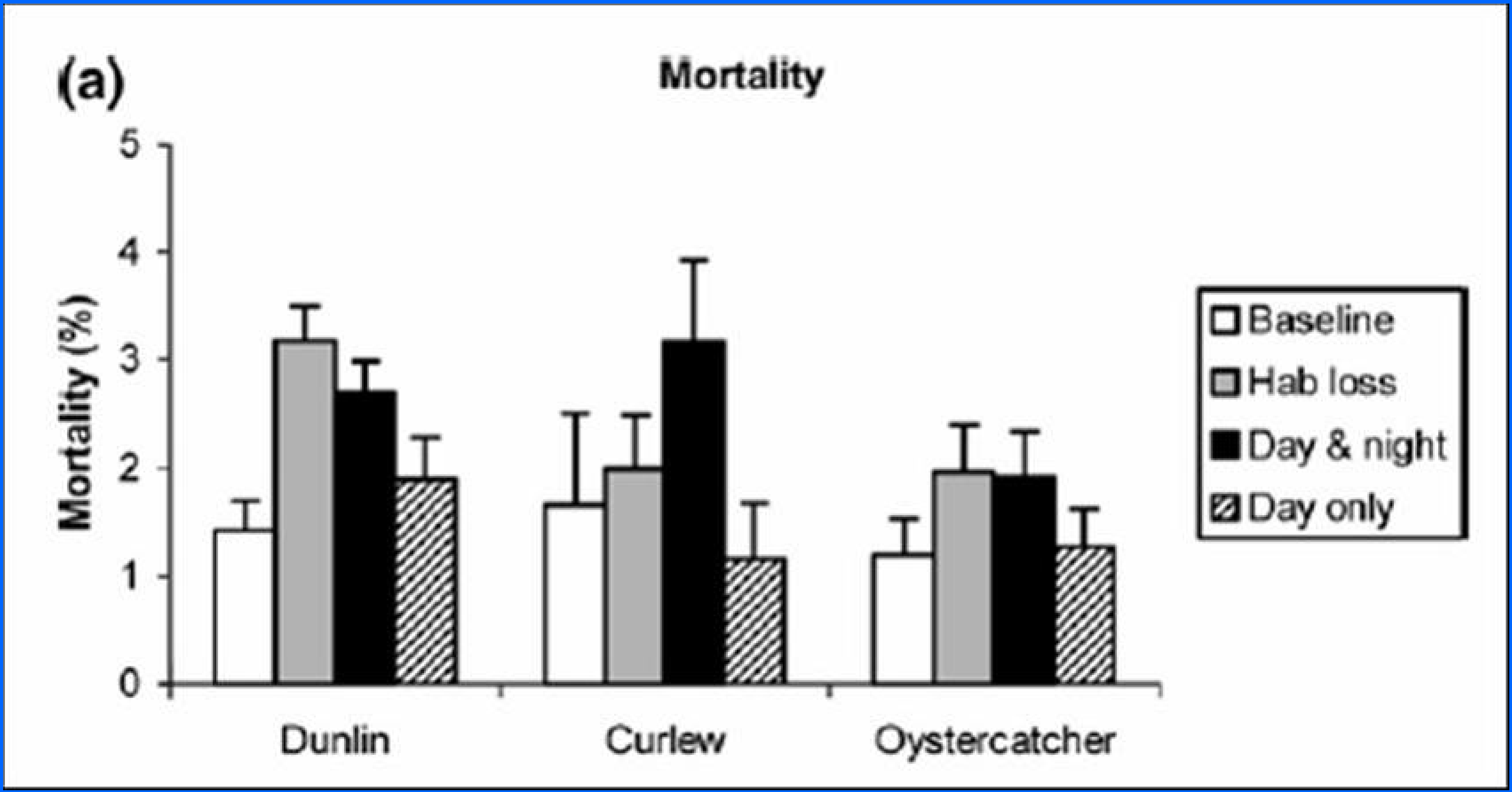
- White bars = field observations- Grey bars = model predictions
- Model accurately predicted use of different foraging patches
- Effects of expansion will vary by patch and species

Compare baseline mortality without expansion with…

Physical habitat loss (105 ha) of flats due to expansion

Disturbance-related habitat loss due to expansion

Combined effect not shown here

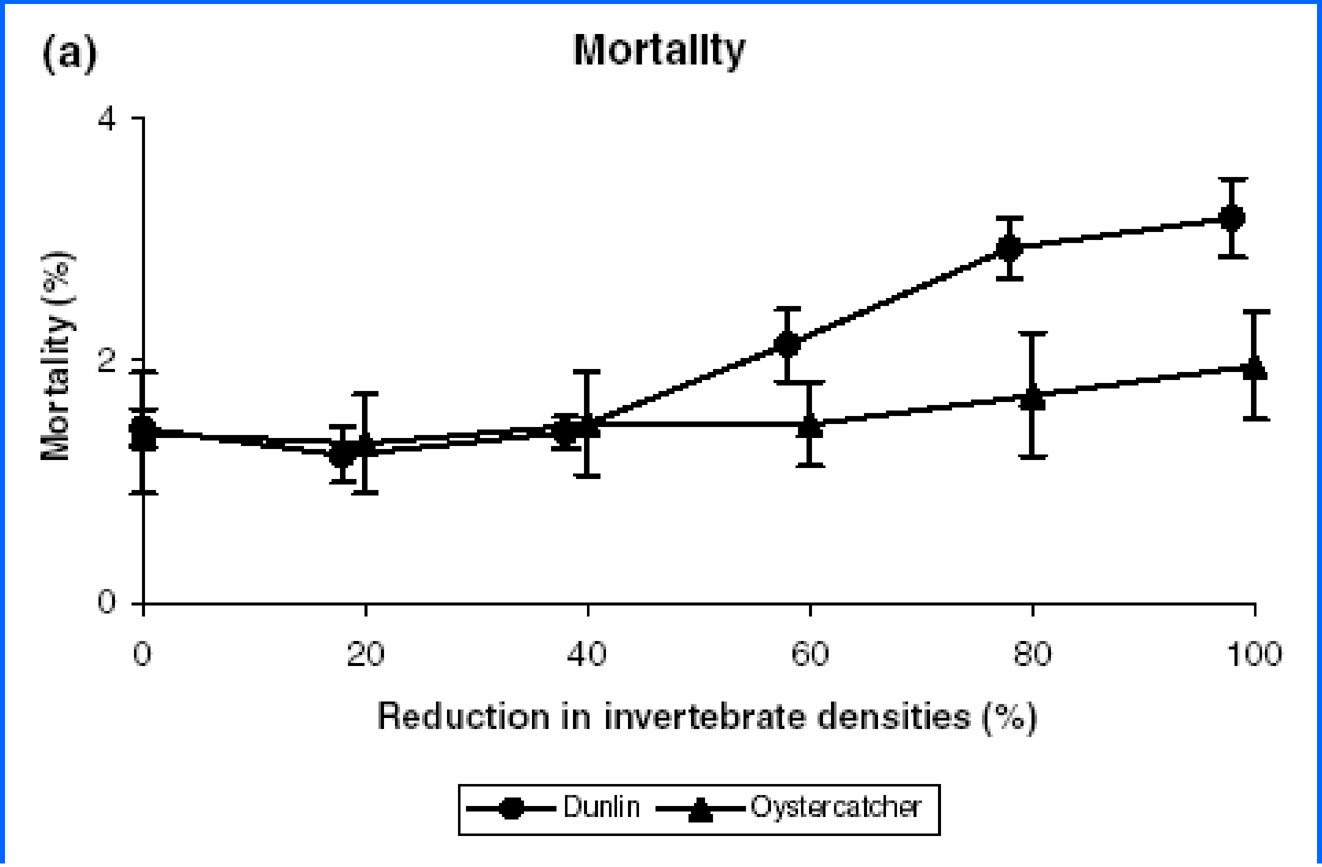


Model used to design mitigation area

Oystercatchers needed 50 ha mitigation area to compensate for habitat lost to port expansion (no buffer)

Dunlins needed 100 ha mitigation area (no buffer)

Effectiveness of mitigation depended on prey densities



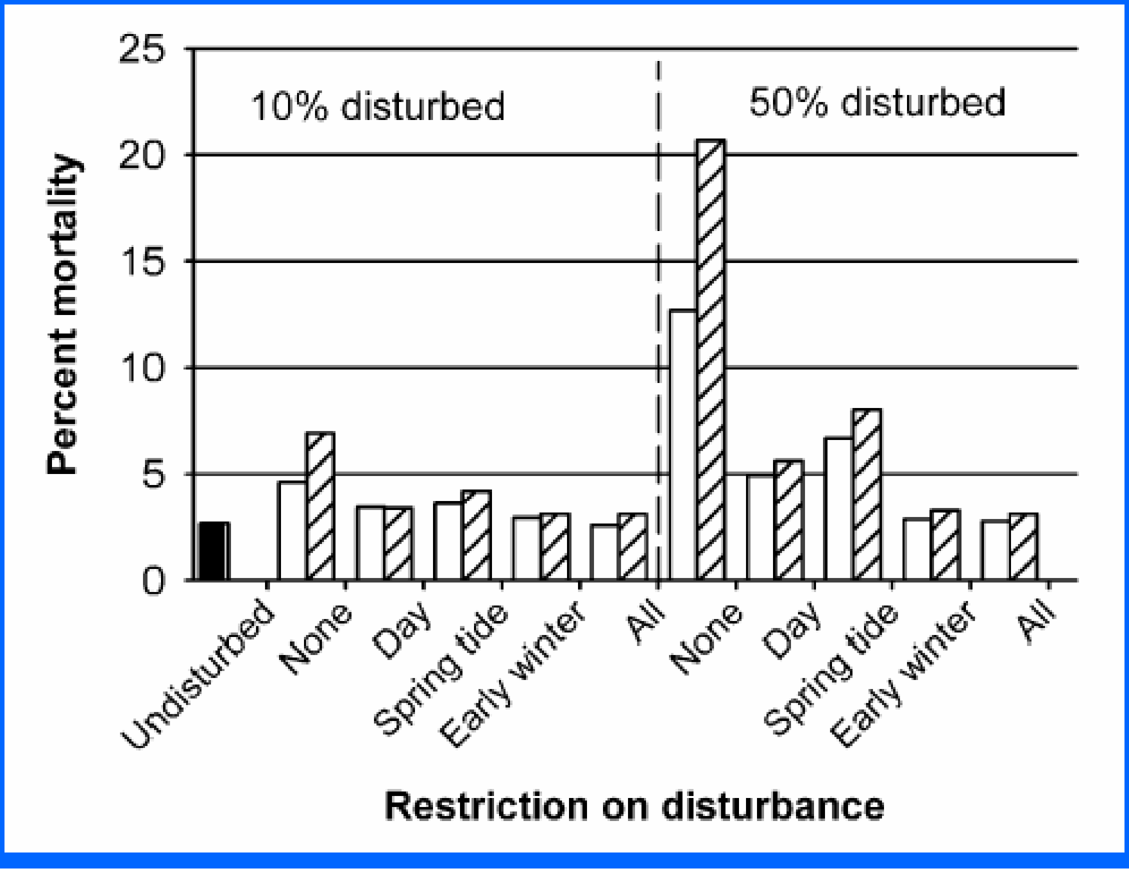
Insights from applications of shorebird model

Disturbance can increase mortality just like habitat loss

Keeps some birds from high quality foraging areas

Increases energy expenditures

Increases competitor density in undisturbed areas



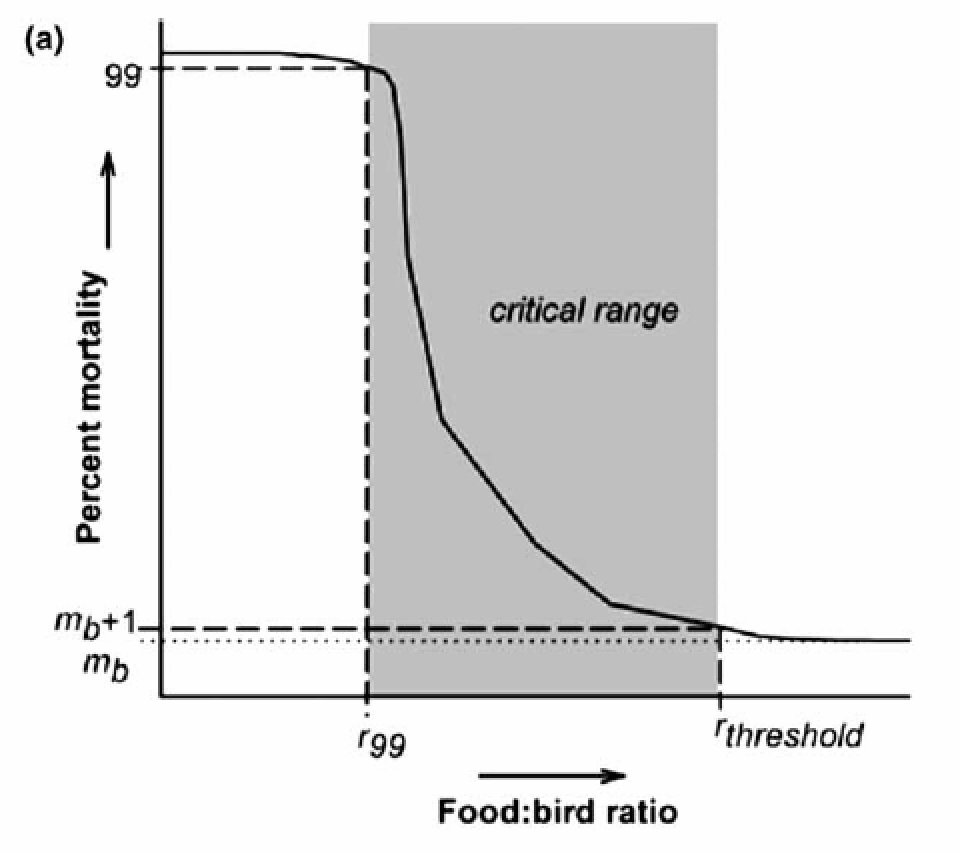
Mortality starts to increase well before food is depleted

Due to factors that restrict access to food supplies

Competition with other birds, human disturbance

4-8 times as much food as birds will eat is needed

Food:bird ratio can be seen as carrying capacity



Summary: bird monitoring for inlets and estuaries

Do systematic sampling of intertidal invertebrates in early winter (when first birds arrive)

Map and measure the area of foraging patches

Measure or model the exposure time of foraging patches

Identify all areas used for roosting by birds

Count birds at high tide (1x/ mo.) for population size

Do focal observations at low tide in different patches to document disturbance frequency & behavioral response

Develop models to test effects of management alternatives based on bird, food, and disturbance data on over-winter survival for priority species

Repeat periodically to test predictions, track changes