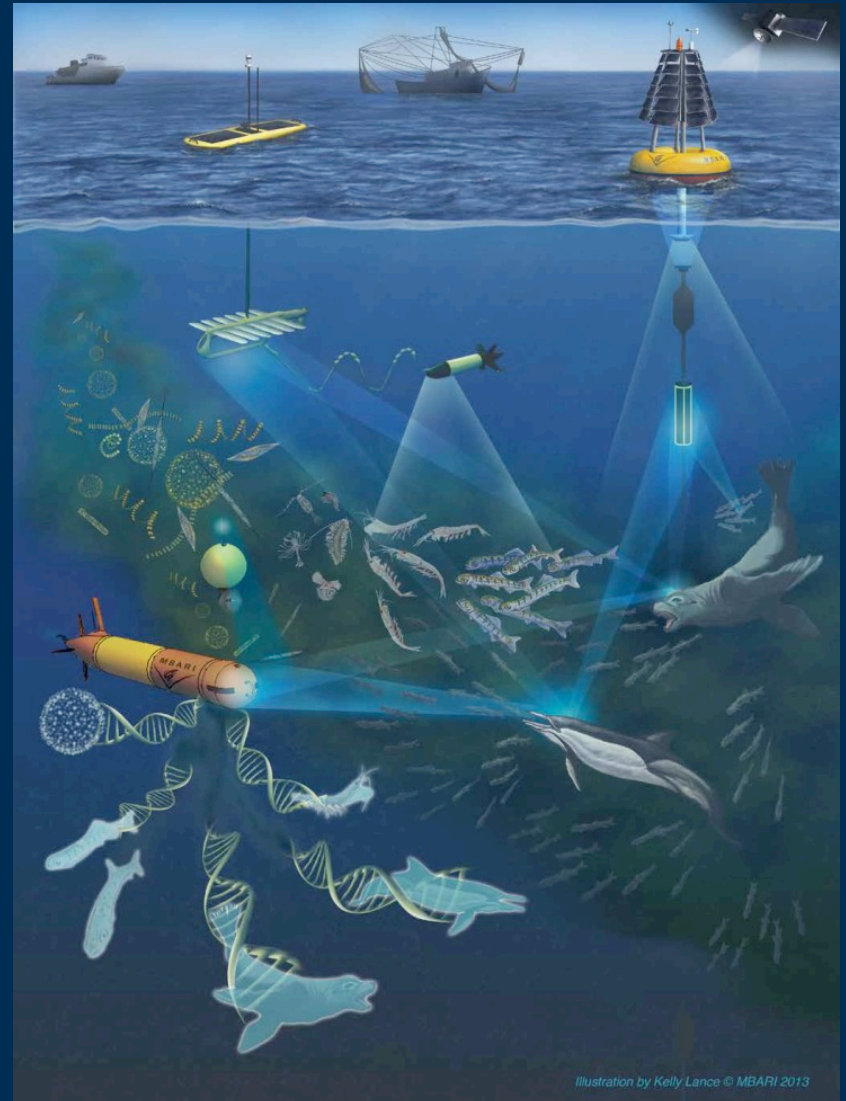


Enabling Standardized Marine Biodiversity Observations at Large Scales

An introduction to Environmental
DNA

Tina Dohna, MARUM



(Source: Monterey Bay Research Institute/MBARI)

Illustration by Kelly Lance © MBARI 2013

What, where and when – environmental DNA

- All organisms leave DNA in their environment (skin, hair, slime etc.)
- Common in forensic applications
- Terrestrial examples:
 - Sampling leach guts for metazoan inventory/rare species
 - Sample drinking holes for species presence/absence



What, where and when – environmental DNA

- All organisms leave DNA in their environment (skin, hair, slime etc.)
- Common in forensic applications
- Terrestrial examples:
 - Sampling leach guts for metazoan inventory/rare species
 - Sample drinking holes for species presence/absence



...move to indirect sampling

Marine Environments?

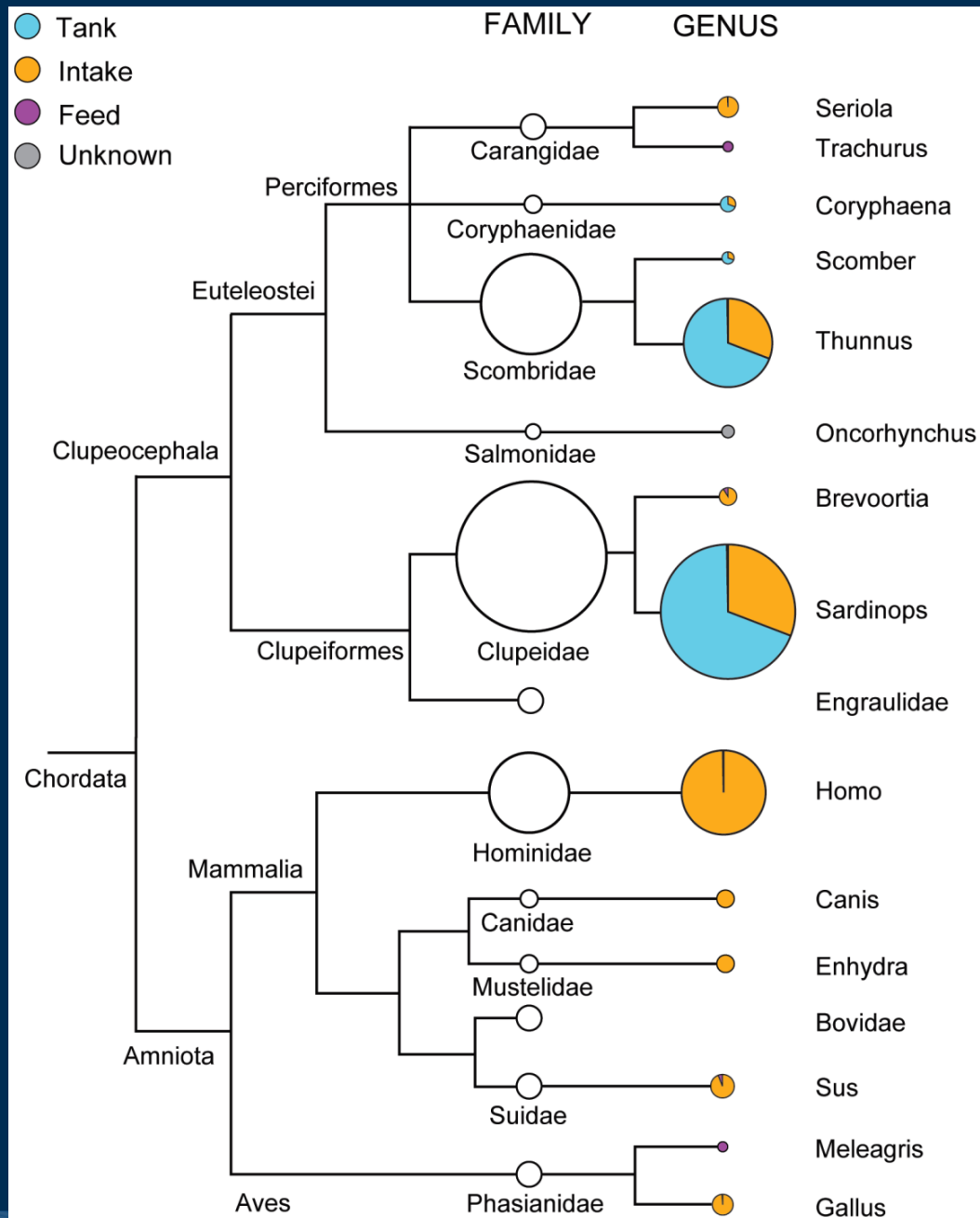
- Observations of mobile biological life can be very difficult (rare, elusive, cryptic, buried, transient...you name it)
- Small water samples (1-5L) contain DNA signatures of local marine communities
- Microbiologists have been doing this for a long time!
- Indirect sampling through eDNA work for all scales:
microbes > whales (metabarcoding)

What effects eDNA

- Microbial degradation rates
- Currents
- Import through other organisms

- Temporal/spatial footprint → uncertainty
- Lots of work going into reducing this uncertainty

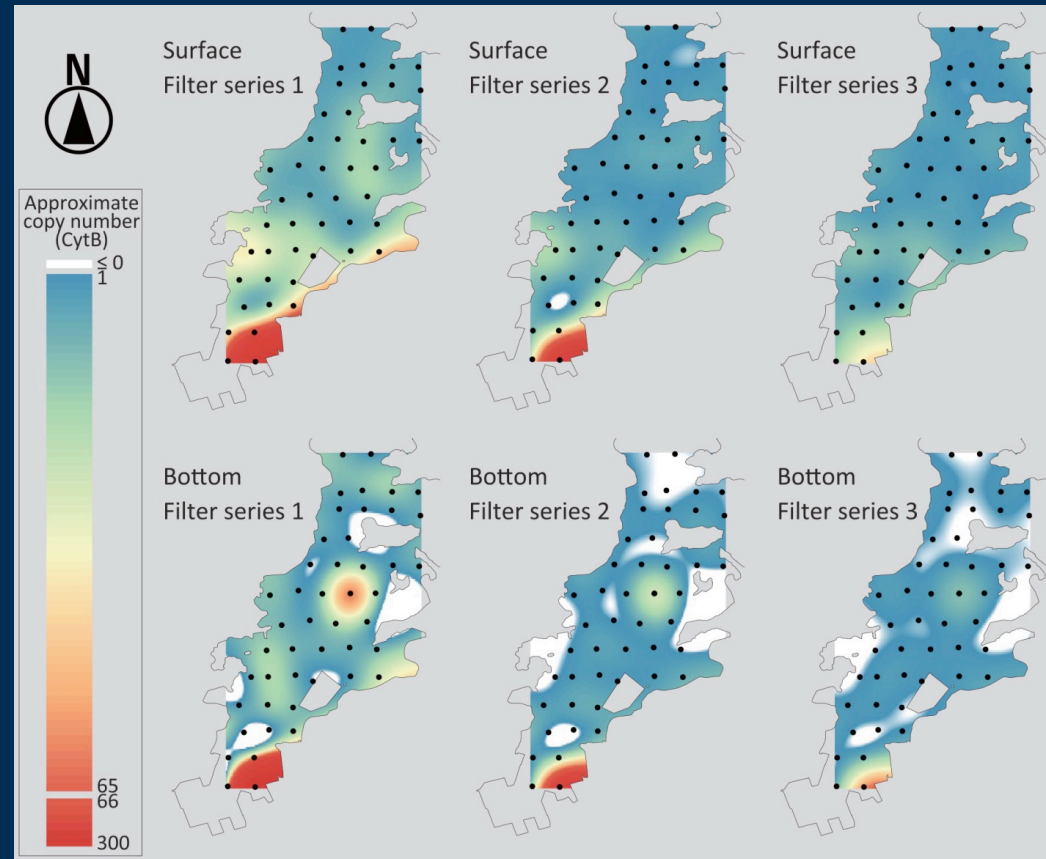
- Large tank at MB Aquarium
- 12S rRNA
 - Species recovered
 - Low false negative rate



Kelly et al. 2014

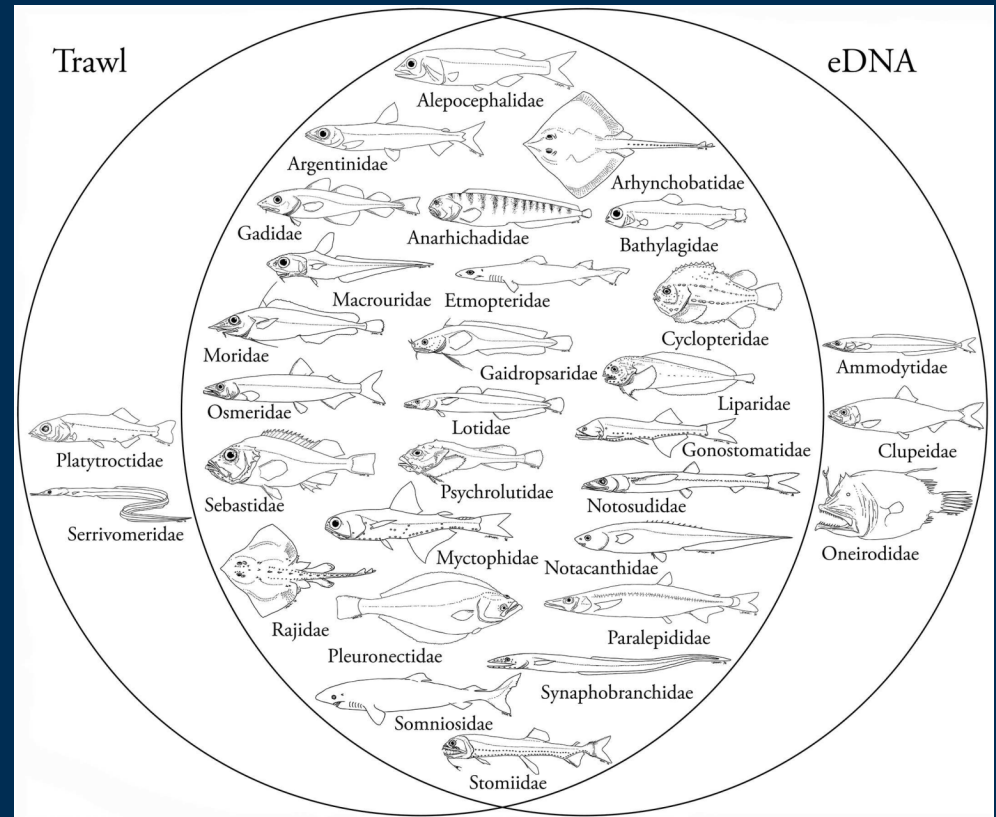
Examples of applications

- Jack mackrel densities in Maizuru Bay, Japan:
 - found that a snapshot of localized fish resources over a large area can be revealed using the eDNA method
- Validated with ecosounder
- Fish market as eDNA source



Examples of applications

- Environmental DNA from Seawater Samples Correlate with Trawl Catches of Subarctic, Deepwater Fishes (Thomsen et al. 2016)



What advantages from eDNA

- Sample collection:
 - Indirect sampling
 - Automatable
 - Can be standardized through protocols across communities
 - Sample anywhere (marine, space, deep sea, artic etc.)
- Sampling through non experts (SPYGEN)
- Large temporal and horizontal and vertical spatial scales
- Adds missing biodiversity observation component for:
...Rare, elusive, cryptic, buried, transient...marine species

What advantages from eDNA

- Sample collection:
 - Indirect sampling
 - Automatable
 - Can be standardized through protocols across communities
 - Sample anywhere (marine, space, deep sea, artic etc.)
- Sampling through non experts (SPYGEN)
- Large temporal and horizontal and vertical spatial scales
- Adds missing biodiversity observation component for:
...Rare, elusive, cryptic, buried, transient...marine species

Some of Our Current eDNA Projects

Current projects:

- Arctic zooplankton metabarcoding through eDNA
 - Presence/absence
 - Biomass estimates (qPCR)
 - Investigate vertical stratification in the water column
- Coral Reef Biodiversity (TARA Pacific expedition)
 - Detect effect of bleaching through metabarcoding of benthic fauna (pairing with ENMAP images? In-situ hyperspectral images)
 - Fish diversity and relative biomass (validate with optical diver surveys)