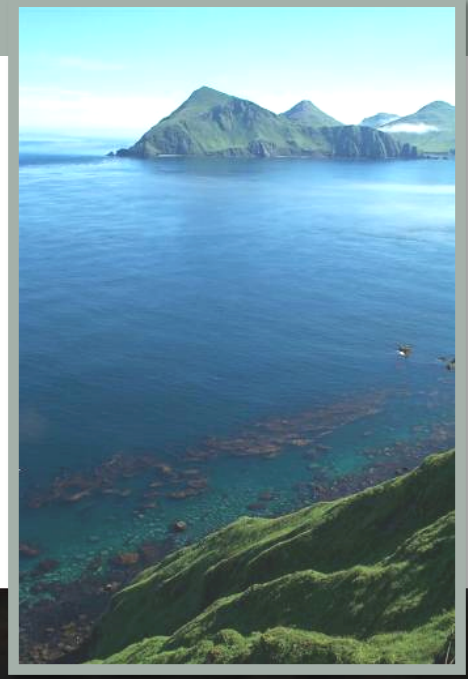
You can tell a lot about a place from the menu: lessons learned from the diet of a very hungry mammal



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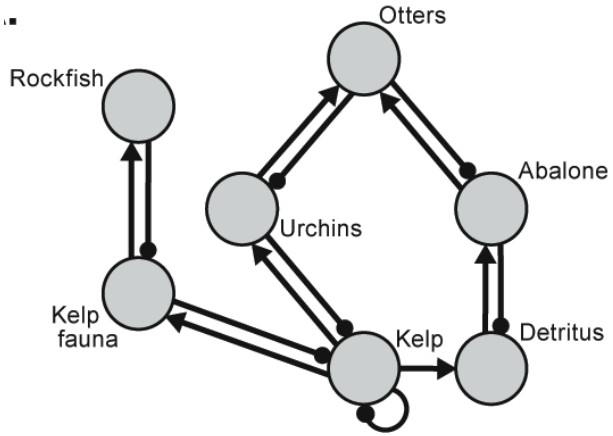
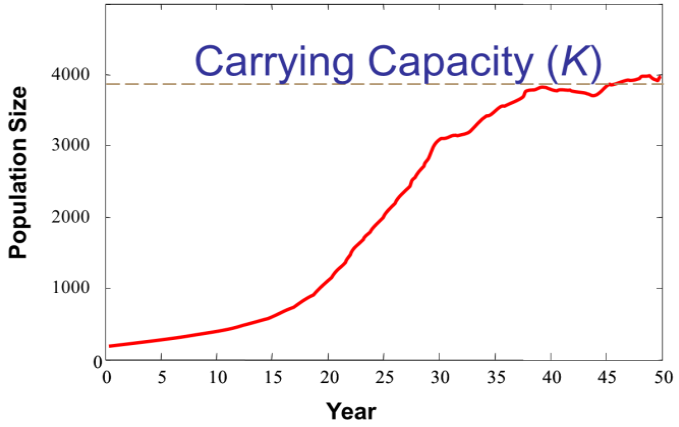
Photos courtesy of Nicole LaRoche, Joe Tomoleoni, Jim Capwell and Bryant Austin

What do we learn from sea otter foraging ecology?

1. Understanding food-web effects of sea otter predation



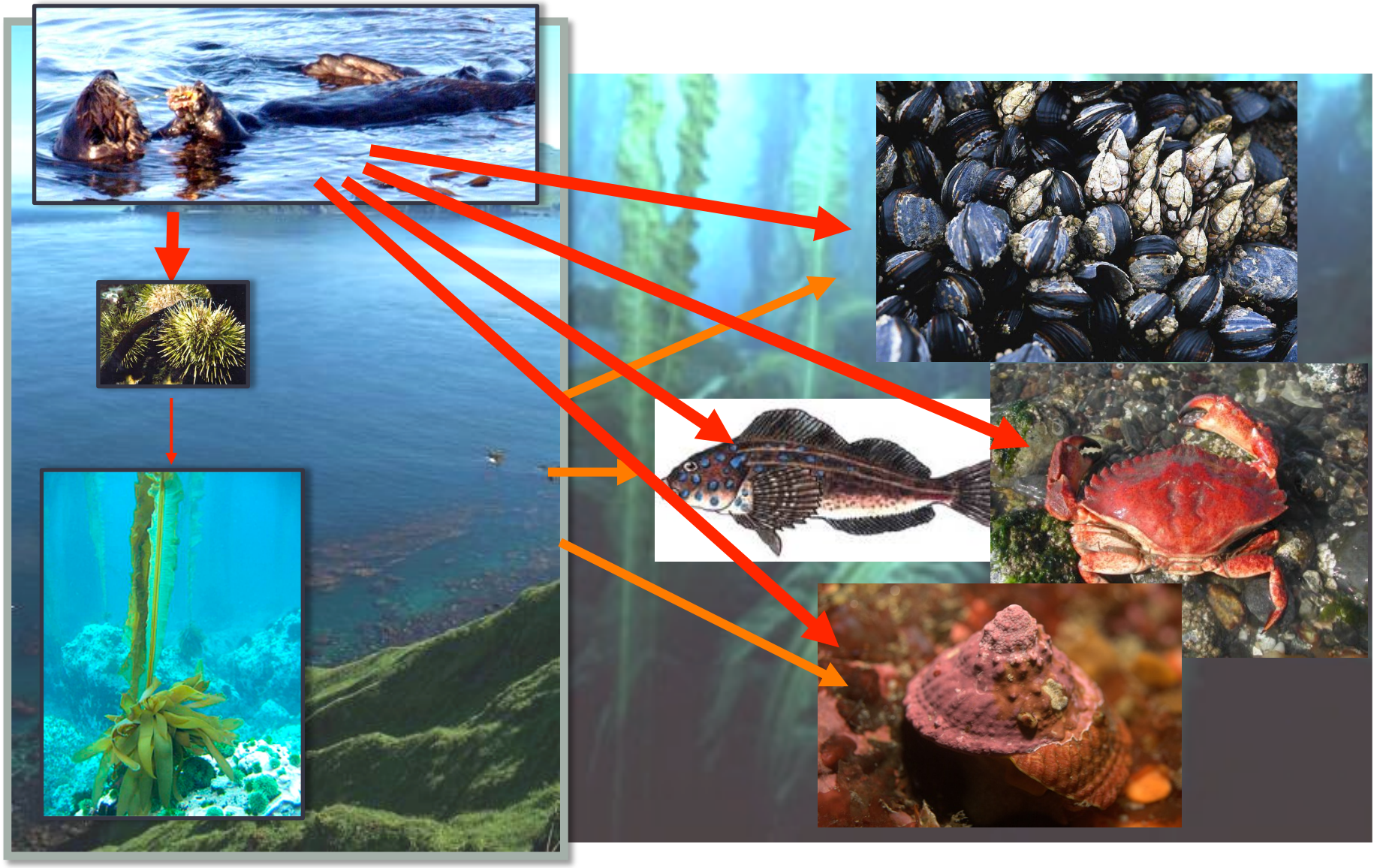
2. Assessing local population status



1. Food Web Impacts of Sea Otters

- Sea otter abundance impacts ecosystem structure and function via feeding interactions

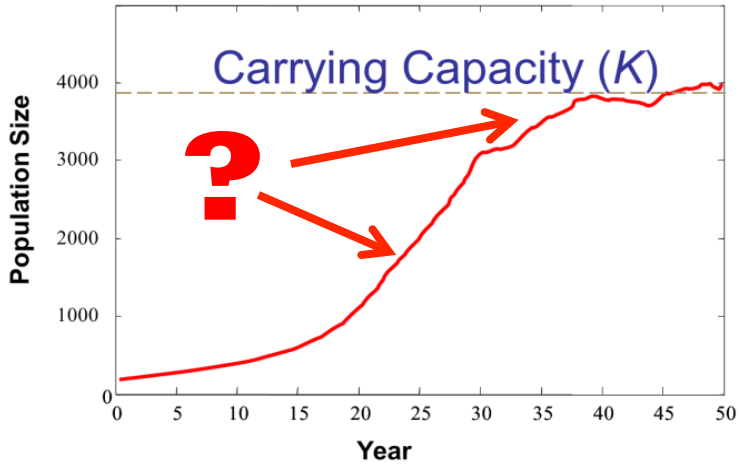
Kelp forest food webs and sea otters



2. Foraging and population status

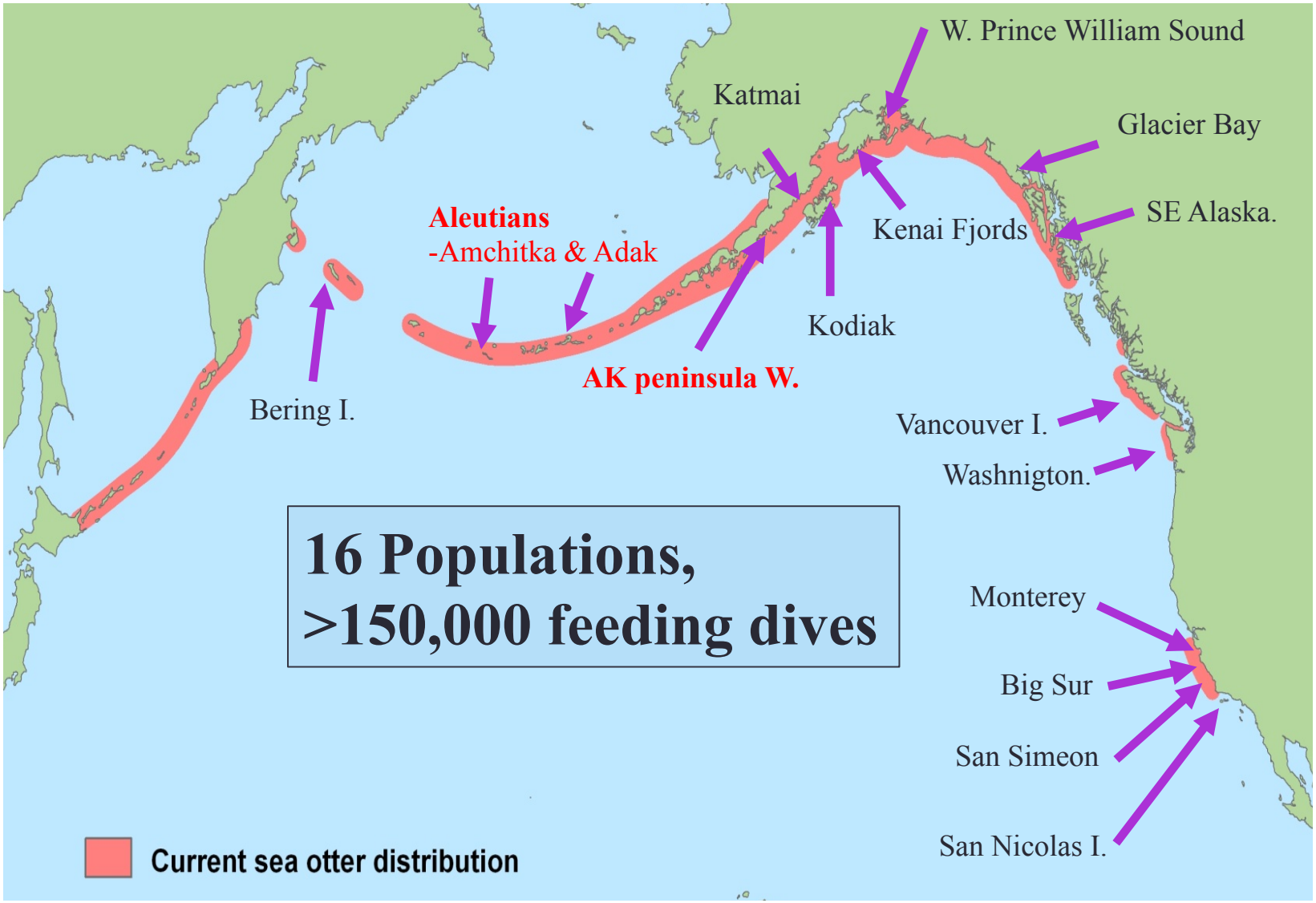
- As with many top predators, sea otters are ultimately "food limited": more otters → less food → lower survival
- **Carrying Capacity (*K*)** is the equilibrium abundance of a population that can be supported in a given habitat over the long term: ***K* occurs when births = deaths**

How can we tell the status of a population with respect to *K*?

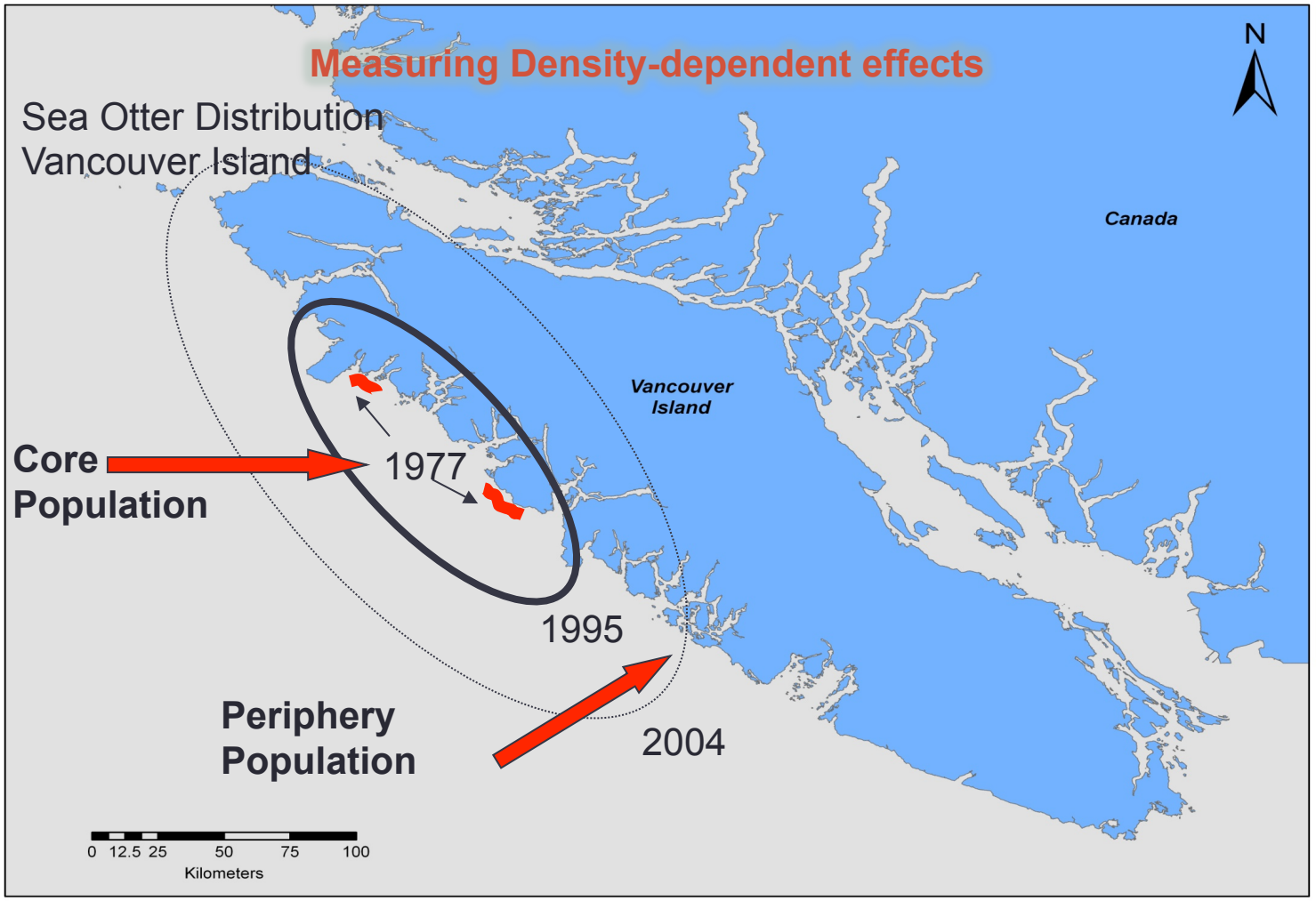


- Challenging – ***K*** varies with habitat type, local productivity, prey recruitment dynamics, etc.
- Logistically difficult to directly measure prey abundance
- SOLUTION: measure foraging success and diet

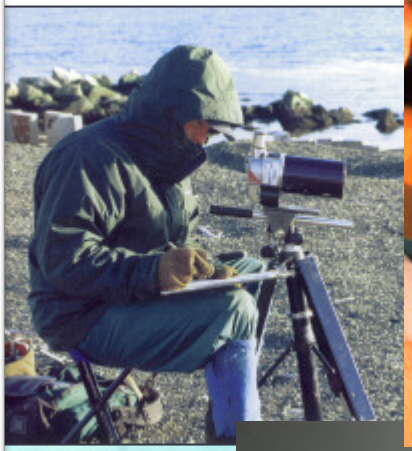
Sea Otter Foraging, Comparative Approach

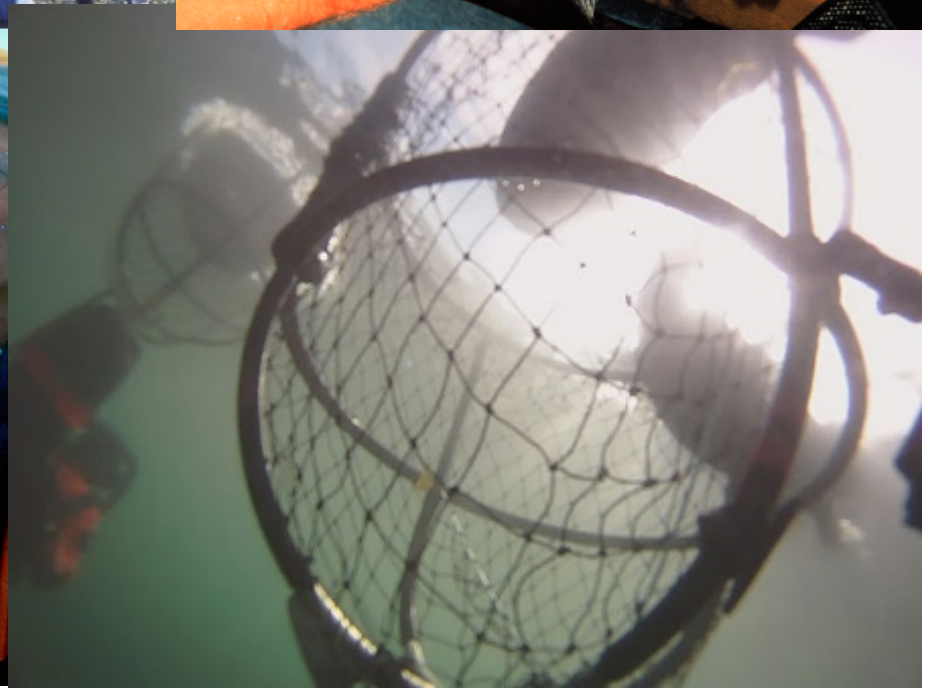


Comparisons across sub-populations



Collecting Foraging data: Field Research on Sea Otters

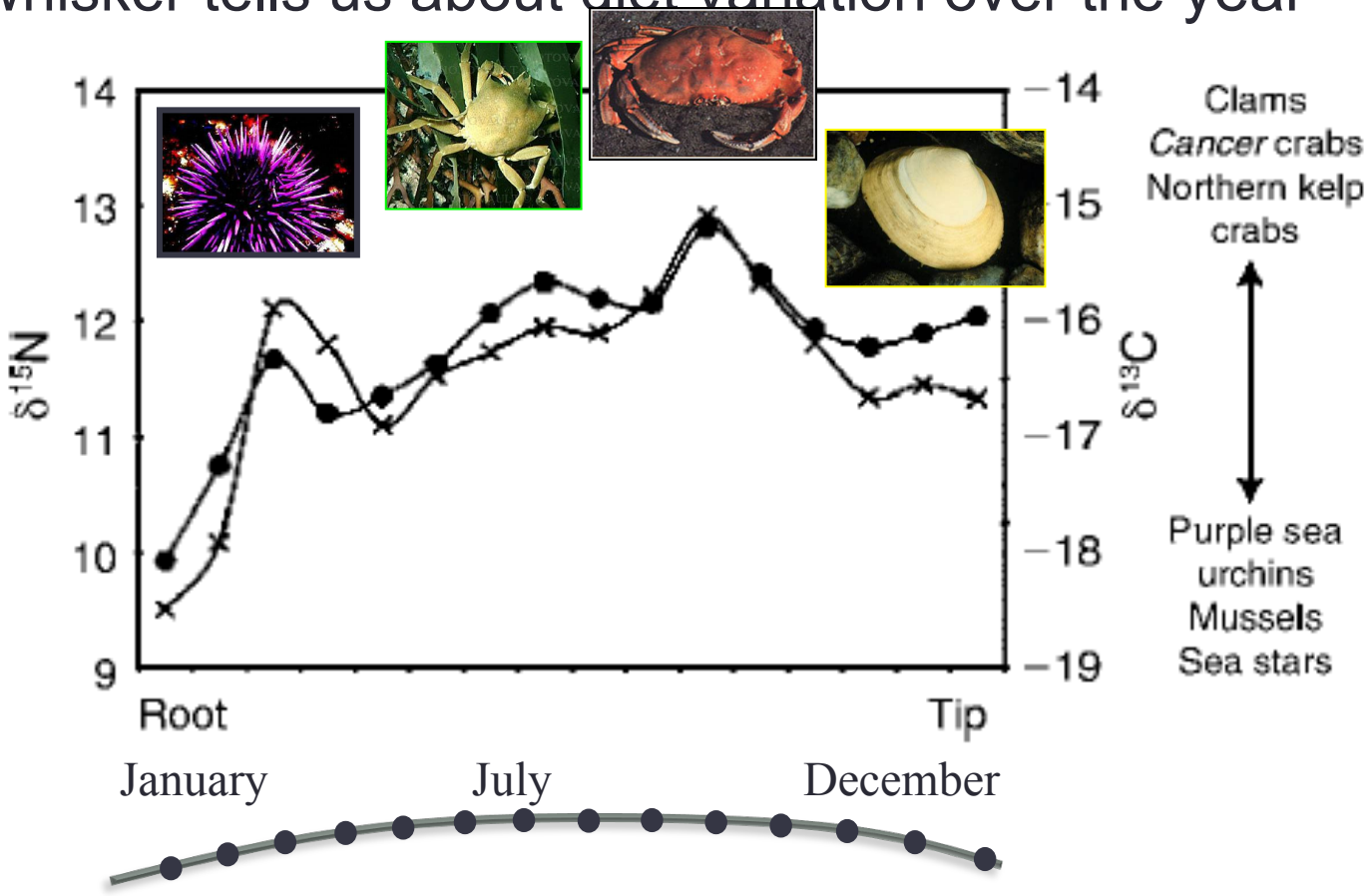




Measuring Individual diets: direct observation **and** stable isotopes

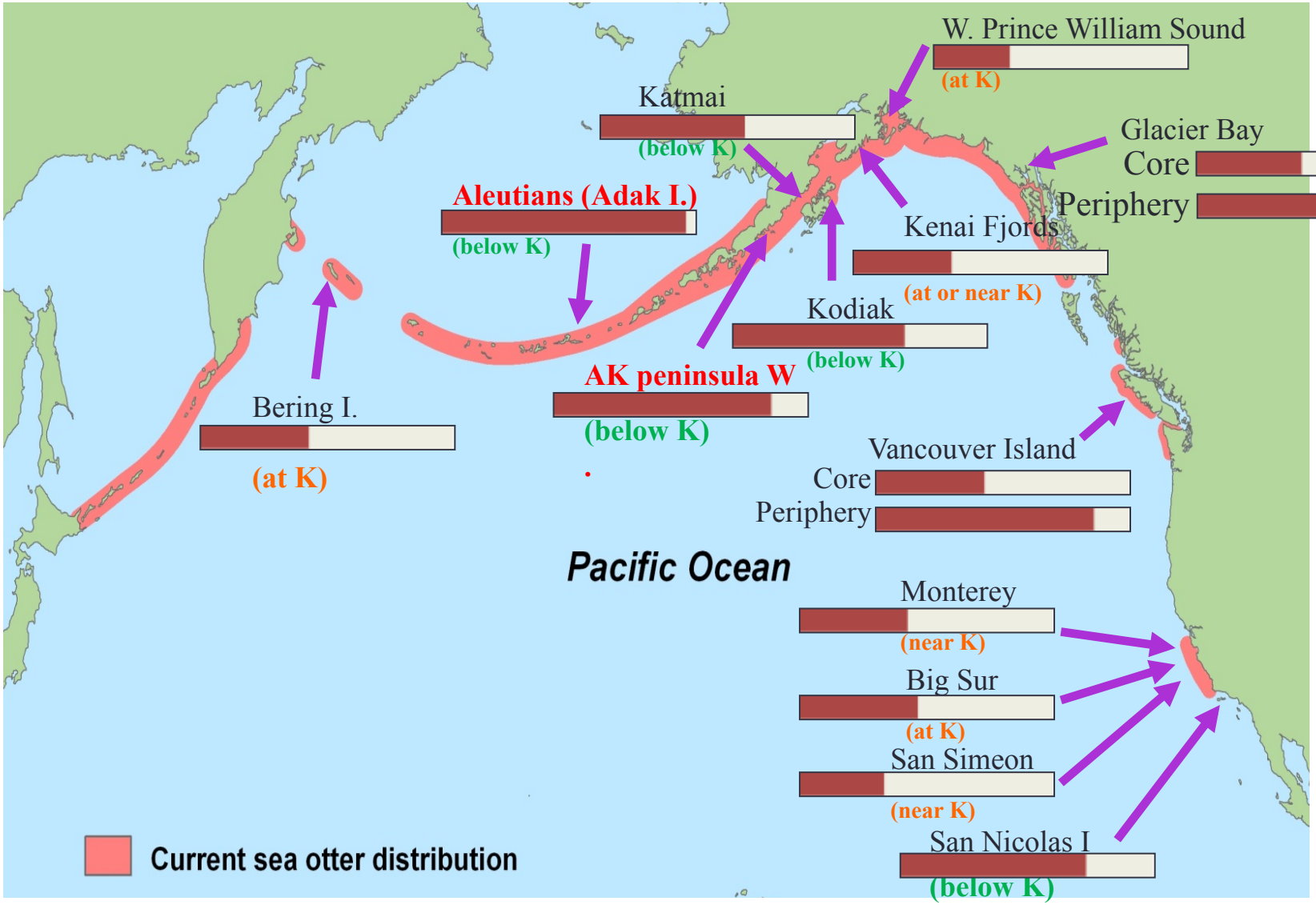
Every whisker tells a story

- Measuring stable isotope ratios for a series of samples along the whisker tells us about diet variation over the year



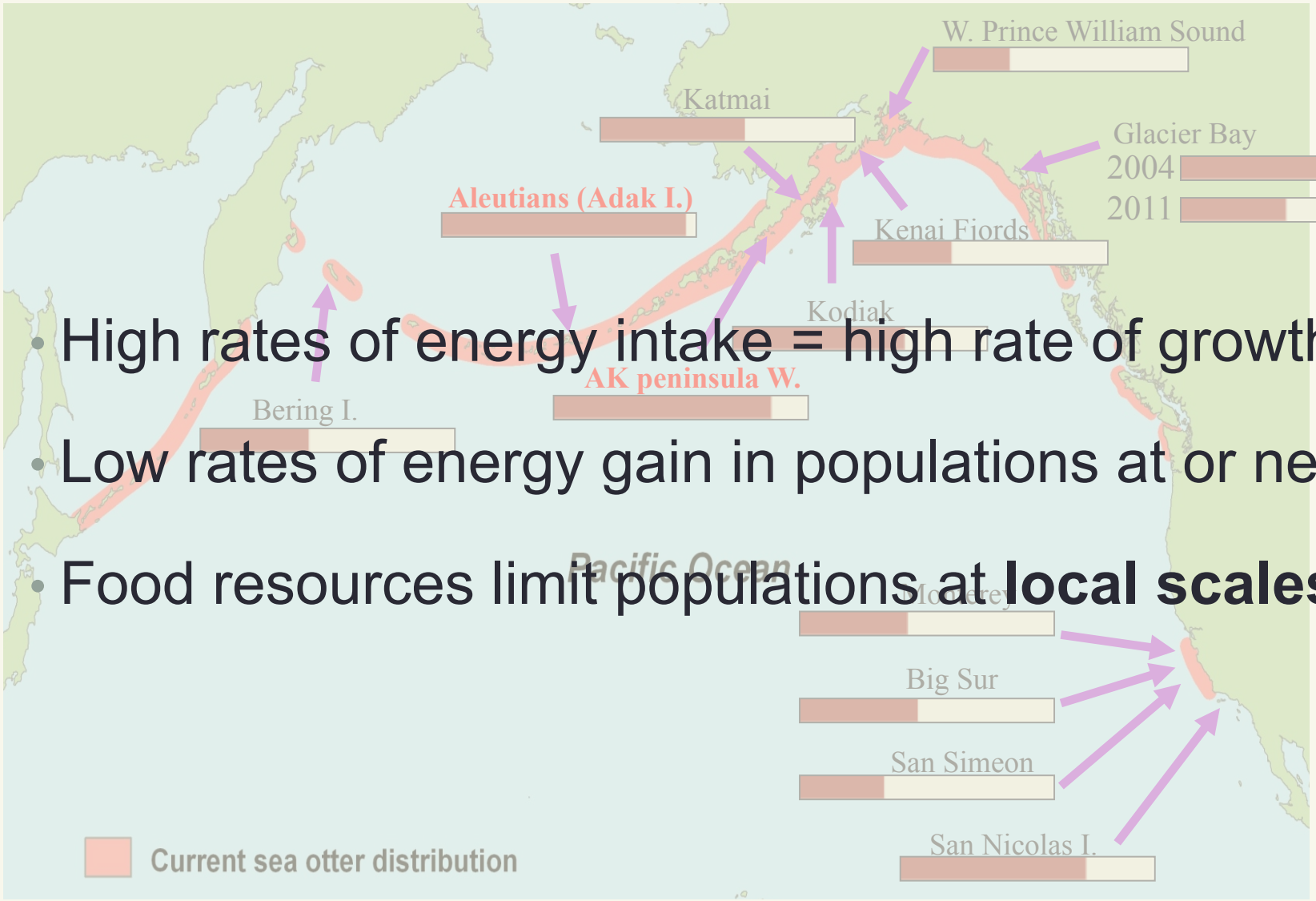
Results: Rate of Energy Intake (kcal/min) & Diet Composition (% consumed biomass)

Results: Rate of Energy Intake (kcal/min)



Legend: = rate of energy intake (relative to 20 kcal/min)

Results: Rate of Energy Intake (kcal/min)



- High rates of energy intake = high rate of growth
- Low rates of energy gain in populations at or near K
- Food resources limit populations at **local scales**

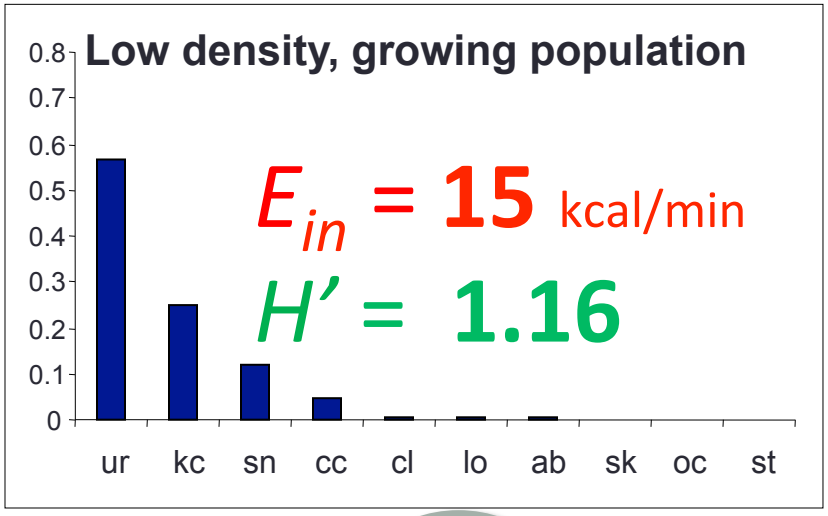
Legend: = rate of energy intake (relative to 20 kcal/min)

Other Clues to Status: Diet Diversity

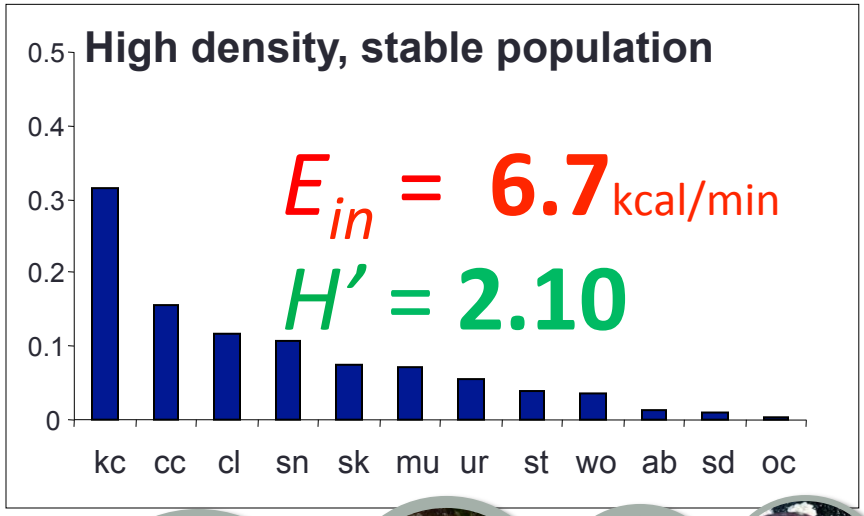
- Predator populations often expand their dietary niche as competition increases and preferred prey are depleted

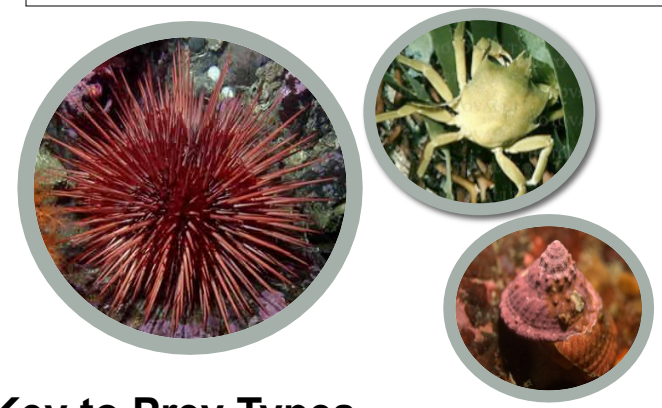
Diet Diversity vs. Food Abundance

San Nicolas Island



San Simeon (Central CA)

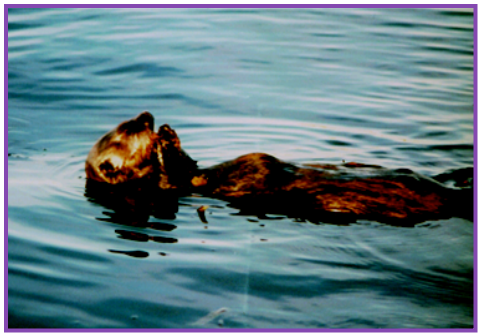




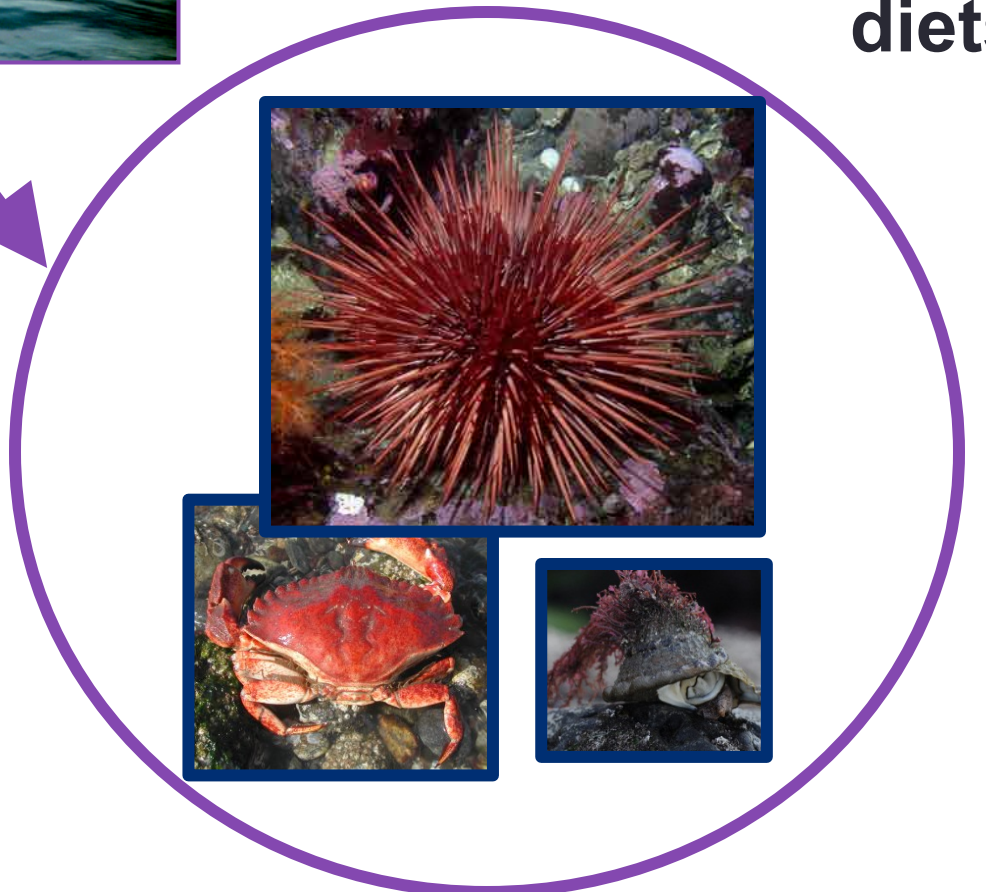
Key to Prey Types

kc = kelp crab	cc = Cancer crab	ur = urchin	sn = marine snail
ch = chiton	mu = mussel	cl = clam	st = sea star
wo = worm	ab = abalone	oc = octopus	sd = sand dollar

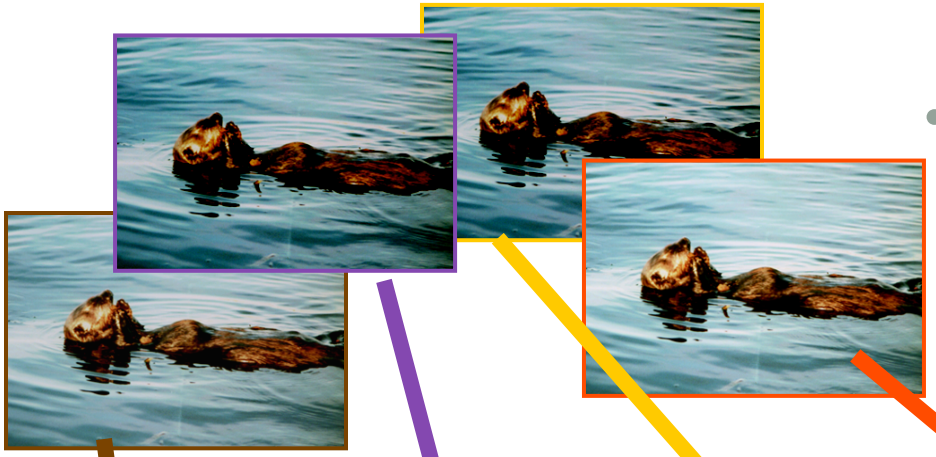
Low density, growing population



- **When preferred prey abundant, all otters have similar diets**



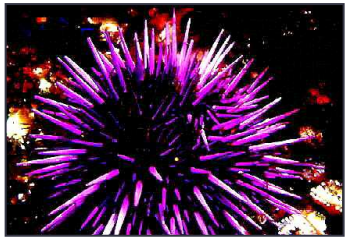
High density, stable population



- **When preferred food scarce, diets vary between individual otters**

Summary

- Extensive direct and indirect effects of sea otter foraging on food web structure/dynamics
- Feed-back from these changes in turn affects sea otter diets (alternative prey more abundant)
- Rate of energy gain decreases as sea otter's approach equilibrium (*K*)
- As preferred prey depleted, diet diversifies to include less profitable prey
- Diet diversification can reflect individual diet specialization



Questions?