POD Moorings
a collection of ideas

A problem for cetaceans:

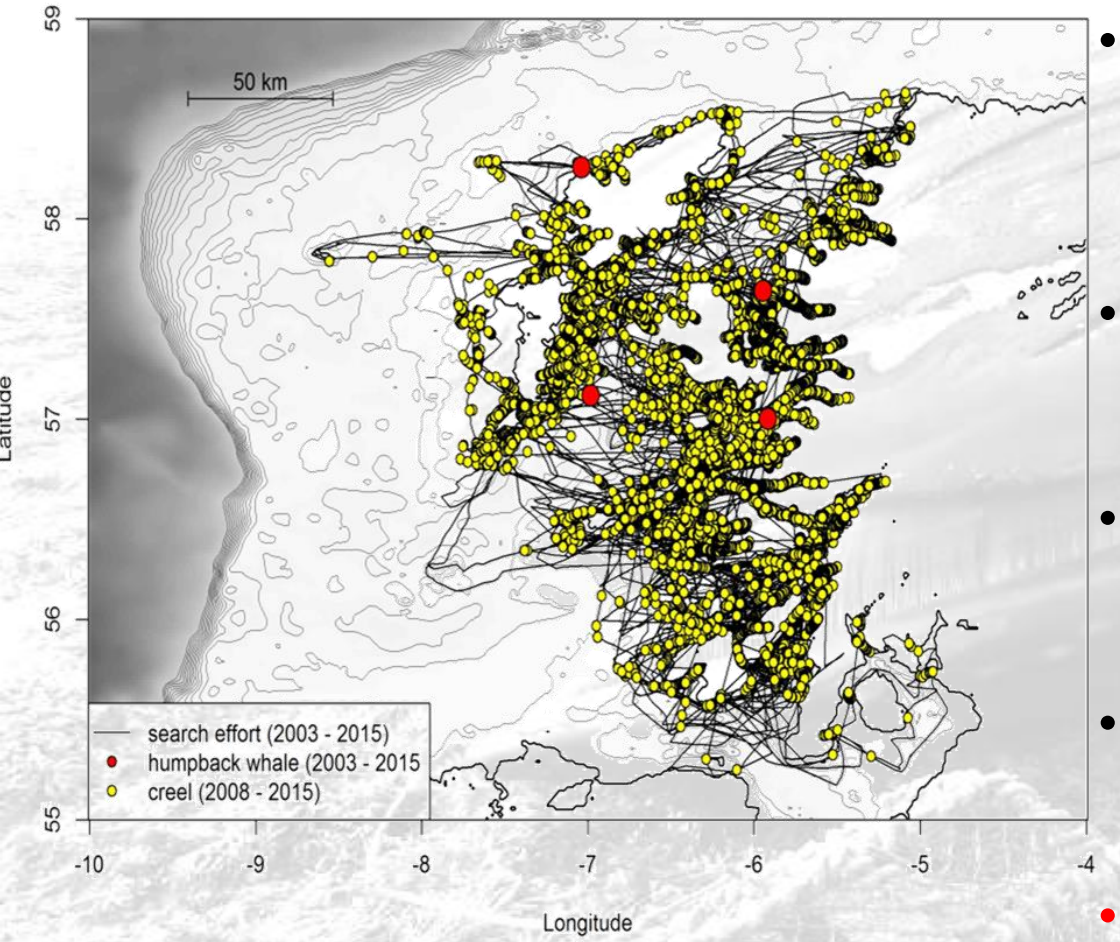
- Whale entanglement : esp minke whales

Scottish Marine Animal Stranding Scheme

M106-10
Juvenile male, W Scotland

- Osteomyelitis, fracture of lower mandible
- Death after 6 months
- Severe welfare problem

Population effects of entanglement?



- Simulation modelling approach based on:
  - Silurian effort-based dataset
  - Public sightings data

- Calculated a daily probability of entanglement for a humpback whale in Scottish inshore waters of 0.0017
- Annual probability of fatal entanglement of around 0.12 for an animal which was resident year round.
- Human-induced mortality in NW Atlantic is sustainable at 0.014 ±0.007 SD (Van der Hoop et al., 2013)
- This source of mortality alone could be an order of magnitude higher than sustainable levels.

Ryan, C., Leaper, R., Evans, P.G.H., Dyke, K., Robinson, K.P., Haskins, G.N., Calderan, S., van Geel, N., Harries, O., Froud, K., Brownlow, A. and Jack, A. (2016). Entanglement: an emerging threat to humpback whales in Scottish waters. Report to the Scientific Committee of the International Whaling Commission, SC/66b/HIM/01, 1-12.

problems for vessels and fishers

- Floating ropes foul propellers. Good design reduces this.
- Gear conflict – tangling with fishing pots etc

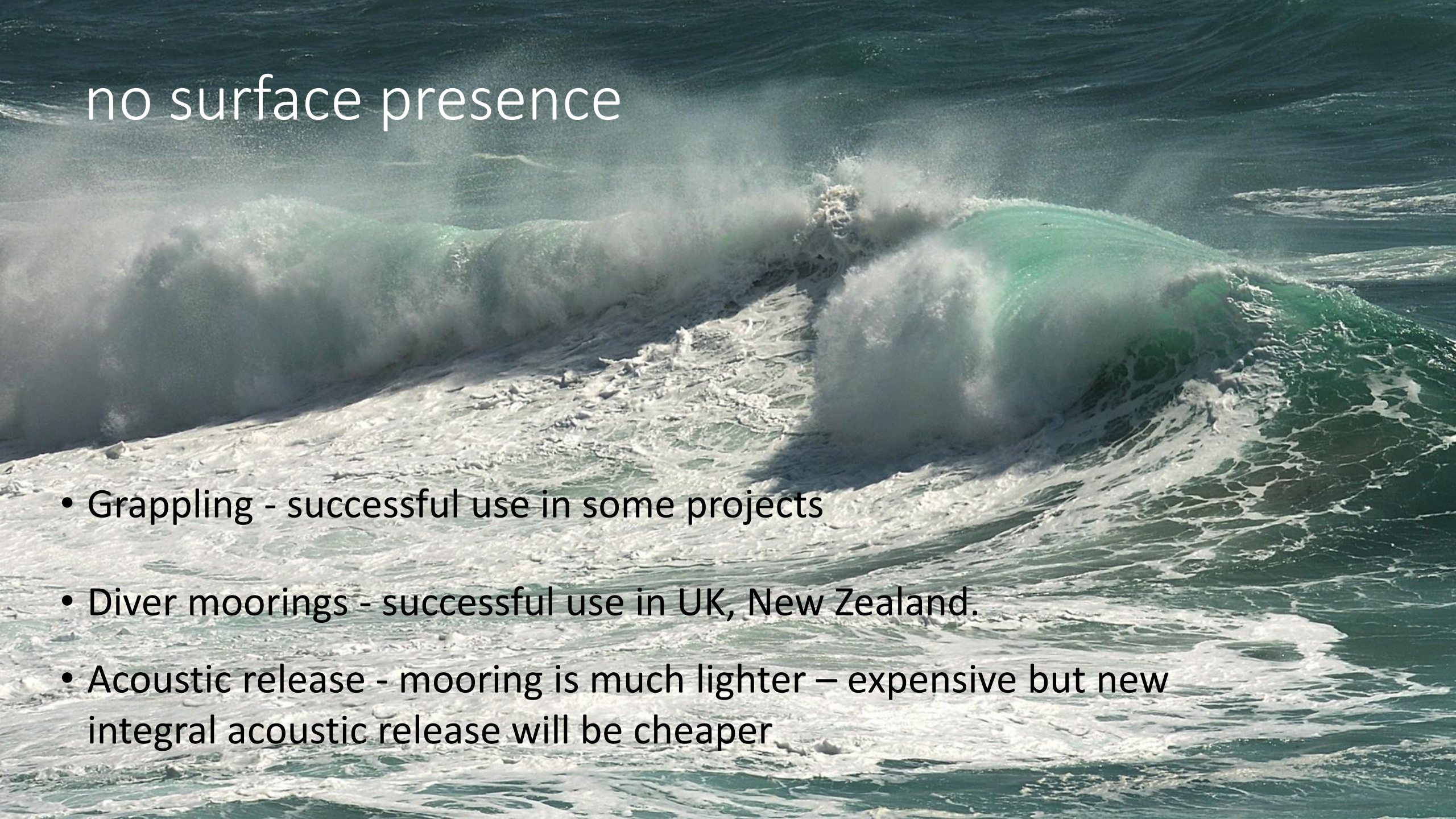
problems for POD owner:

- Theft : mostly by fishers…
- Bottom trawlers
- Storms: can move moorings, or the ground they sit on, or break things.
- Biofouling: can sink surface buoys.
- Abrasion: can weaken or break ropes
- Mooring noise - ropes rubbing POD, chains. Very rarely a serious problem.
- ADCPs - sound sources on same mooring acoustic doppler current profilers

Theft - possible solutions

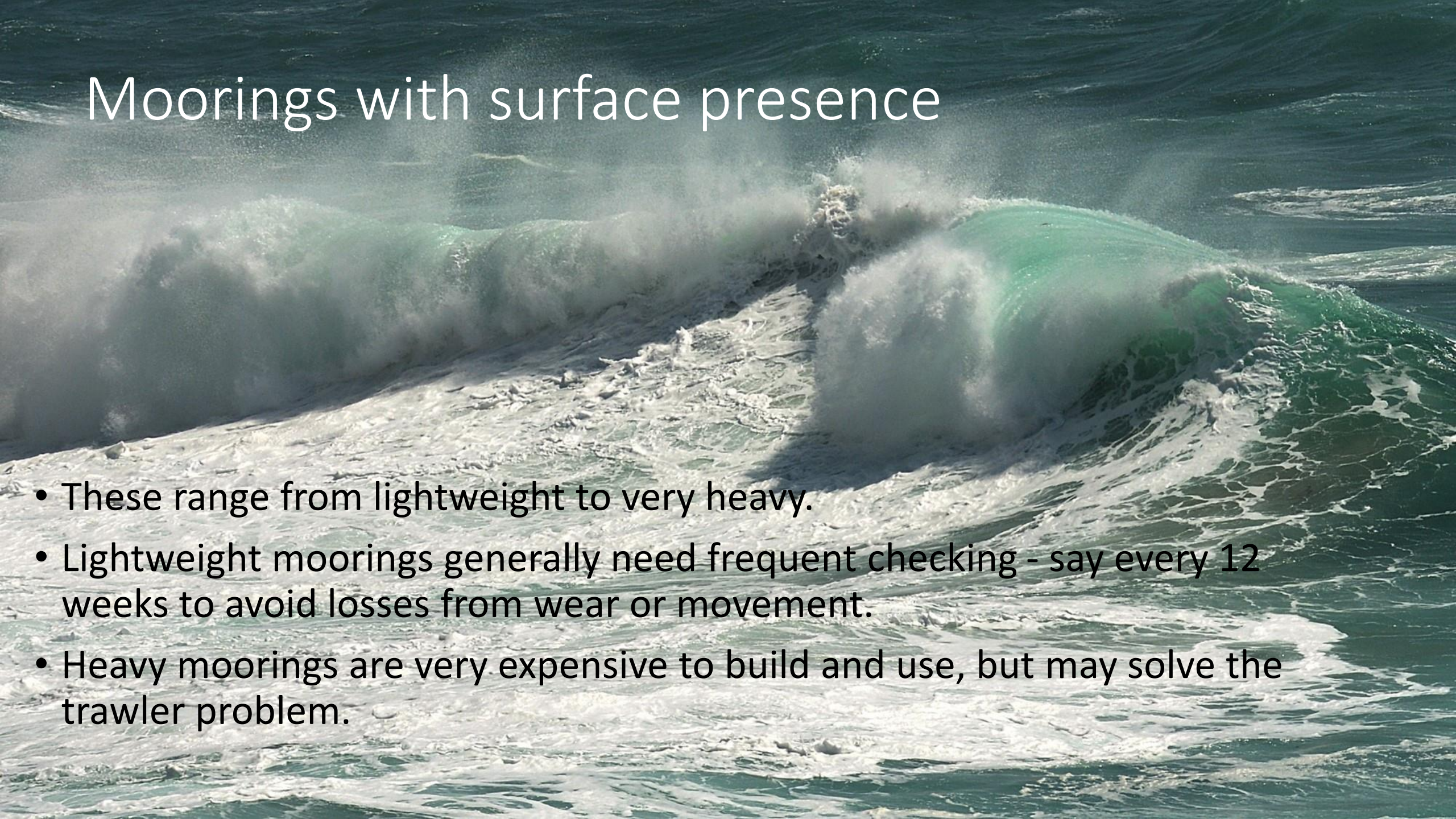
- No surface presence
- Minimal or disguised surface presence
- Use a fisherman to deploy them

no surface presence



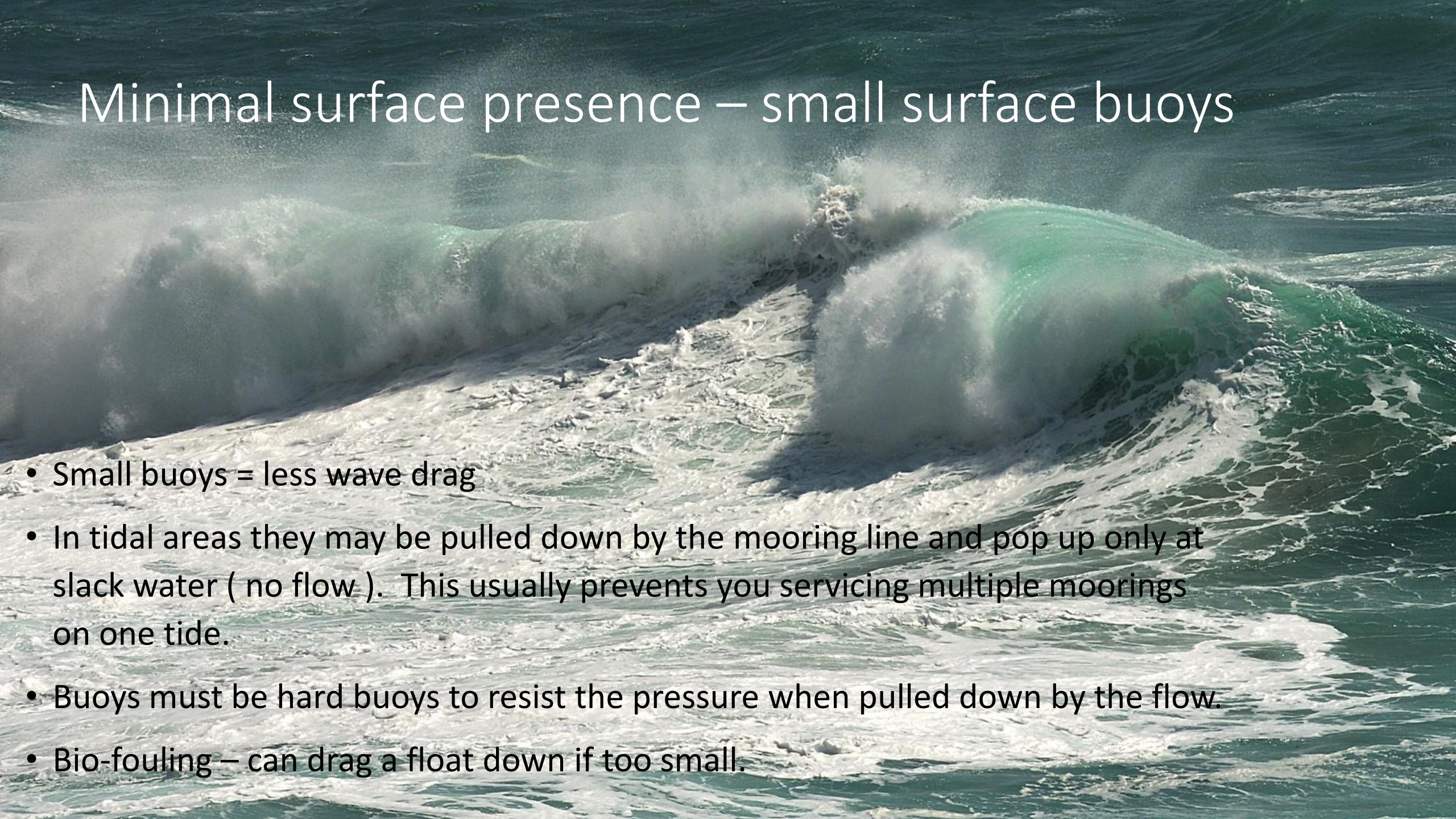
- Grappling - successful use in some projects
- Diver moorings - successful use in UK, New Zealand.
- Acoustic release - mooring is much lighter – expensive but new integral acoustic release will be cheaper

Moorings with surface presence



- These range from lightweight to very heavy.
- Lightweight moorings generally need frequent checking - say every 12 weeks to avoid losses from wear or movement.
- Heavy moorings are very expensive to build and use, but may solve the trawler problem.

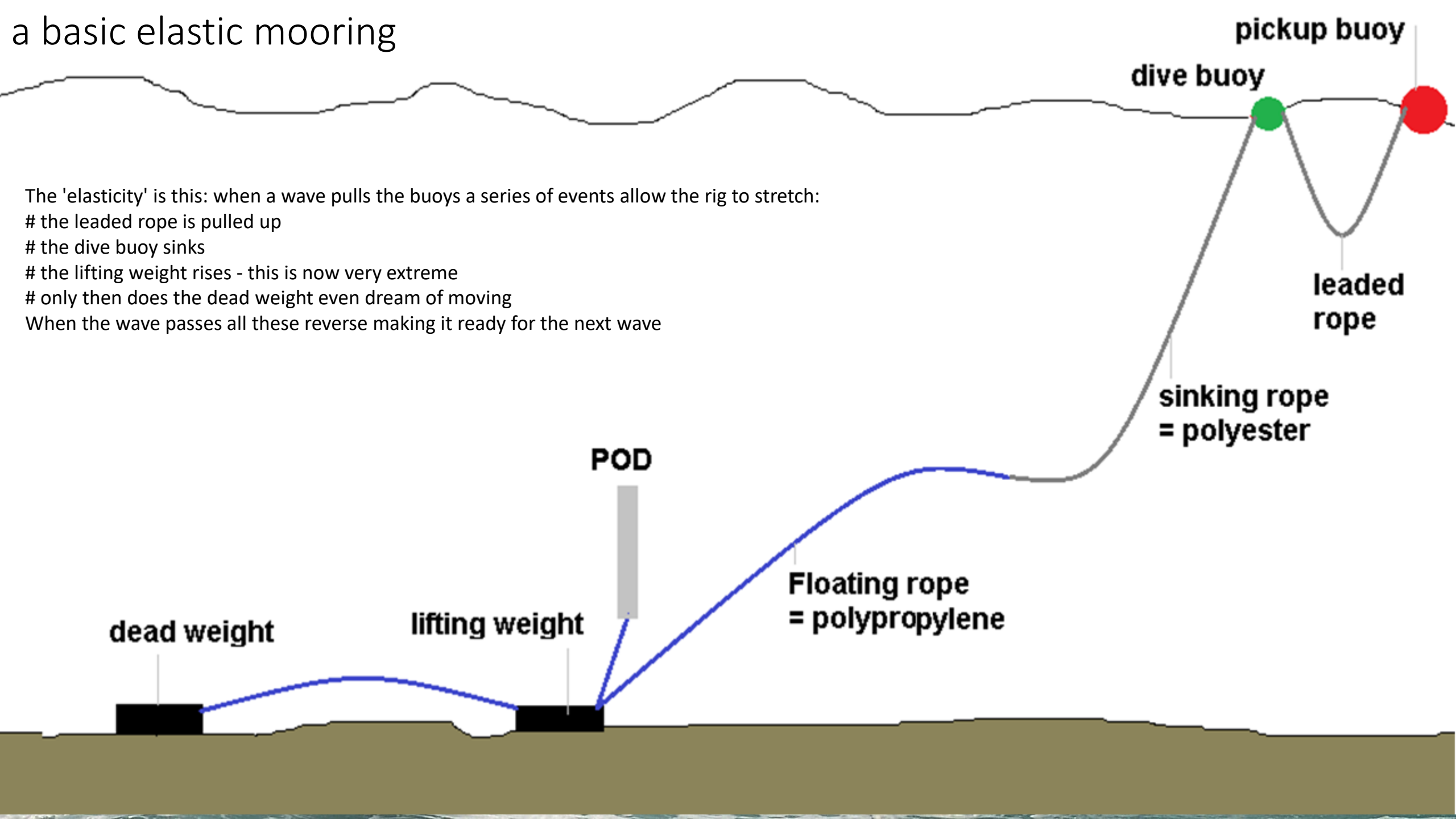
Minimal surface presence – small surface buoys



- Small buoys = less wave drag
- In tidal areas they may be pulled down by the mooring line and pop up only at slack water (no flow). This usually prevents you servicing multiple moorings on one tide.
- Buoys must be hard buoys to resist the pressure when pulled down by the flow.
- Bio-fouling – can drag a float down if too small.

a basic elastic mooring

The 'elasticity' is this: when a wave pulls the buoys a series of events allow the rig to stretch:
the leaded rope is pulled up
the dive buoy sinks
the lifting weight rises - this is now very extreme
only then does the dead weight even dream of moving
When the wave passes all these reverse making it ready for the next wave



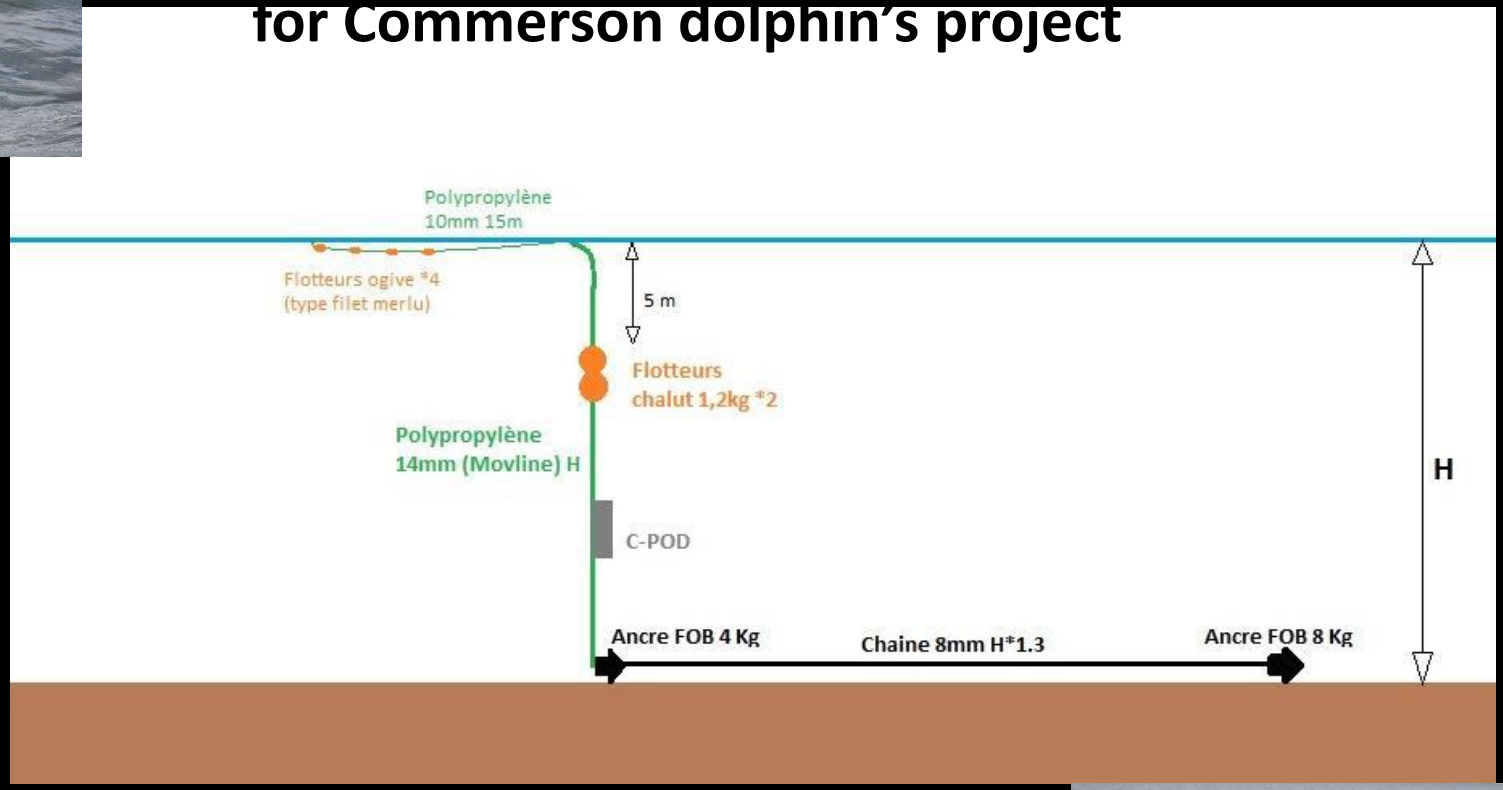
36 moorings in 12m depth experienced this severe storm in Newquay. Only one moved.

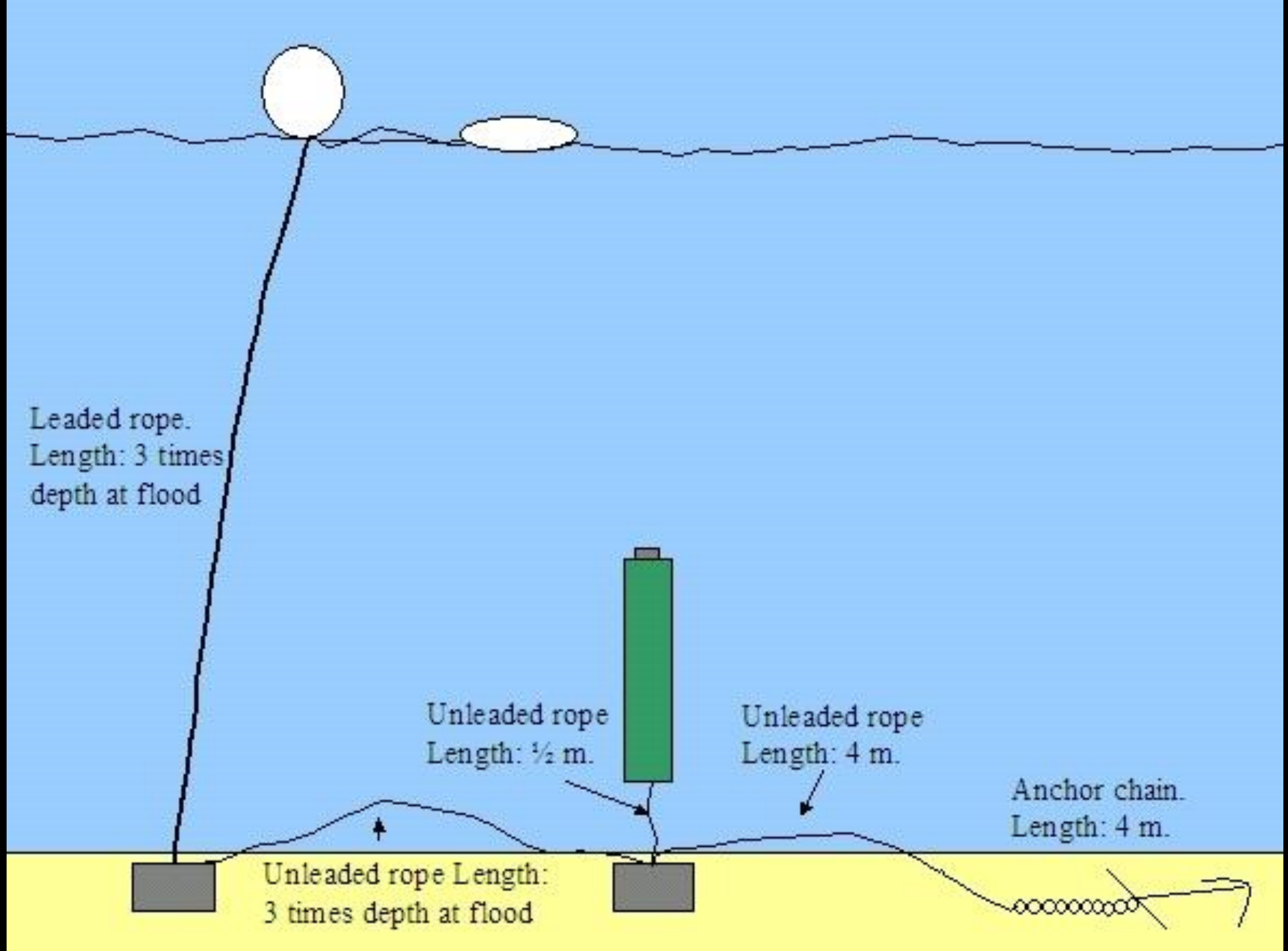
A hauler is needed!

... take care placing the incoming line so that it can run out safely if control is lost.

Some examples from users:

for Commerson dolphin's project




Leaded rope.
Length: 3 times
depth at flood
Unleaded rope
Length: ½ m.
Unleaded rope
Length: 4 m.
Anchor chain.
Length: 4 m.
Unleaded rope Length:
3 times depth at flood

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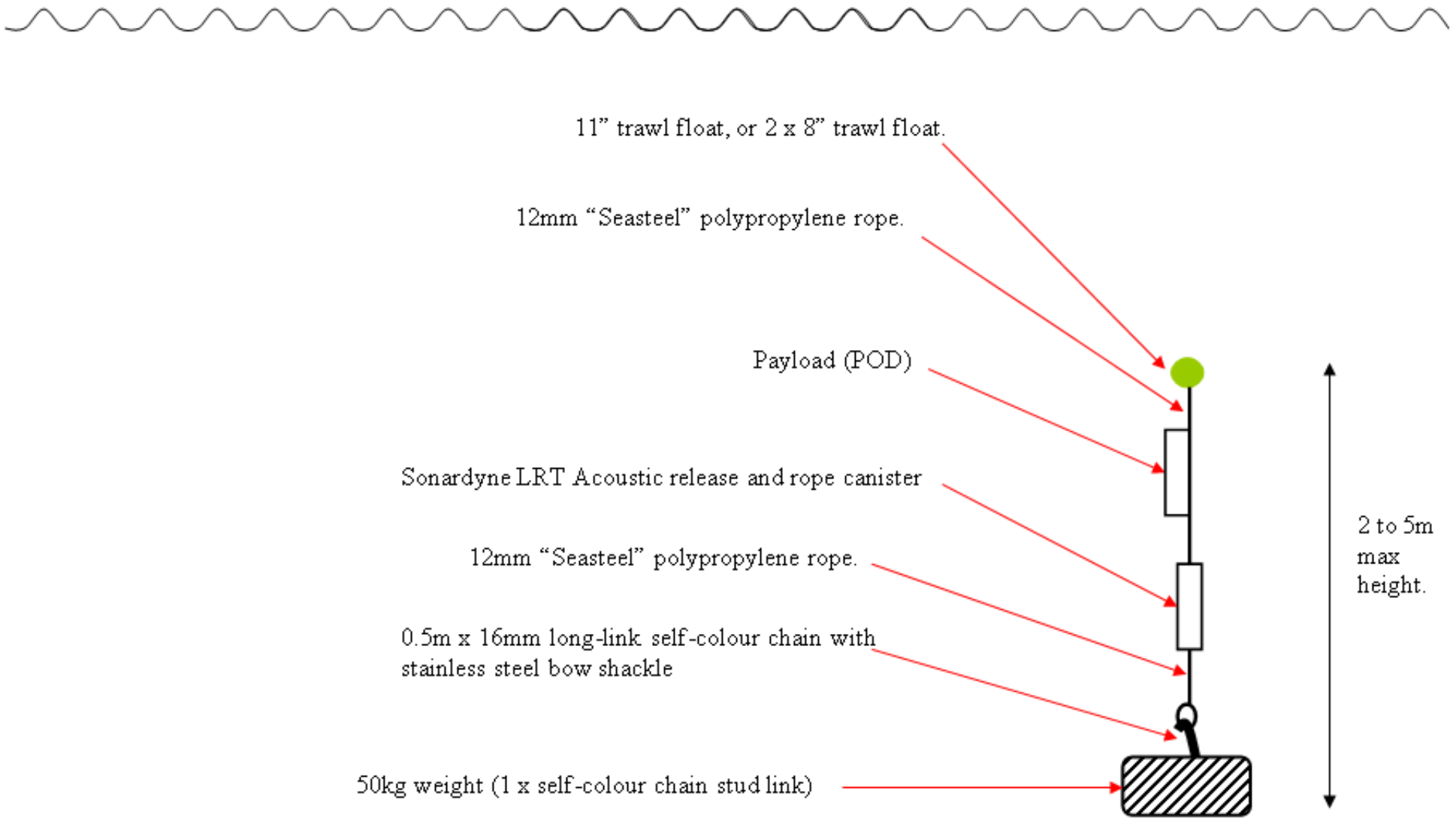
POD Moorings – subsurface riser & acoustic release (not to scale).

T. R. BARTON
t.r.barton@abdn.ac.uk



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POD Moorings – single riser, with dhan (not to scale).

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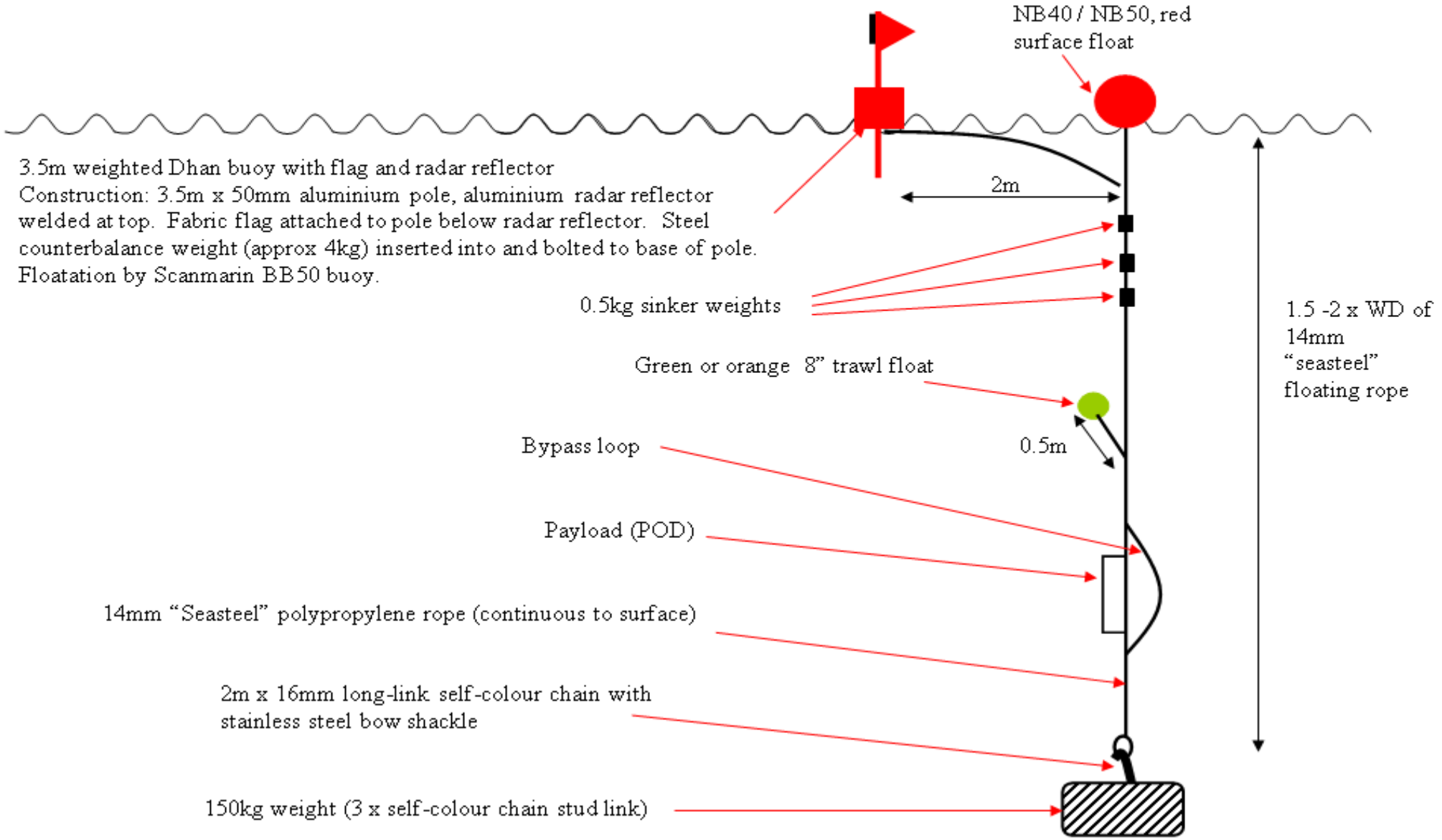
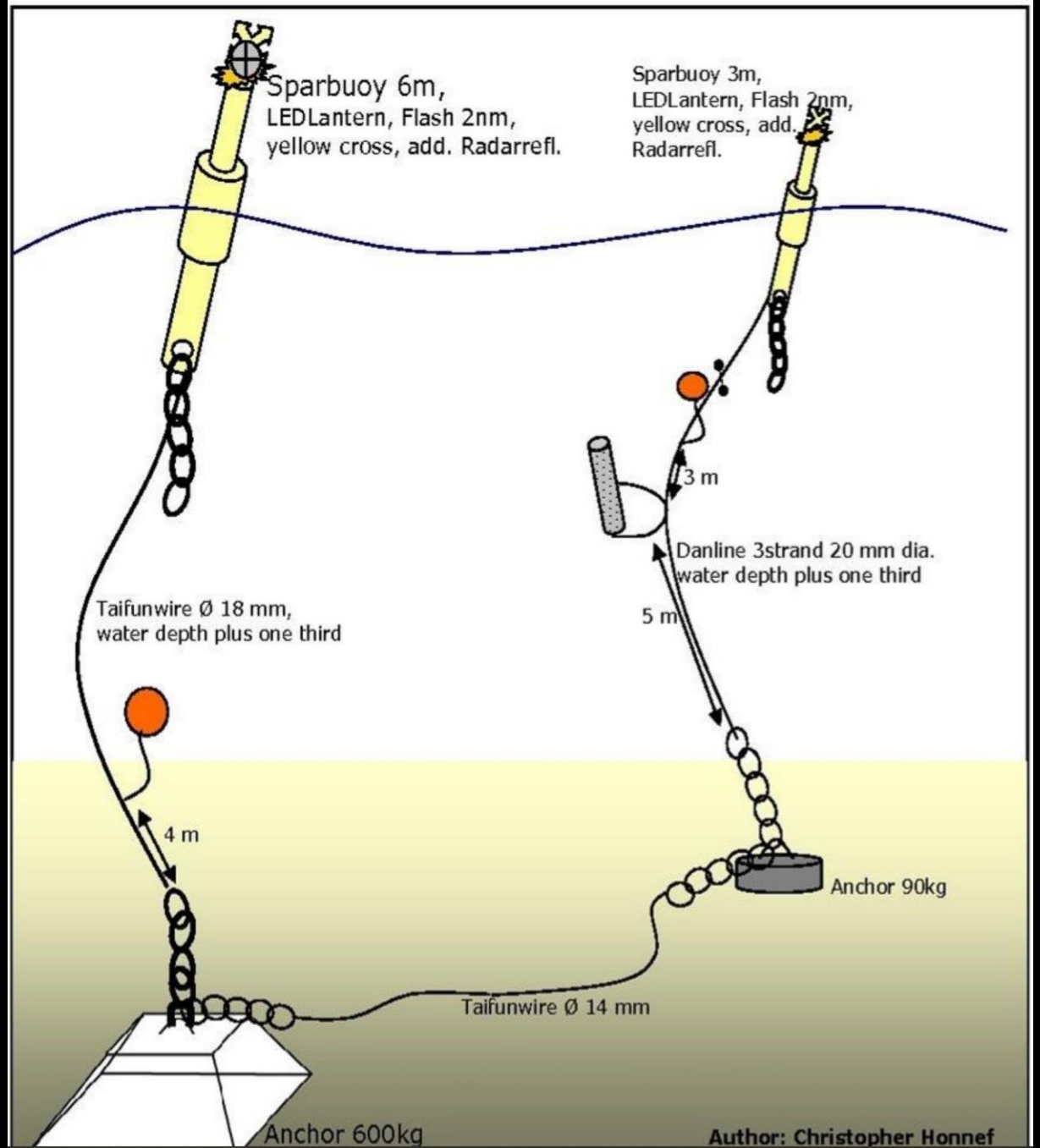


POD Mooring Gear, North Sea Open Water with Trawling Fishery, Depth 40m



Grappling

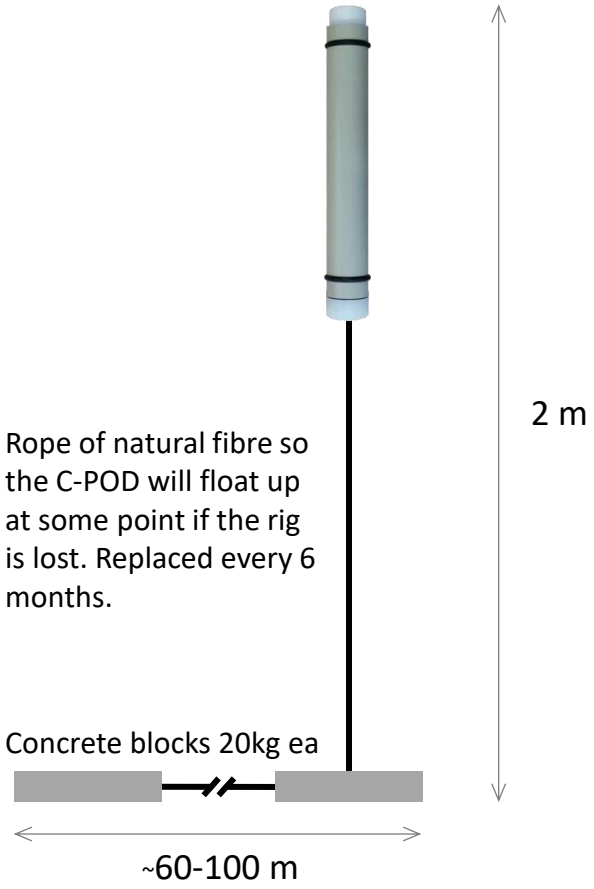
Vaquita:
Highly expert grappling team…
Now the sole method.

Grappling

System used in Mexico for Vaquita

Grapple is a boat anchor, used with the boat travelling forwards.

Swedish national monitoring programme



Bottom rope with positive buoyancy. Sometimes with a weight in the middle to prevent a high arch, sometimes with floats ~2m m from the anchors to keep it above the bottom.

See ‘Moorings Swedish grappling.pdf’ for a very useful account of this.

Grappling

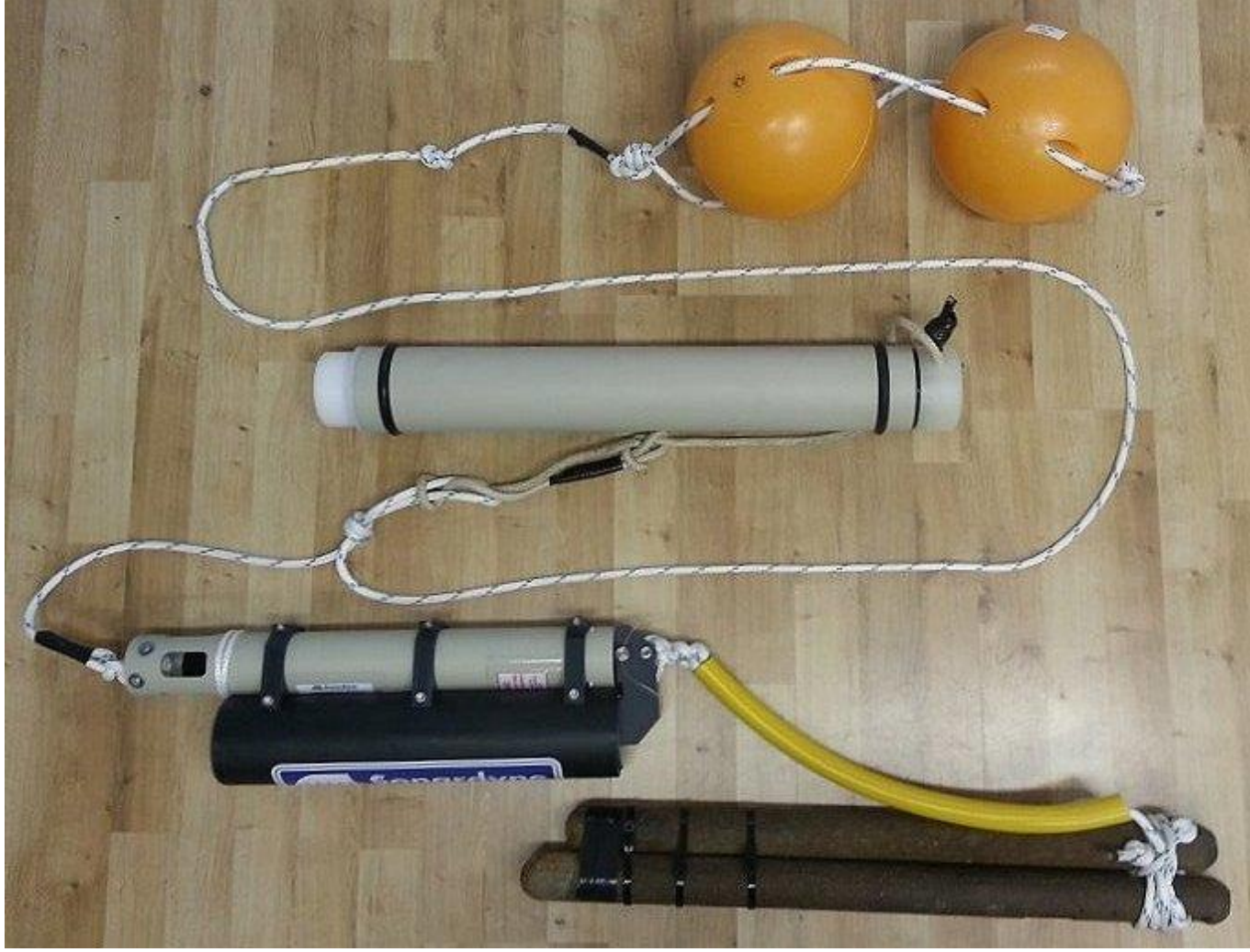
System used in Sado Estuary, Portugal.

Grapple is the boat anchor, used with the boat travelling backwards.

Others have used ground lines up to 100m.

Consider currents, bottom type and trawlers

Acoustic release mechanisms

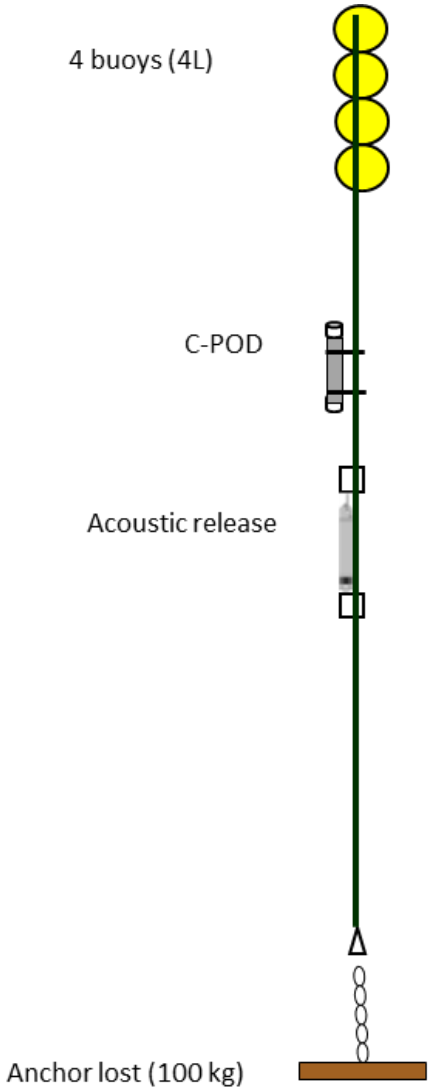


Problems:

- cost
- failures
- recovery rope failures
- recovery rope repacking is slow.

Mooring around French coasts for differents porpoises projects

Mooring line with acoustic release



Acoustic release + sacrificial anchor

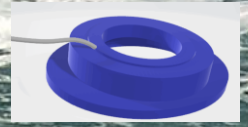
A bag of sand or rocks, or an iron weight is left on the sea bed.

The bag is hessian and slowly rots away so if the acoustic release fails to operate the POD comes free and may be found on a beach.

If the acoustic release operates a small piece of plastic or metal may be left in the sea.

F-POD integral acoustic release

A lorry brake disk is a suitable anchor



Moorings of Opportunity (MOPS?)

- Navigational buoys – at surface
- Oceanographic instrument stations
- Rigid structures - diving
- Fishing gear – pots and nets

Navigational buoys

The POD is weighted to make it less buoyant.

The rope link decouples the POD from the vertical movement of the buoy.

A current is needed to keep the POD out of the line of the chain as it moves up and down. A tough ‘arm’ between the chain and the POD (eg the rope goes through a plastic tube) may help to achieve this.

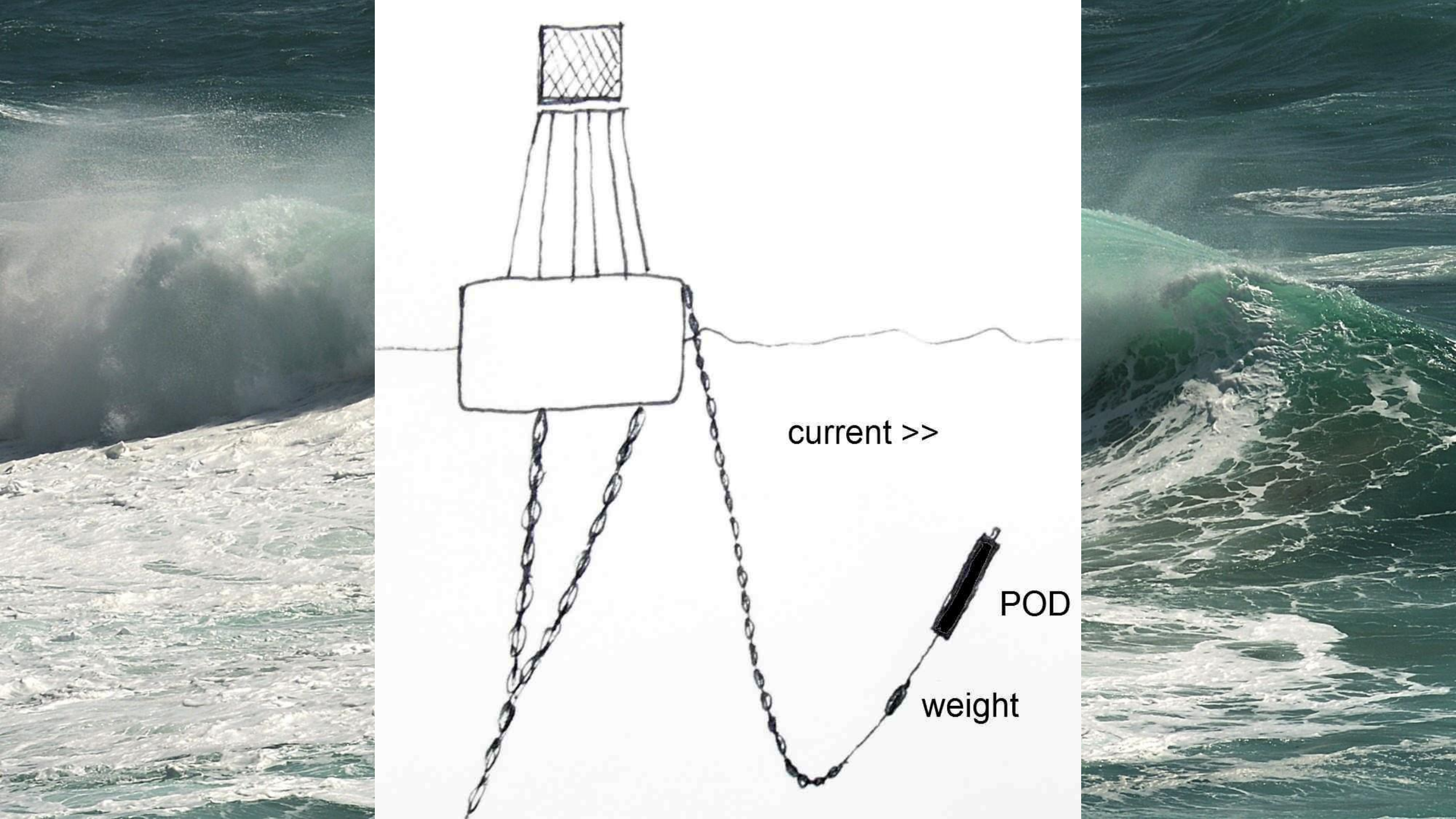
Needs stainless chain?

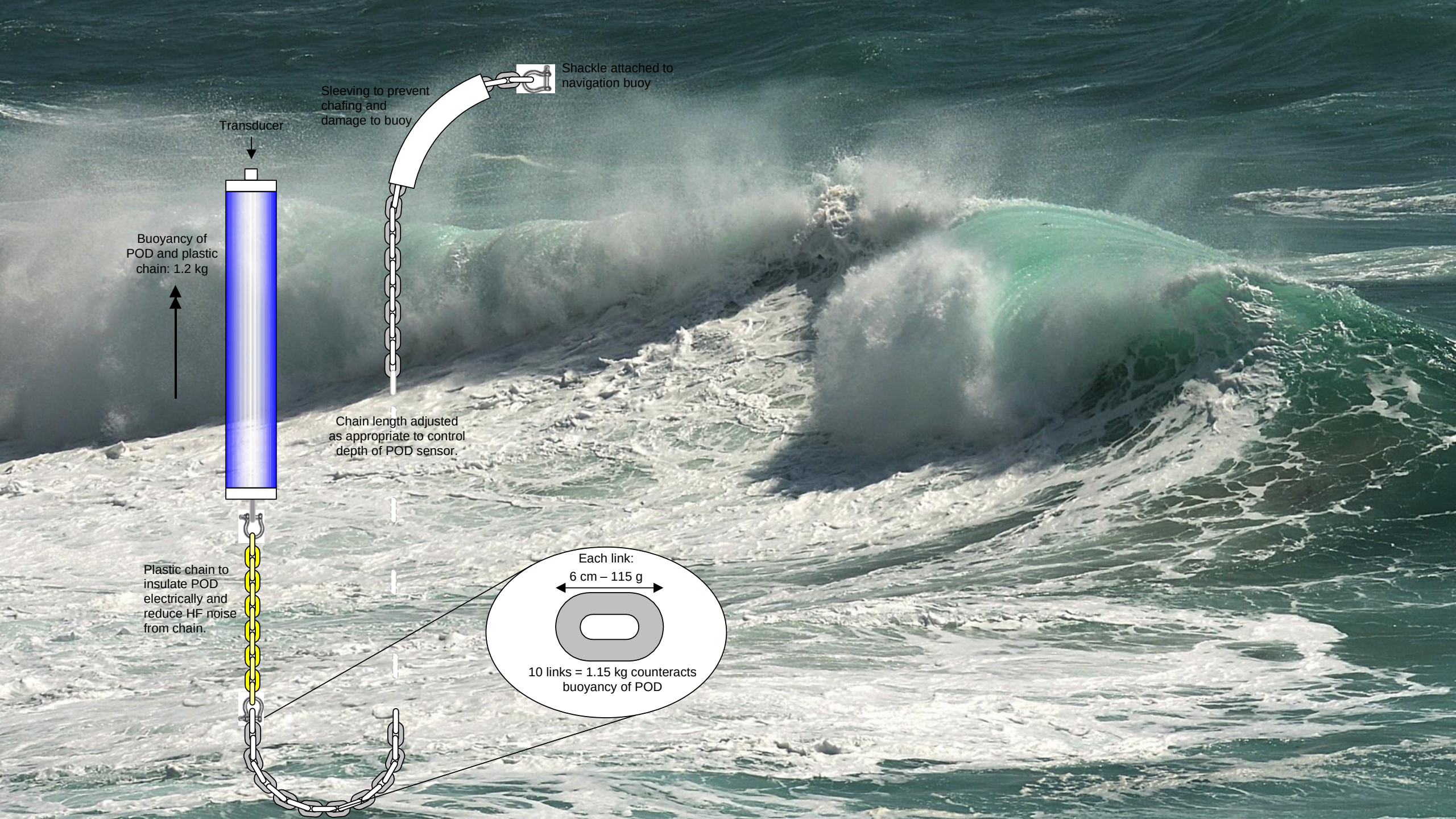
Navigational buoys

Chain can wear rapidly in this situation.

The buoy may be lifted regularly to service it … and your lovely POD may be thrown away…

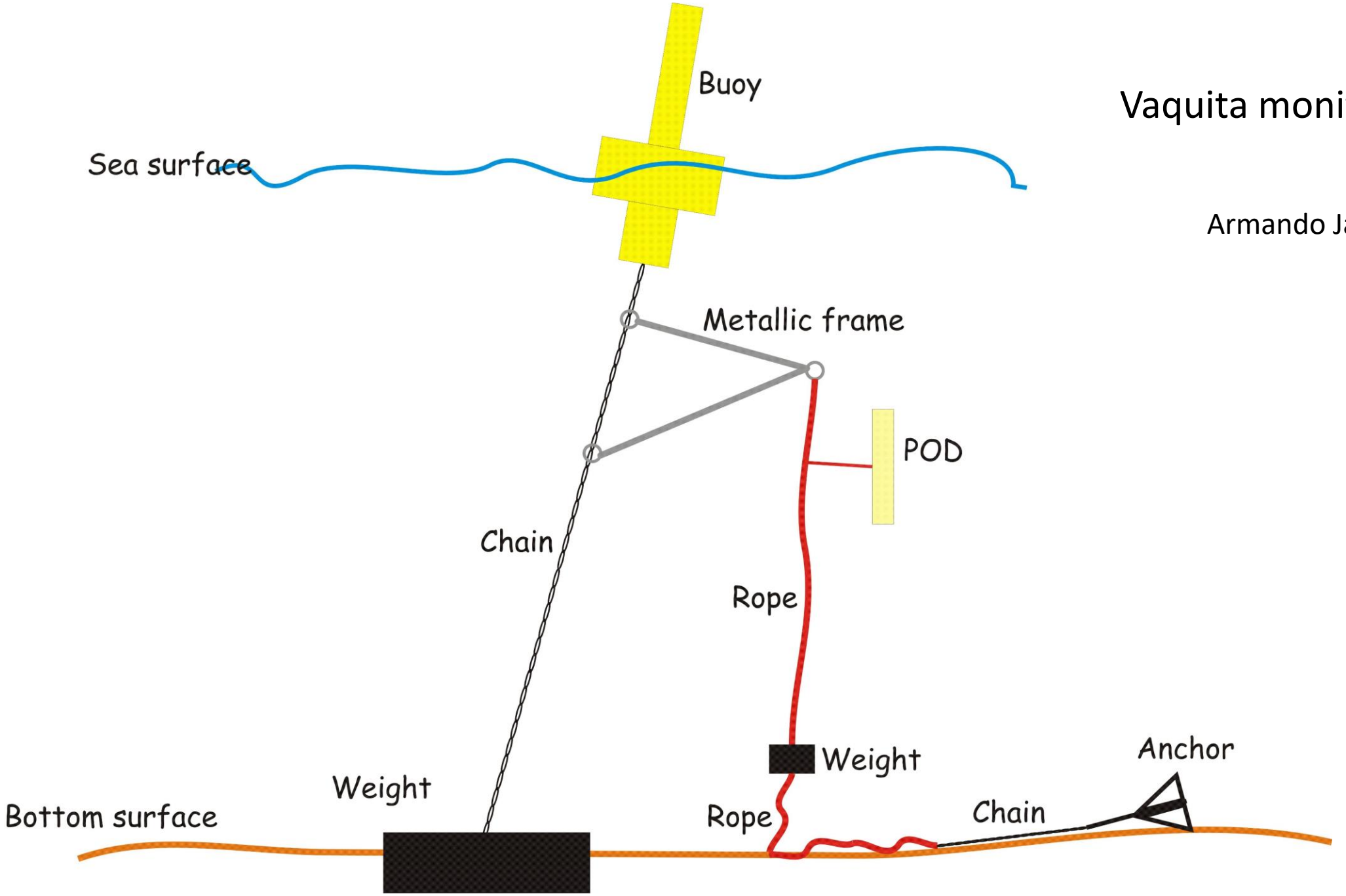
It may be possible to shackle the POD to some loop or lug that is below the waterline on the bouy, by snorkelling. You need a small bouy to hold the weight of the POD rig while you attach it.


current >>
POD
weight


Shackle attached to navigation buoy
Sleeving to prevent chafing and damage to buoy
Transducer
Buoyancy of POD and plastic chain: 1.2 kg
Chain length adjusted as appropriate to control depth of POD sensor.
Plastic chain to insulate POD electrically and reduce HF noise from chain.
Each link:
6 cm – 115 g
10 links = 1.15 kg counteracts buoyancy of POD

Vaquita monitoring

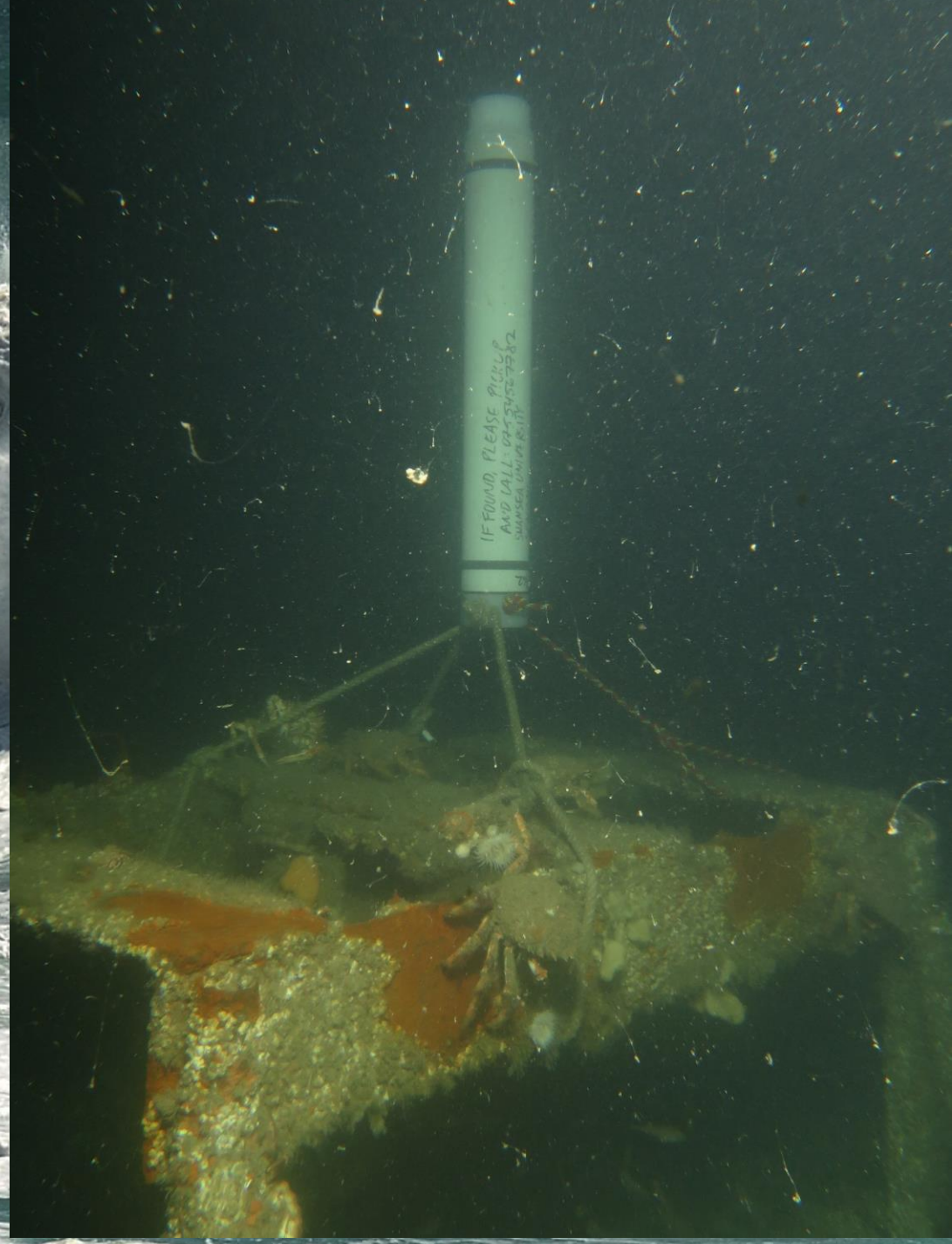
Armando Jaramillo



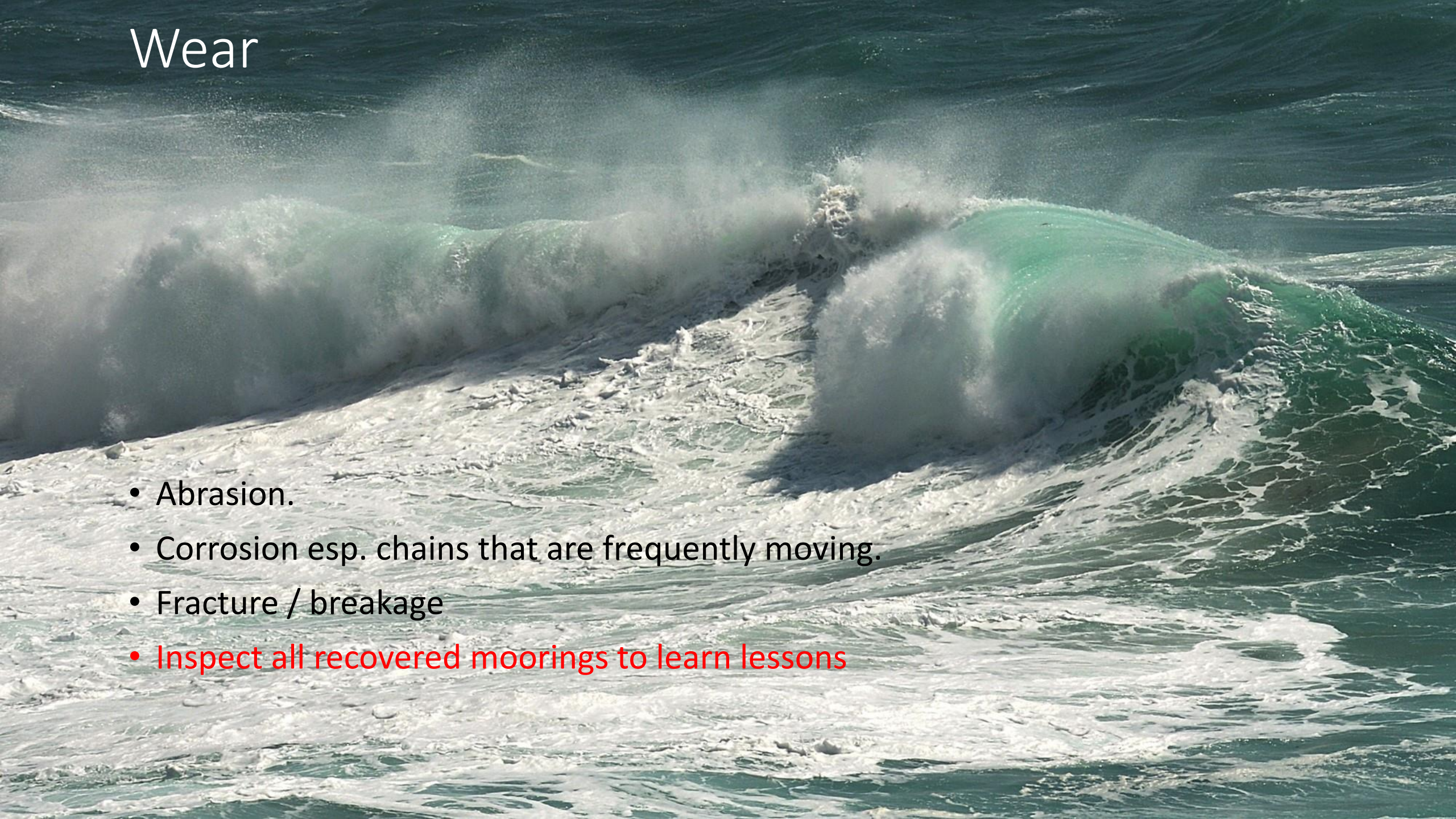
Mooring in a flooded forest Mamiraua, Amazonia

Diver Moorings

- Ideal if it’s not too expensive

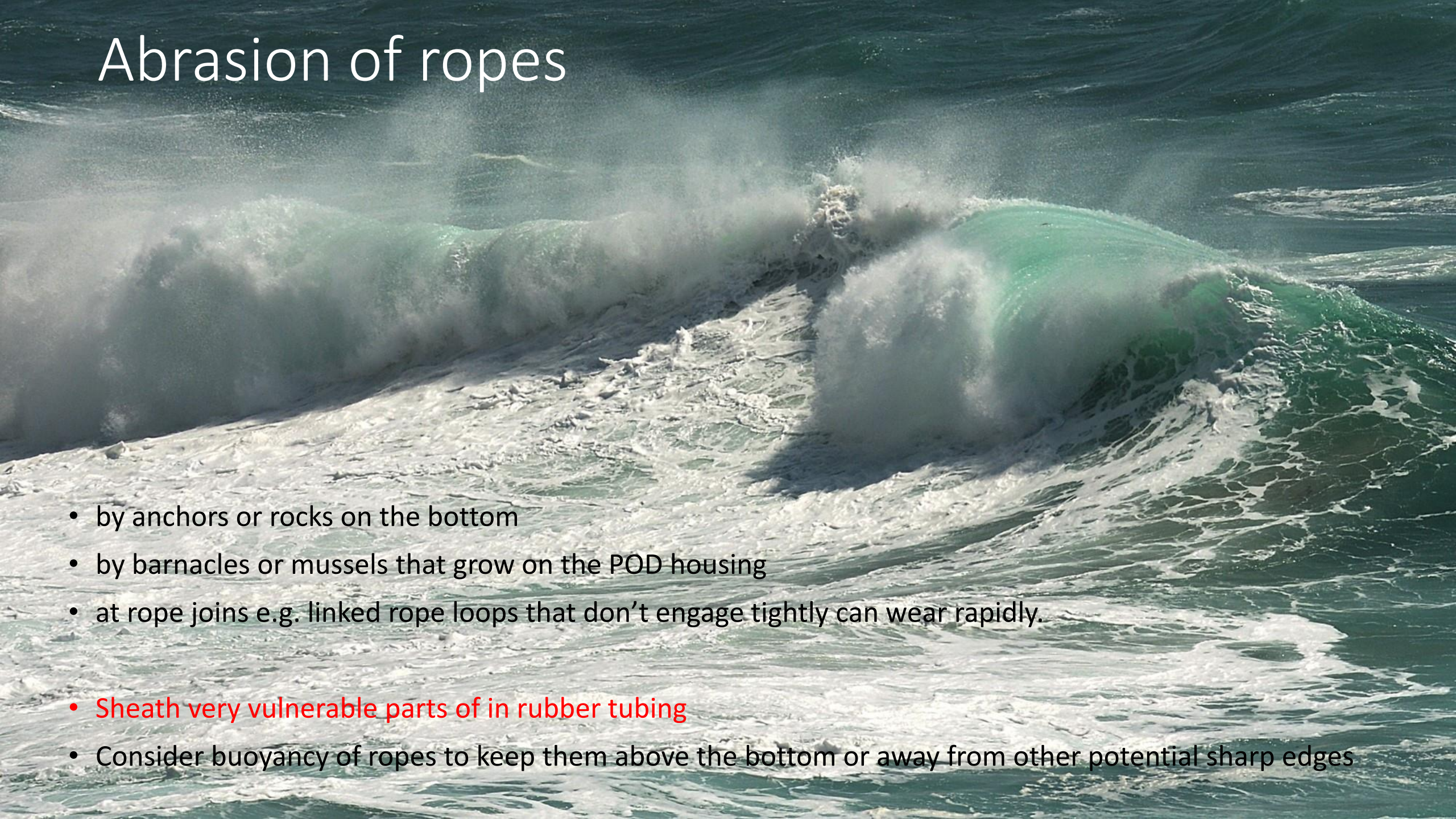


Wear



- Abrasion.
- Corrosion esp. chains that are frequently moving.
- Fracture / breakage
- Inspect all recovered moorings to learn lessons

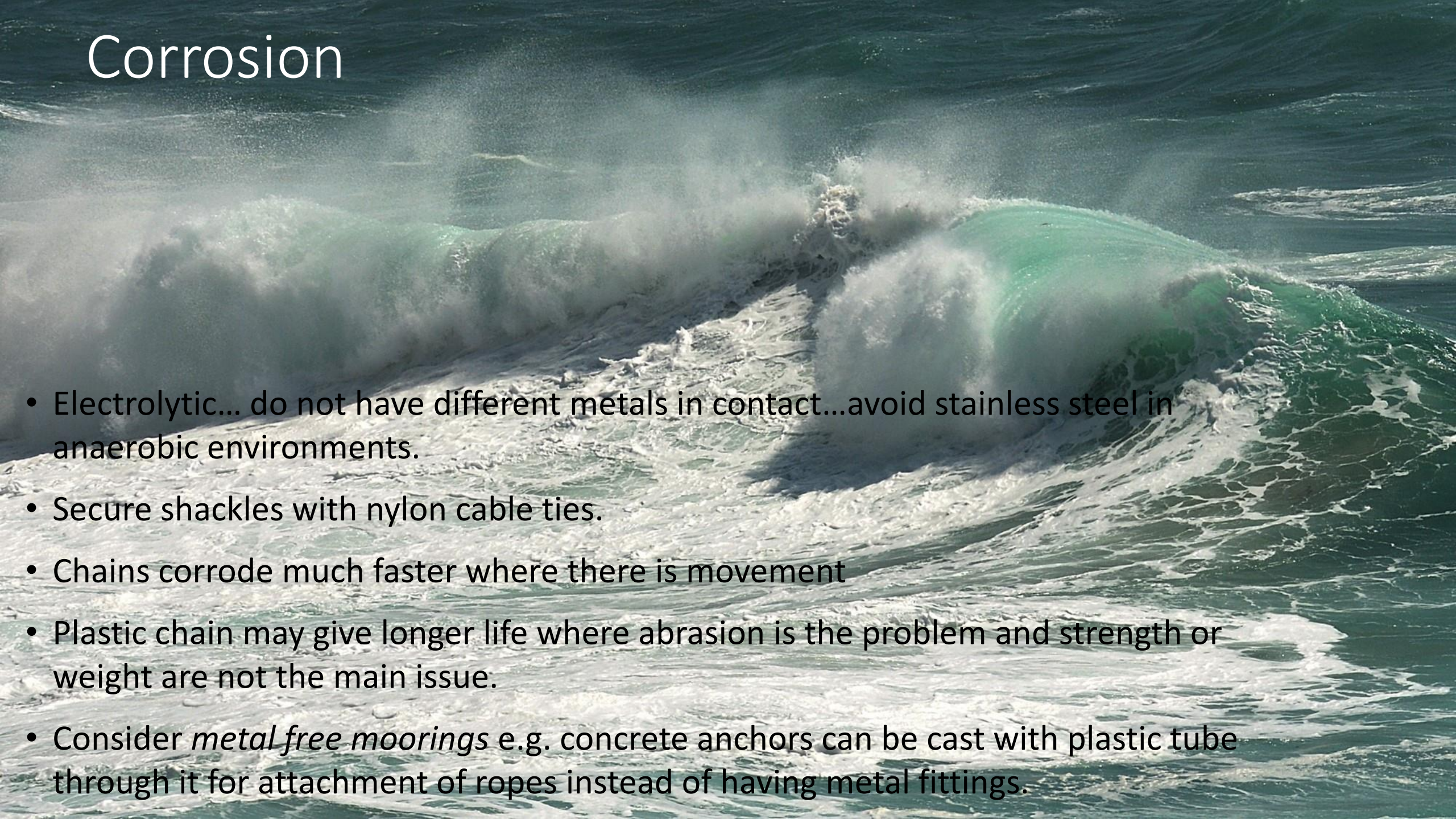
Abrasion of ropes



- by anchors or rocks on the bottom
- by barnacles or mussels that grow on the POD housing
- at rope joins e.g. linked rope loops that don't engage tightly can wear rapidly.

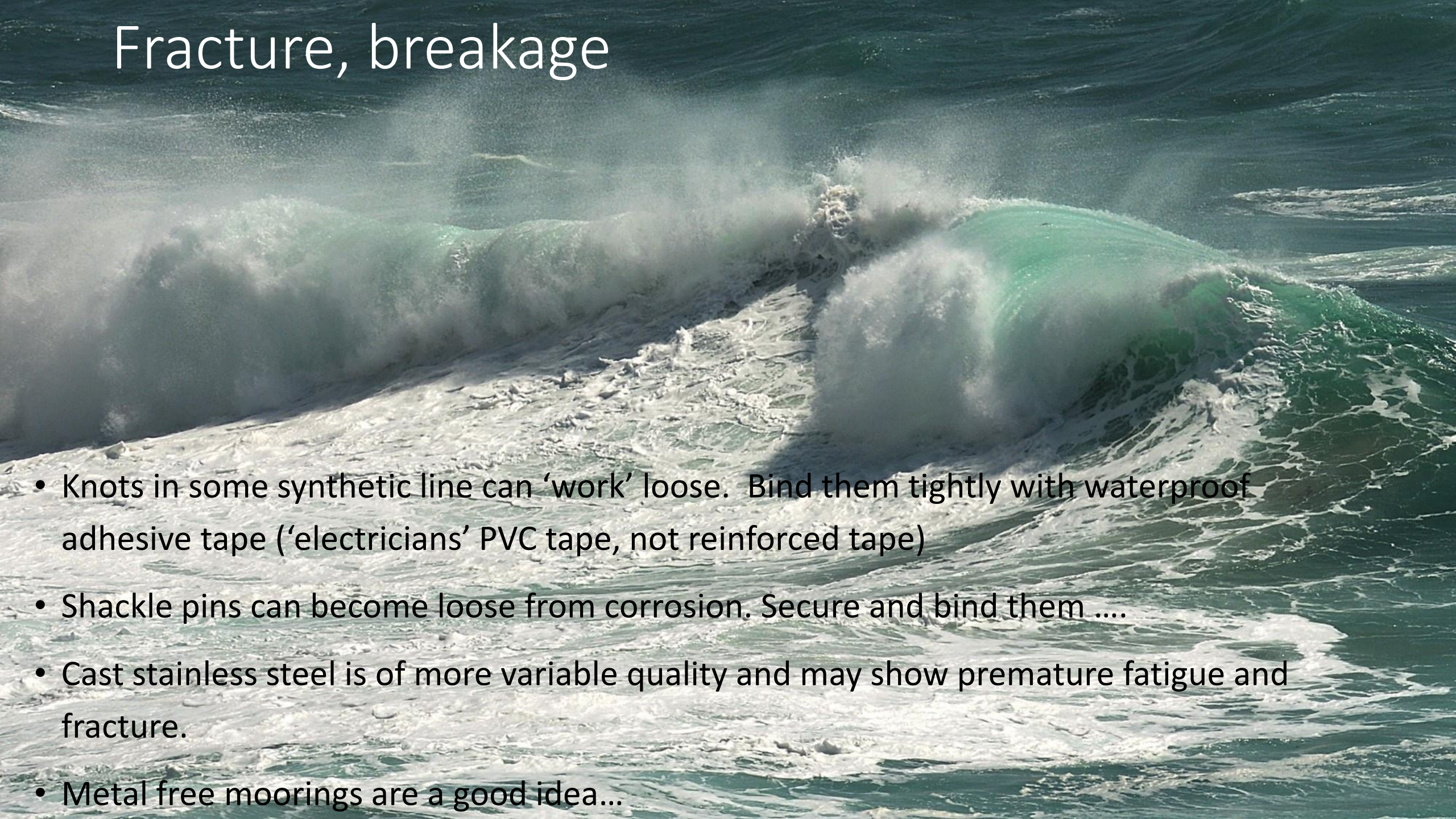
- Sheath very vulnerable parts of in rubber tubing
- Consider buoyancy of ropes to keep them above the bottom or away from other potential sharp edges

Corrosion



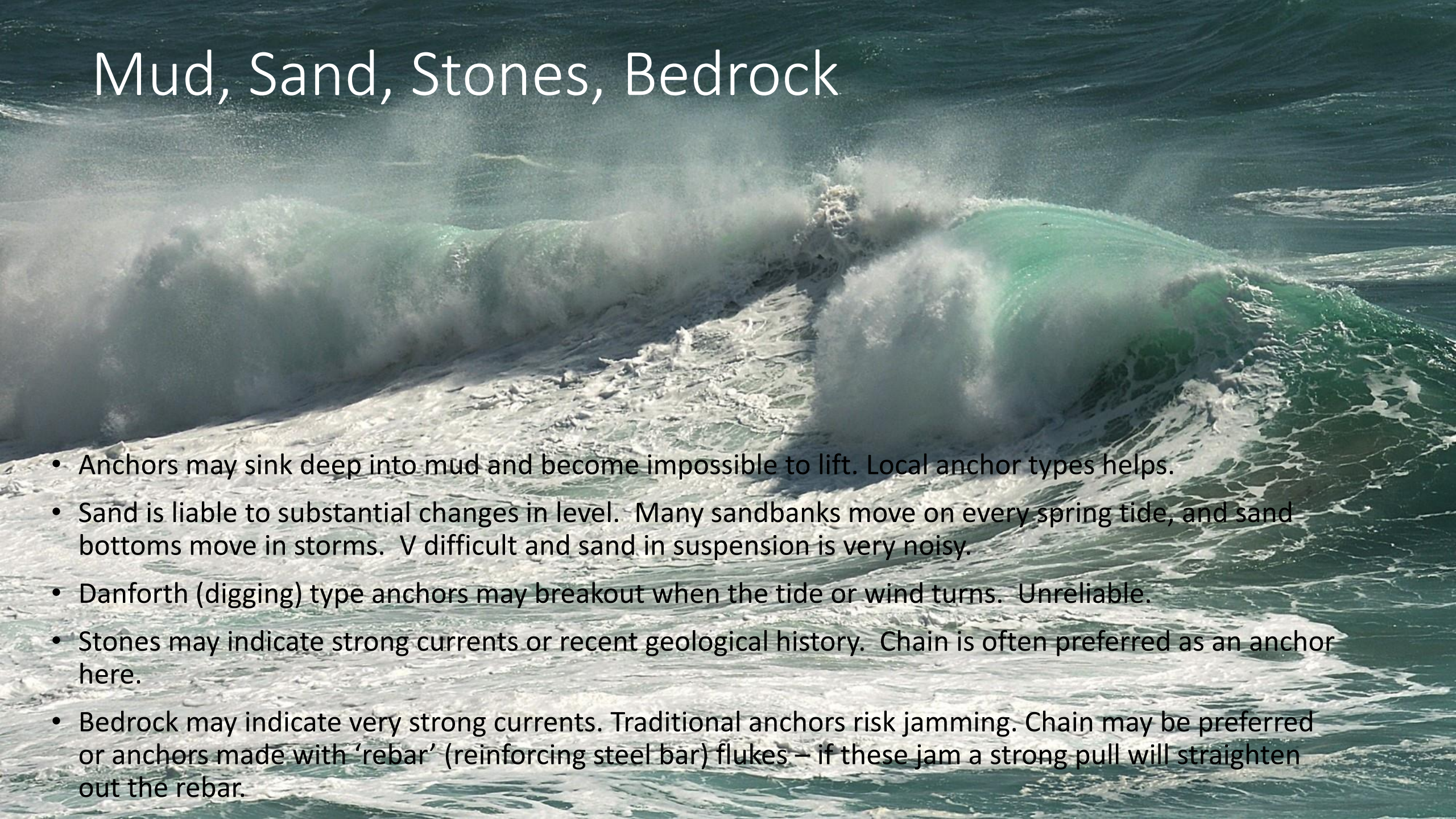
- Electrolytic… do not have different metals in contact…avoid stainless steel in anaerobic environments.
- Secure shackles with nylon cable ties.
- Chains corrode much faster where there is movement
- Plastic chain may give longer life where abrasion is the problem and strength or weight are not the main issue.
- Consider *metal free moorings* e.g. concrete anchors can be cast with plastic tube through it for attachment of ropes instead of having metal fittings.

Fracture, breakage



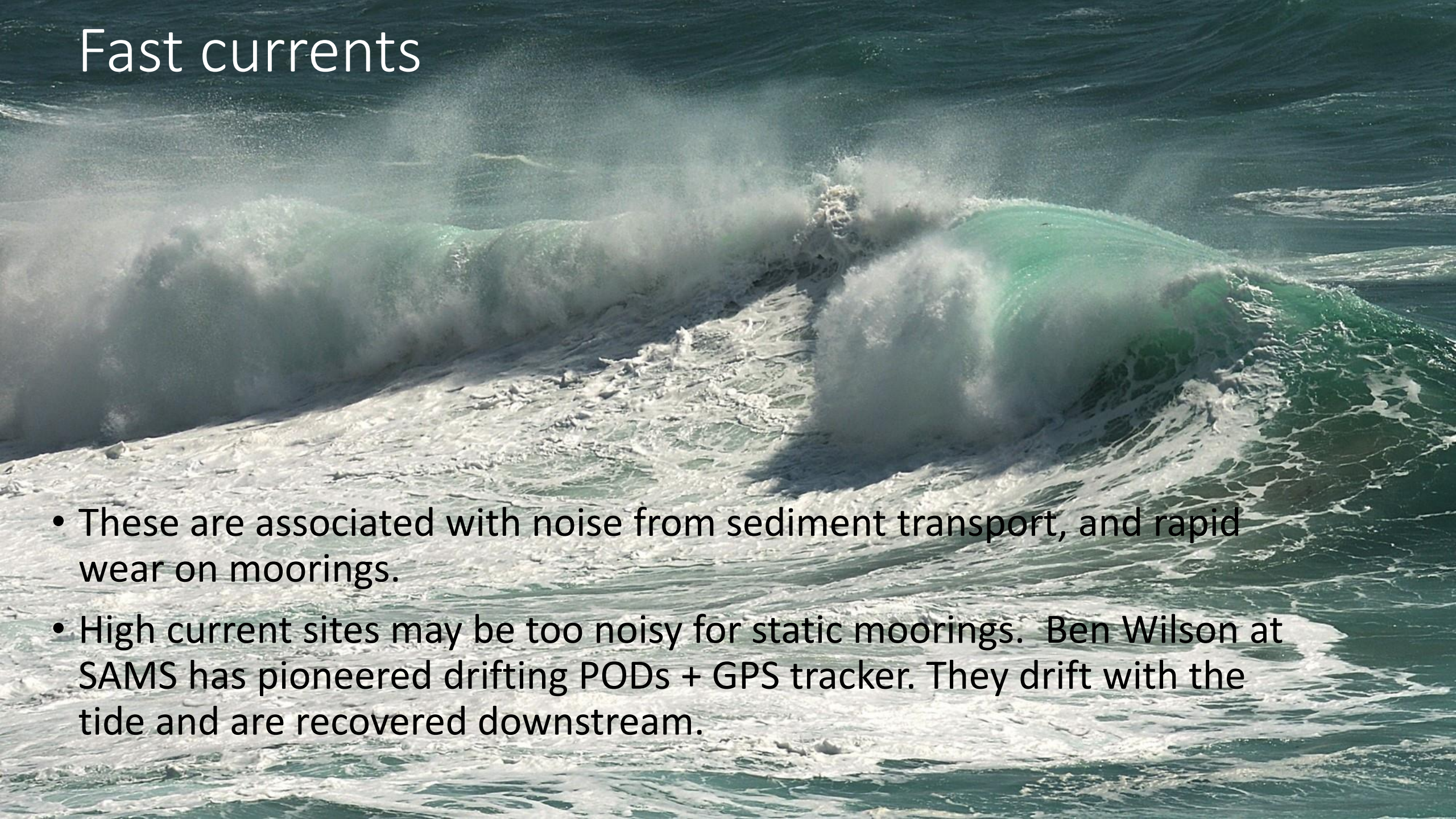
- Knots in some synthetic line can ‘work’ loose. Bind them tightly with waterproof adhesive tape (‘electricians’ PVC tape, not reinforced tape)
- Shackle pins can become loose from corrosion. Secure and bind them ….
- Cast stainless steel is of more variable quality and may show premature fatigue and fracture.
- Metal free moorings are a good idea…

Mud, Sand, Stones, Bedrock



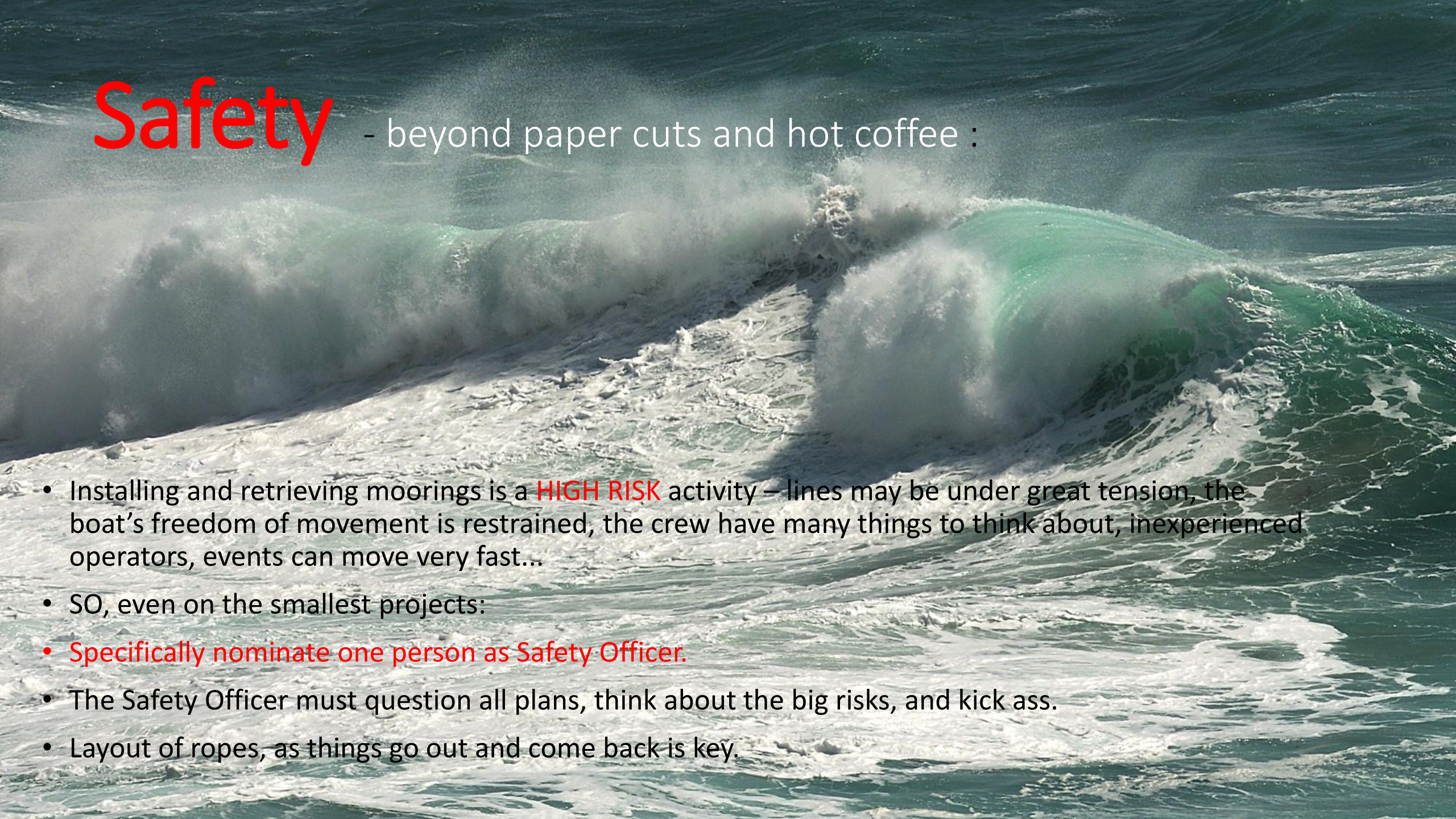
- Anchors may sink deep into mud and become impossible to lift. Local anchor types helps.
- Sand is liable to substantial changes in level. Many sandbanks move on every spring tide, and sand bottoms move in storms. V difficult and sand in suspension is very noisy.
- Danforth (digging) type anchors may breakout when the tide or wind turns. Unreliable.
- Stones may indicate strong currents or recent geological history. Chain is often preferred as an anchor here.
- Bedrock may indicate very strong currents. Traditional anchors risk jamming. Chain may be preferred or anchors made with ‘rebar’ (reinforcing steel bar) flukes – if these jam a strong pull will straighten out the rebar.

Fast currents



- These are associated with noise from sediment transport, and rapid wear on moorings.
- High current sites may be too noisy for static moorings. Ben Wilson at SAMS has pioneered drifting PODs + GPS tracker. They drift with the tide and are recovered downstream.

Safety - beyond paper cuts and hot coffee :



- Installing and retrieving moorings is a HIGH RISK activity – lines may be under great tension, the boat's freedom of movement is restrained, the crew have many things to think about, inexperienced operators, events can move very fast...
- SO, even on the smallest projects:
- Specifically nominate one person as Safety Officer.
- The Safety Officer must question all plans, think about the big risks, and kick ass.
- Layout of ropes, as things go out and come back is key.

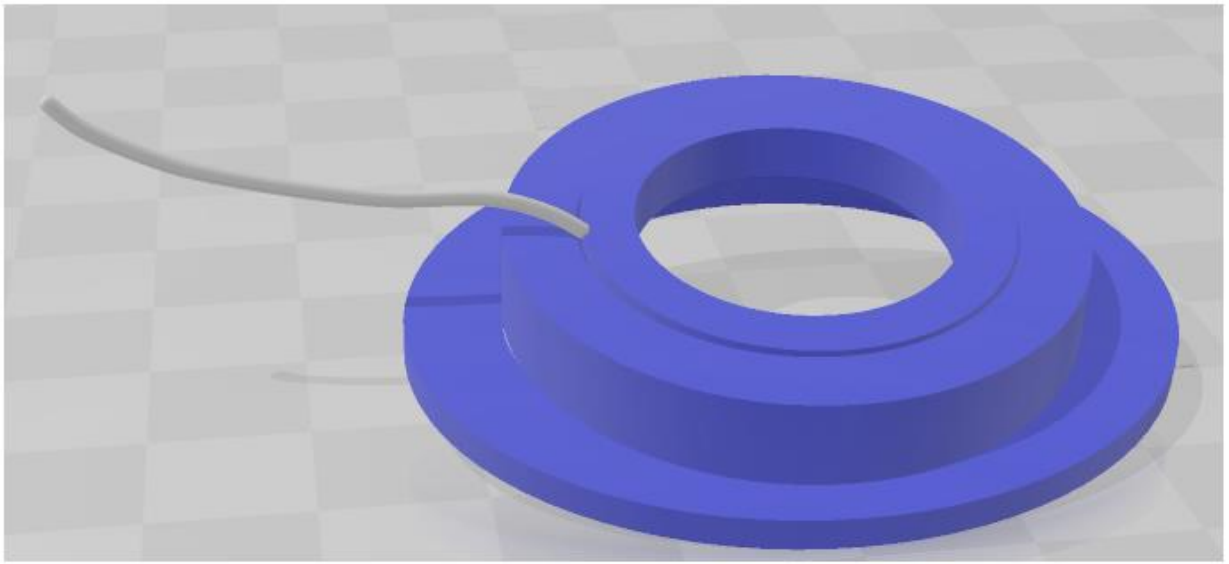
Law

- Permissions for buoys
- Permissions for leaving materials on the sea bed
- More…?

Brake discs

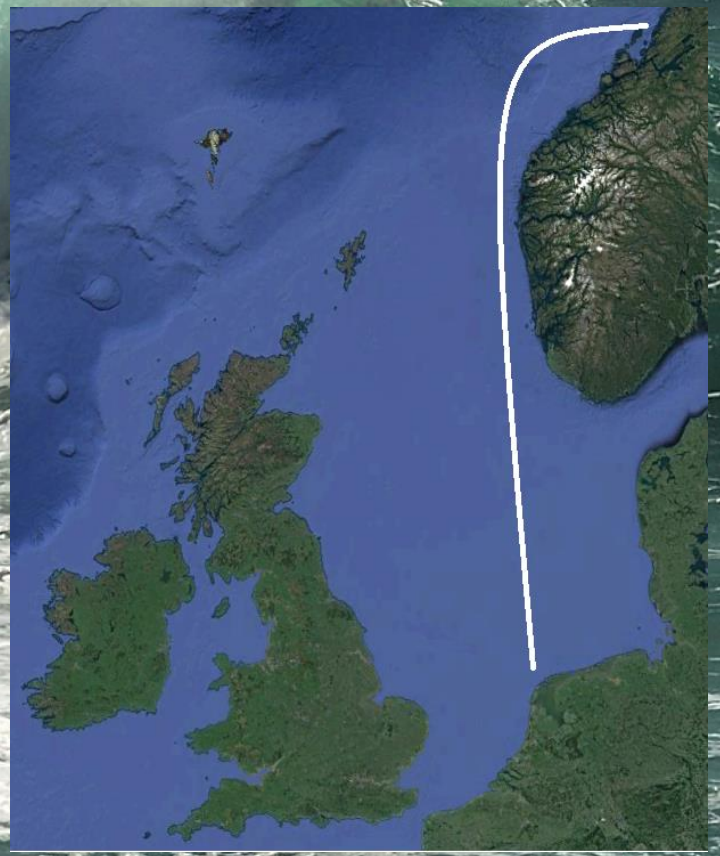
- If the rope is attached like this the disc digs in under strain:

brake disc lines should be attached to this position on the disc

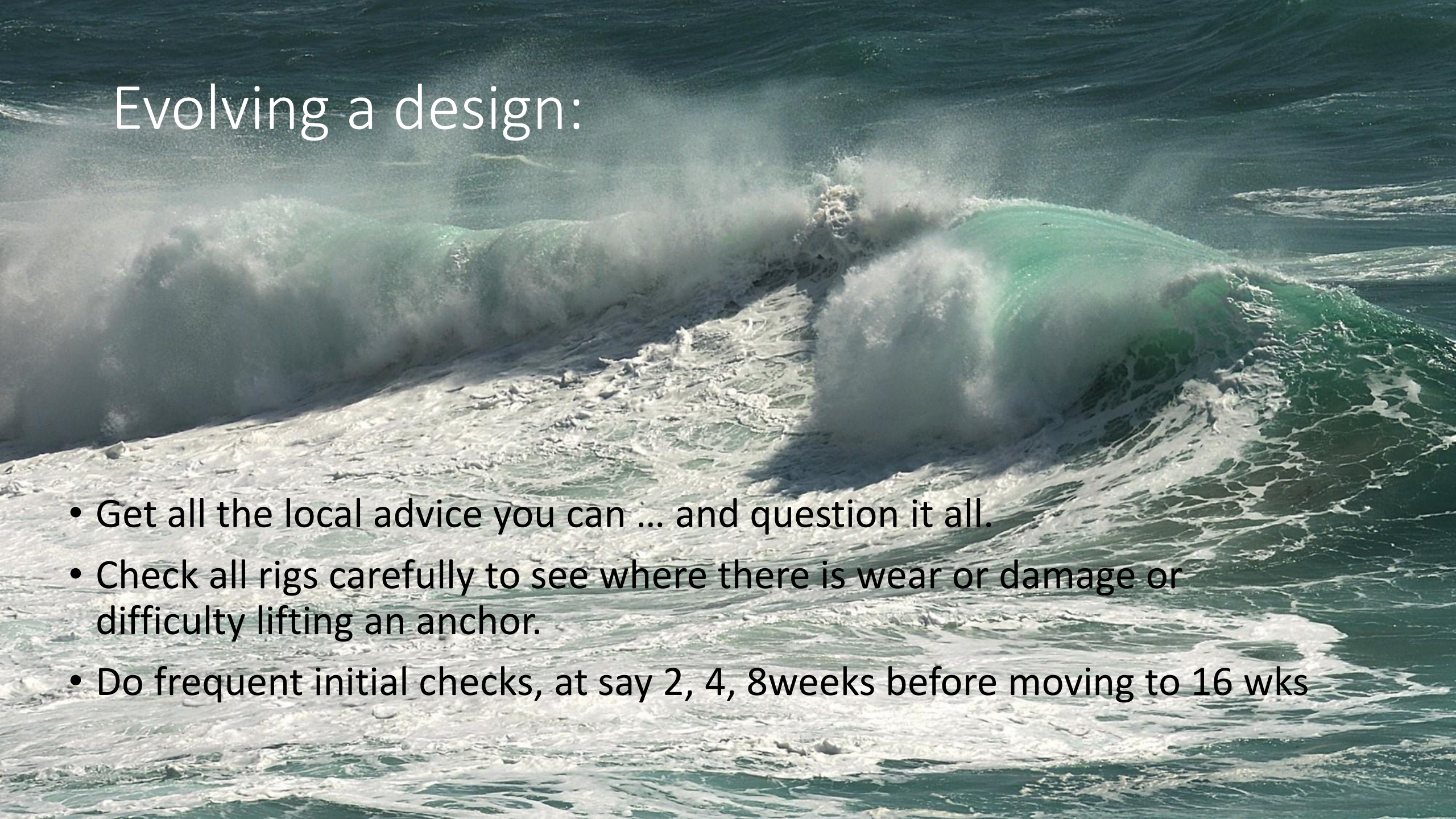


Lost PODs

- PODs have a website engraved on the end. Finders contact this site and Chelonia passes their message to the owner of the POD.
- More than 100 recovered this way so far.
- One crossed the North Sea from Britain and was still logging on the Swedish shore.
- One reached the White Sea from the SE North Sea.



Evolving a design:



- Get all the local advice you can … and question it all.
- Check all rigs carefully to see where there is wear or damage or difficulty lifting an anchor.
- Do frequent initial checks, at say 2, 4, 8weeks before moving to 16 wks

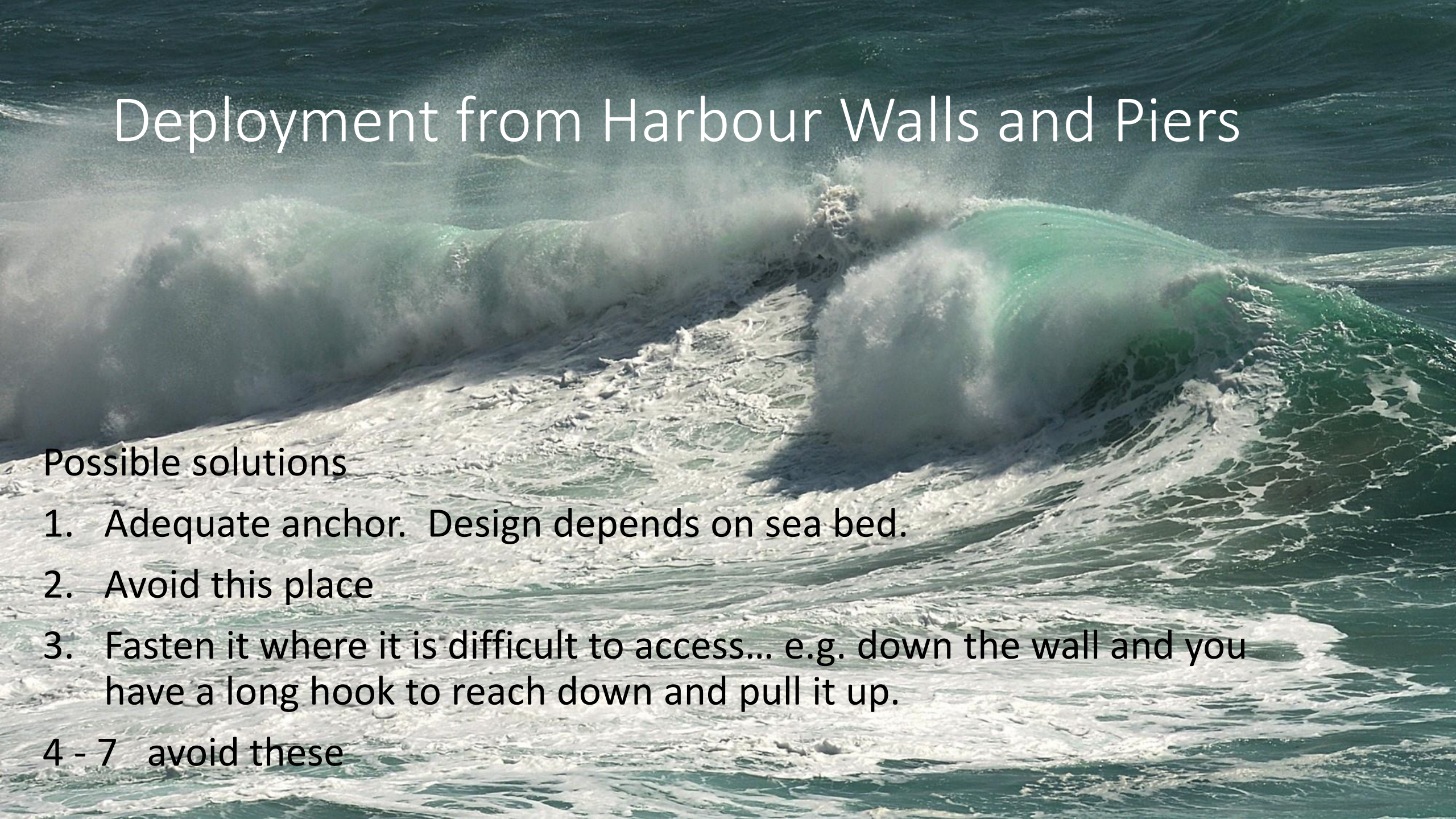
MOPs - Moorings Of Opportunity

Deployment from Harbour Walls and Piers

Possible problems

1. storm waves throw the POD and mooring against the wall
2. fisherpersons on the wall hook the line
3. people see it and pull it up
4. navigation issue if POD is in a position used by boats
5. boat sonars - if logged in most minutes this can impair detection performance
6. noises from harbour may repel cetaceans
7. deeper water species don't come close enough to be logged

Deployment from Harbour Walls and Piers



Possible solutions

1. Adequate anchor. Design depends on sea bed.
2. Avoid this place
3. Fasten it where it is difficult to access… e.g. down the wall and you have a long hook to reach down and pull it up.

4 - 7 avoid these

GOOD LUCK

Thanks to all POD users who have contributed experience, ideas, and drawings.