Tethered SCUBA Diving for Science, AAUS, October 2011

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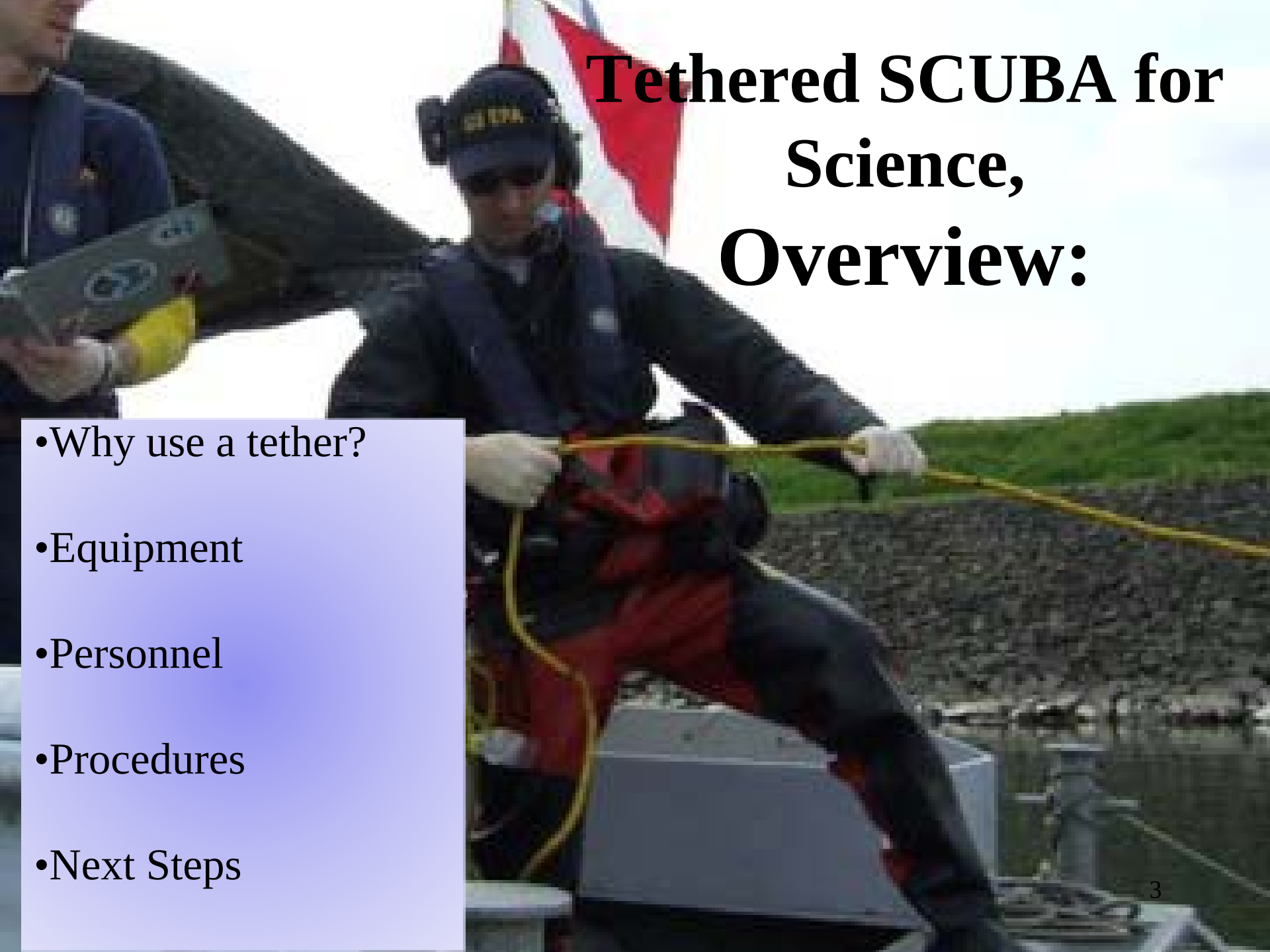
40 Year Anniversary: 1970-2010, Protecting Region 10 Waters

EPA REGION 10 DIVE TEAM

www.epa.gov/region10/dive

Acknowledgements

- **NOAA Tethered Diving Standards and Training Module**
- **University of Michigan "Use of Tethered SCUBA Diving to Improve Safety and Efficiency", AAUS Symposium Proceedings, 1990**
- **Hendrick, "Public Safety Diving," 2000**
- **EPA Environmental Response Team, Region 3, and ORD-Gulf Ecology Division EPA Dive Training Center**



Tethered SCUBA for Science,

Overview:

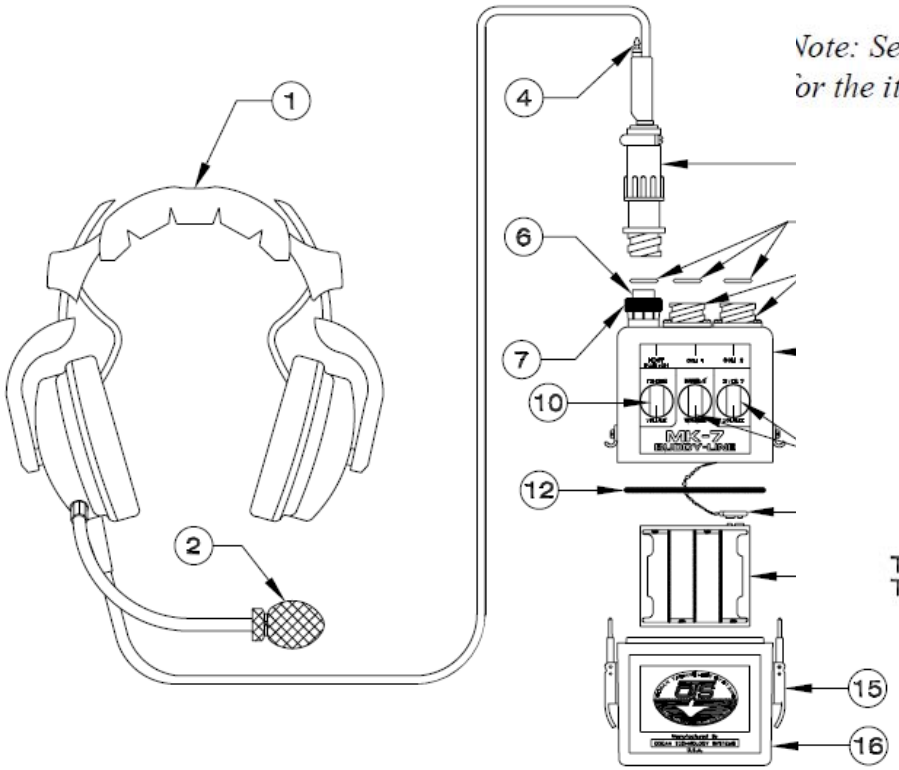
- Why use a tether?
- Equipment
- Personnel
- Procedures
- Next Steps

Why Tethered SCUBA for Science?

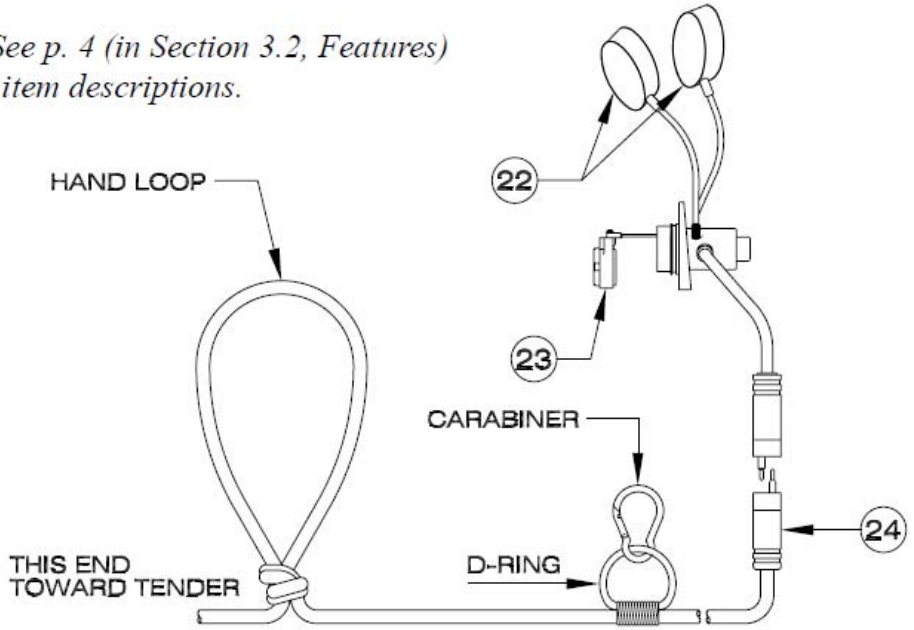
- Currents
- Entanglement
- Low visibility
- Need for constant communication &/or to relay video
- Mapping/search

Tethered SCUBA for Science: Equipment

Communications Unit



Note: See p. 4 (in Section 3.2, Features) for the item descriptions.



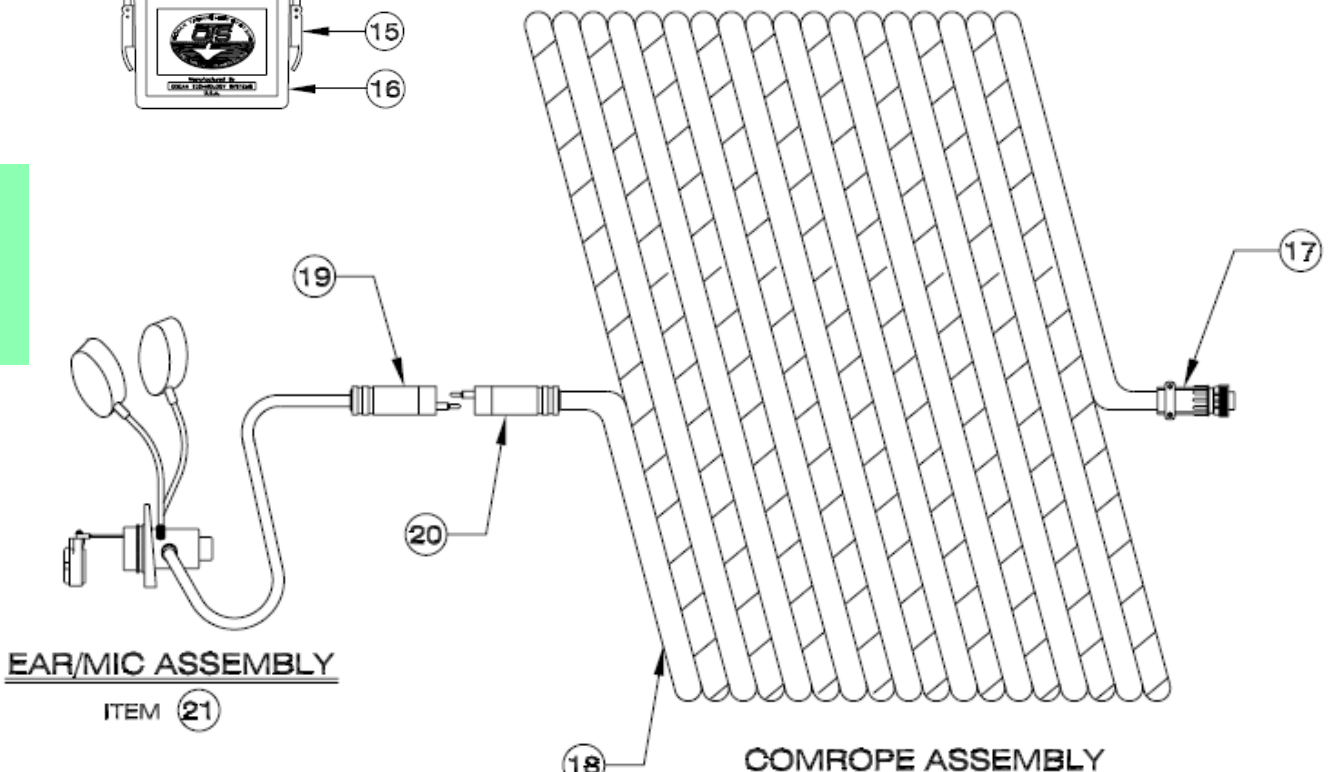


Table 8-3. *Line-Pull Signals.*

From Tender to Diver	
1 Pull	"Are you all right?" When diver is descending, one pull means "Stop."
2 Pulls	"Going Down." During ascent, two pulls mean "You have come up too far; go back down until we stop you."
3 Pulls	"Stand by to come up."
4 Pulls	"Come up."
2-1 Pulls	"I understand" or "Talk to me."
3-2 Pulls	"Ventilate."
4-3 Pulls	"Circulate."

From Diver to Tender	
1 Pull	"I am all right." When descending, one pull means "Stop" or "I am on the bottom."
2 Pulls	"Lower" or "Give me slack."
3 Pulls	"Take up my slack."
4 Pulls	"Haul me up."
2-1 Pulls	"I understand" or "Talk to me."
3-2 Pulls	"More air."
4-3 Pulls	"Less air."

Special Signals From the Diver	
1-2-3-1 Pulls	"Send me a square knot."
3-3-3 Pulls	"Send me a line."

Searching Signals (Without Circling Line)	
7 Pulls	"Go on (or off) searching signals."
1 Pull	"Stop and search where you are."
2 Pulls	"Move directly away from the tender if given slack; move toward the tender if strain is taken on the life line."
3 Pulls	"Face your umbilical, take a strain, move right."
4 Pulls	"Face your umbilical, take a strain, move left."

Searching Signals (With Circling Line)	
7 Pulls	"Go on (or off) searching signals."
1 Pull	"Stop and search where you are."
2 Pulls	"Move away from the weight."
3 Pulls	"Face the weight and go right."
4 Pulls	"Face the weight and go left."

Emergency Signals From the Diver	
2-2-2 Pulls	"I am fouled and need the assistance of another diver."
3-3-3 Pulls	"I am fouled but can clear myself."

Navy Rev. 6 Line Pull Signals

Harness

- Provides strain relief for diver's head
- Quick release for emergency escape
- Ensures against sudden loss of tether connection
- Gives ability of tender to conduct rescue

Full Face Mask

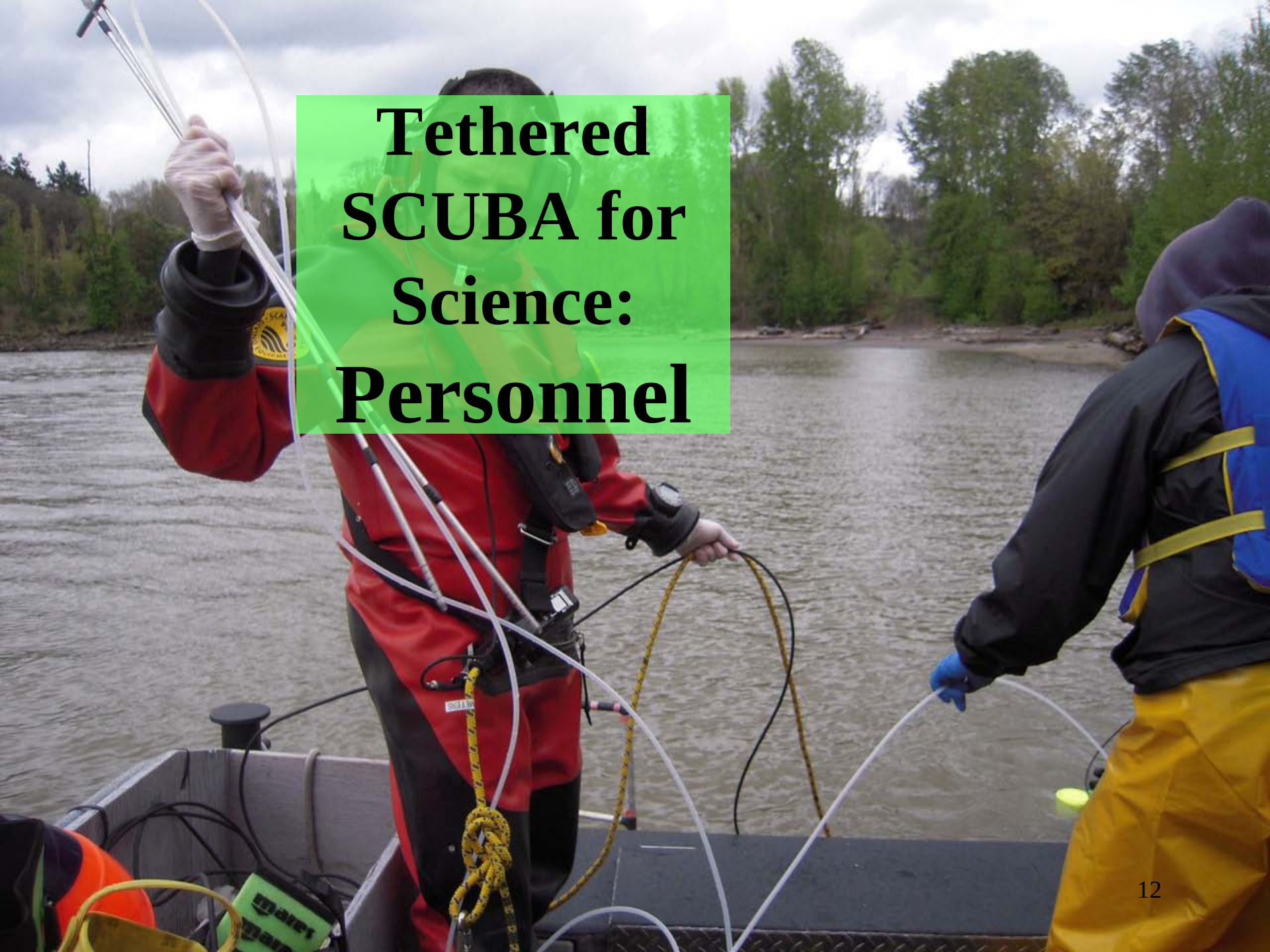
- Provides ability to communicate
- Compatible with lower level polluted water diving when used with dryhood /drysuit/drygloves

Tether

- Typically a comm. Line
- Strength member
- Should be fitted with quick release
- Distance to dive site plus 1.5 x depth
- Marked in regular intervals
- Span of control
- Segregation for polluted water

Emergency Gas Supply (EGS)

- Required as this is “solo diving”
- EGS typically connected thru manifold block
- Size of bailout determined by depth & hazards
- EGS SPG must be in diver’s field of view

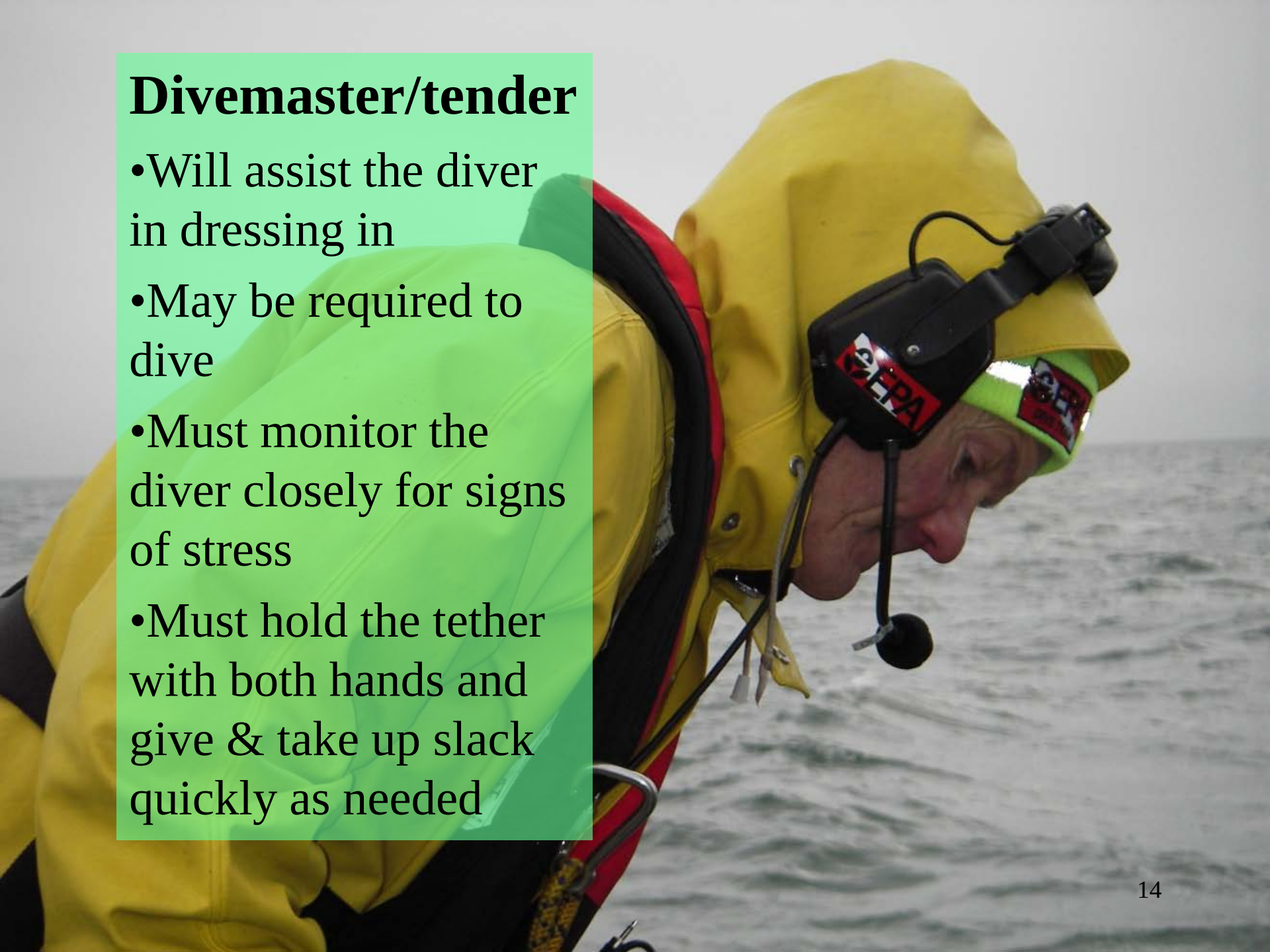

Tethered SCUBA for Science:
Personnel

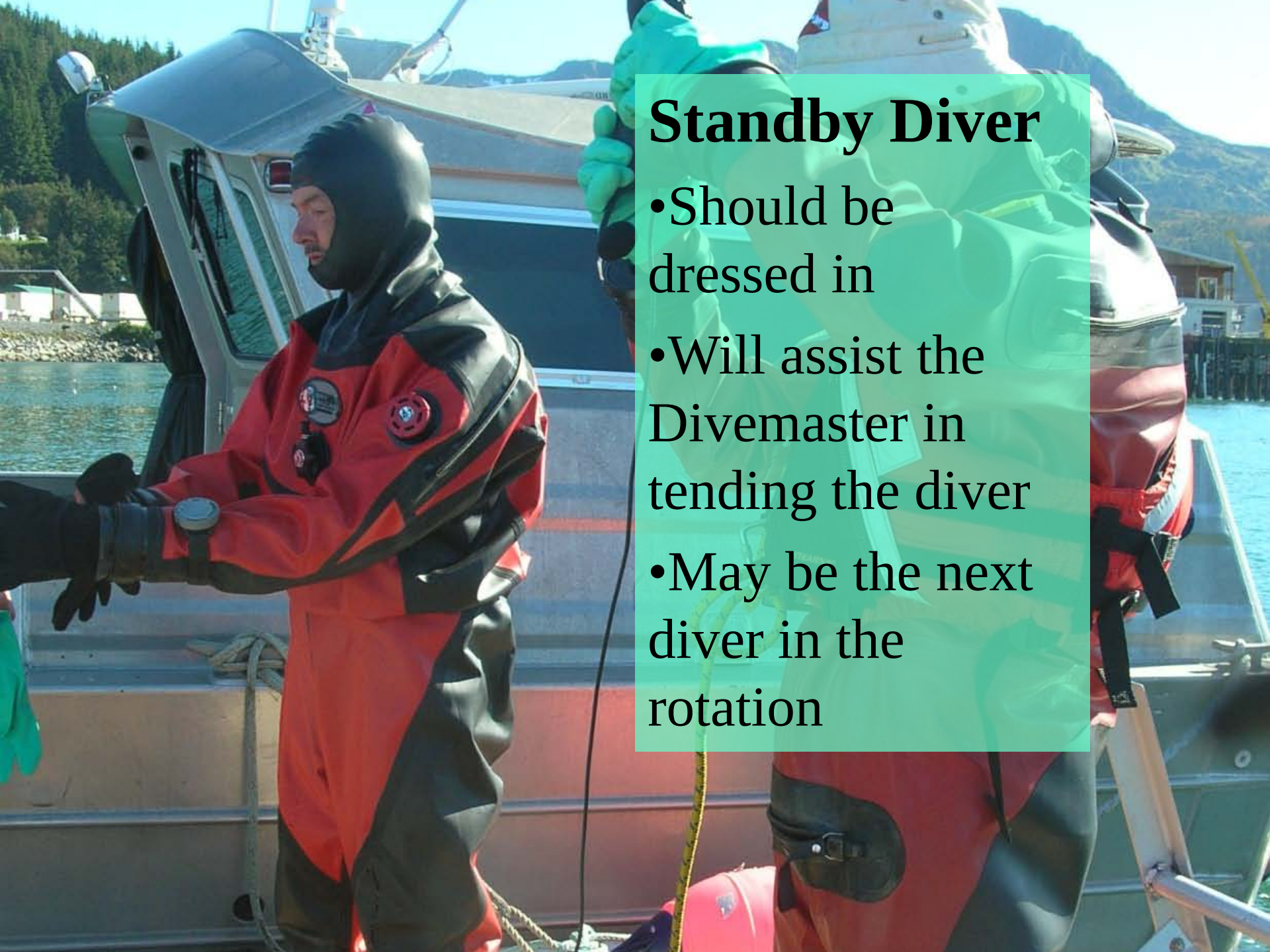
Diver

- Diving “alone”
- Diver needs to realize tender controls many aspects of dive
- Diver may rotate depending on depth profiles thru dive crew, or may be one diver per day

Divemaster/tender

- Will assist the diver in dressing in
- May be required to dive
- Must monitor the diver closely for signs of stress
- Must hold the tether with both hands and give & take up slack quickly as needed





Standby Diver

- Should be dressed in
- Will assist the Divemaster in tending the diver
- May be the next diver in the rotation

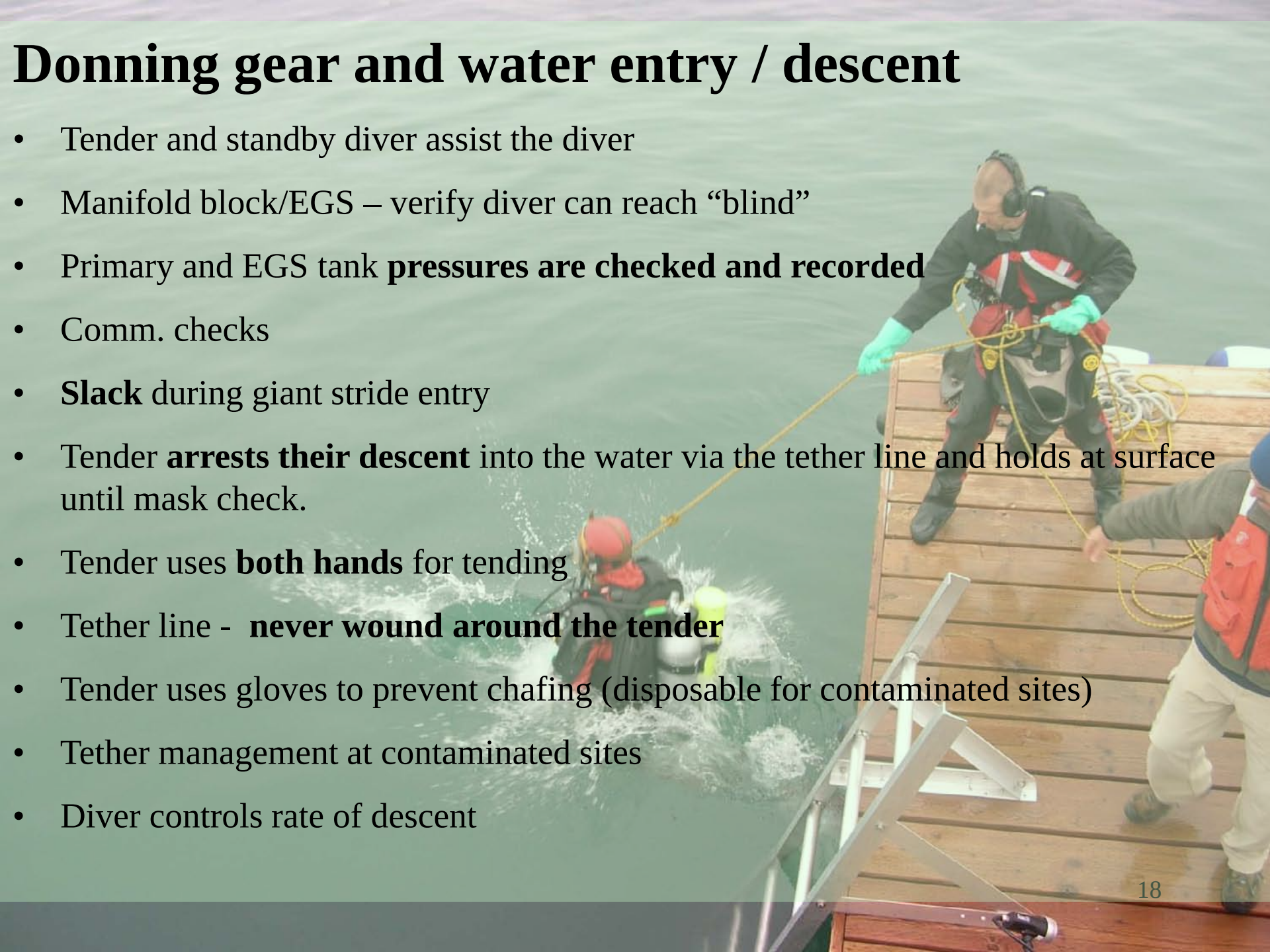
Tethered SCUBA for Science: Procedures

Procedures: Fundamentals

- Minimum crew size of 3
- Rotation of divers allows for maximum efficiency and safety (offgas time)

Donning gear and water entry / descent

- Tender and standby diver assist the diver
- Manifold block/EGS – verify diver can reach “blind”
- Primary and EGS tank **pressures are checked and recorded**
- Comm. checks
- **Slack** during giant stride entry
- Tender **arrests their descent** into the water via the tether line and holds at surface until mask check.
- Tender uses **both hands** for tending
- Tether line - **never wound around the tender**
- Tender uses gloves to prevent chafing (disposable for contaminated sites)
- Tether management at contaminated sites
- Diver controls rate of descent



On the bottom

•Directing the diver – all movements relative to the line “swim toward the line,” “take a 90 right”

•Diver must have trust

•Search patterns – spacing visibility dependent

•Regular pressure checks from the diver will be requested

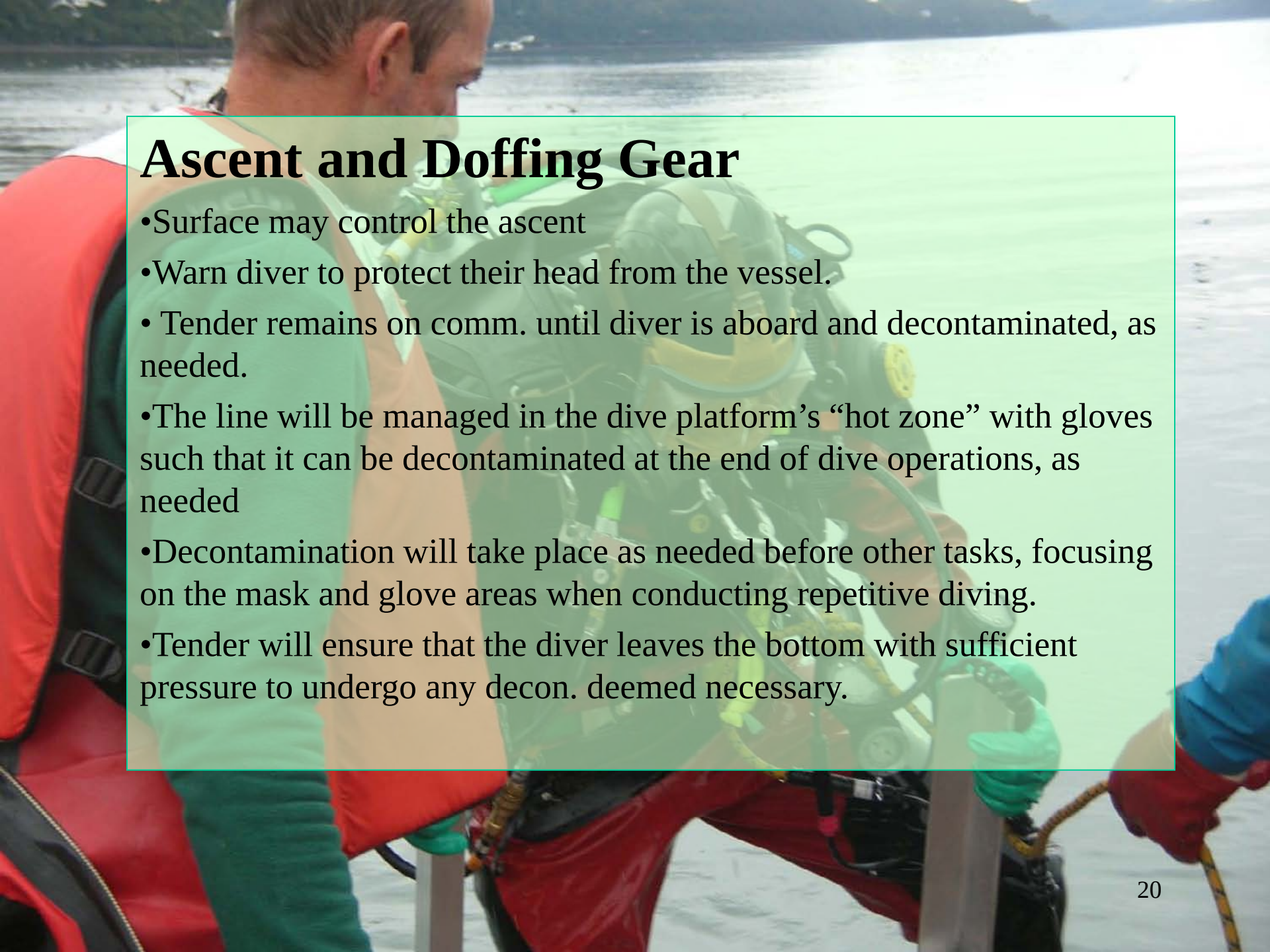
•“Standby surface.”

•Surface holds tension at all times, and releases tension only when requested

•Understand the “airplane wing” in current

•Lack of line tension can lead to:

1. Entanglement
2. No feedback on status of diver
3. Loss of backup (line pull) communications with diver
4. Inability to convey equipment via tether



Ascent and Doffing Gear

•Surface may control the ascent

•Warn diver to protect their head from the vessel.

• Tender remains on comm. until diver is aboard and decontaminated, as needed.

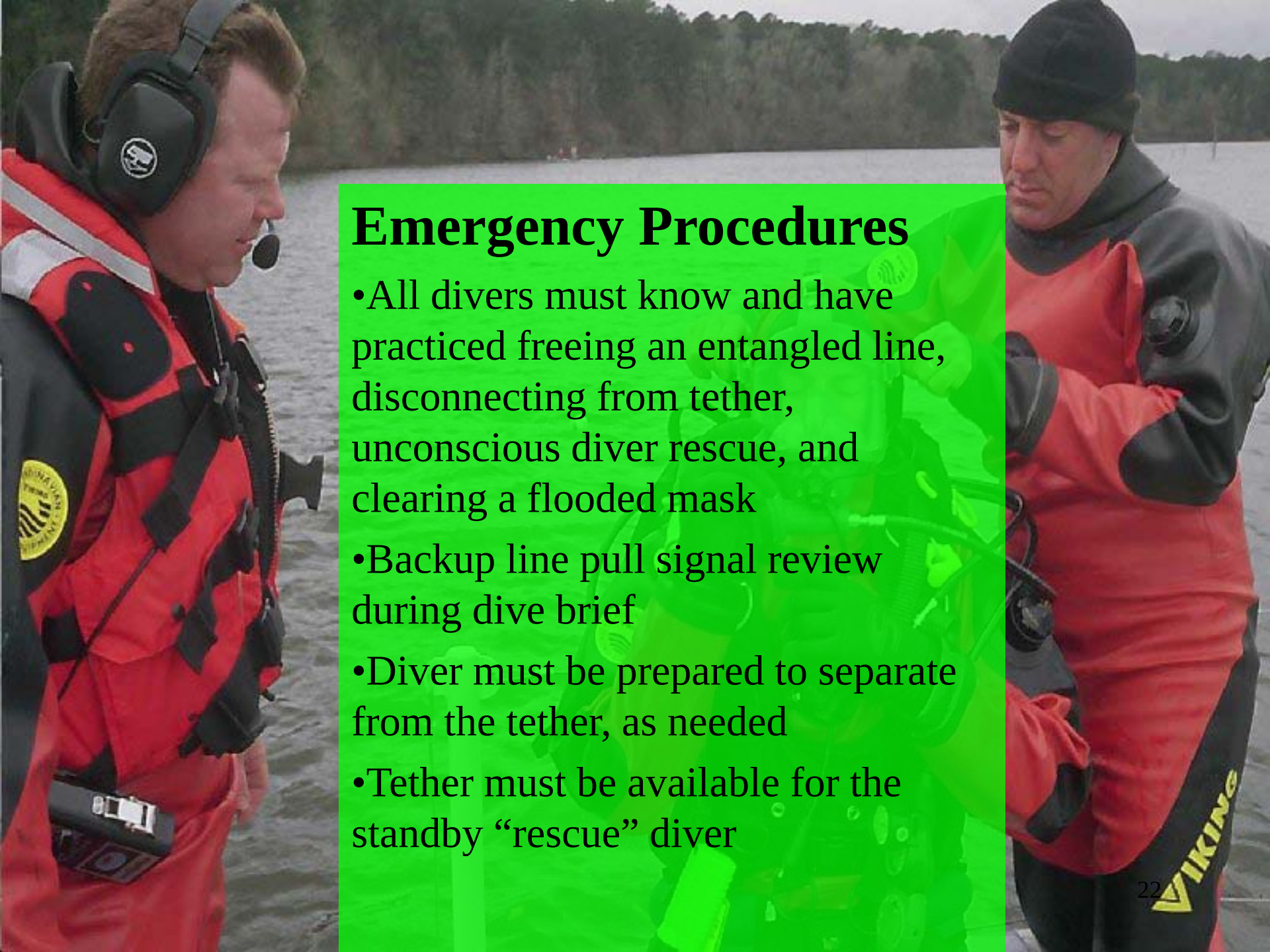
•The line will be managed in the dive platform's "hot zone" with gloves such that it can be decontaminated at the end of dive operations, as needed

•Decontamination will take place as needed before other tasks, focusing on the mask and glove areas when conducting repetitive diving.

•Tender will ensure that the diver leaves the bottom with sufficient pressure to undergo any decon. deemed necessary.

Vessel Operations

- All boat/ship propellers must be deactivated
- Small boats must be on anchor
- Ships do not need to be on anchor for a ship husbandry dive, e.g. clearing a fouled propeller in deep water.
- Bow and stern anchors should be available.
- If the boat were to swing, sufficient slack must be given and/or tension is kept on the diver to ensure they are not swept away in current, or subjected to sudden changes in pressure.
- “Security” call should be made to all concerned traffic over VHF channel 16 for channel dives / monitoring VTS & channel 16



Emergency Procedures

- All divers must know and have practiced freeing an entangled line, disconnecting from tether, unconscious diver rescue, and clearing a flooded mask
- Backup line pull signal review during dive brief
- Diver must be prepared to separate from the tether, as needed
- Tether must be available for the standby “rescue” diver

Summary

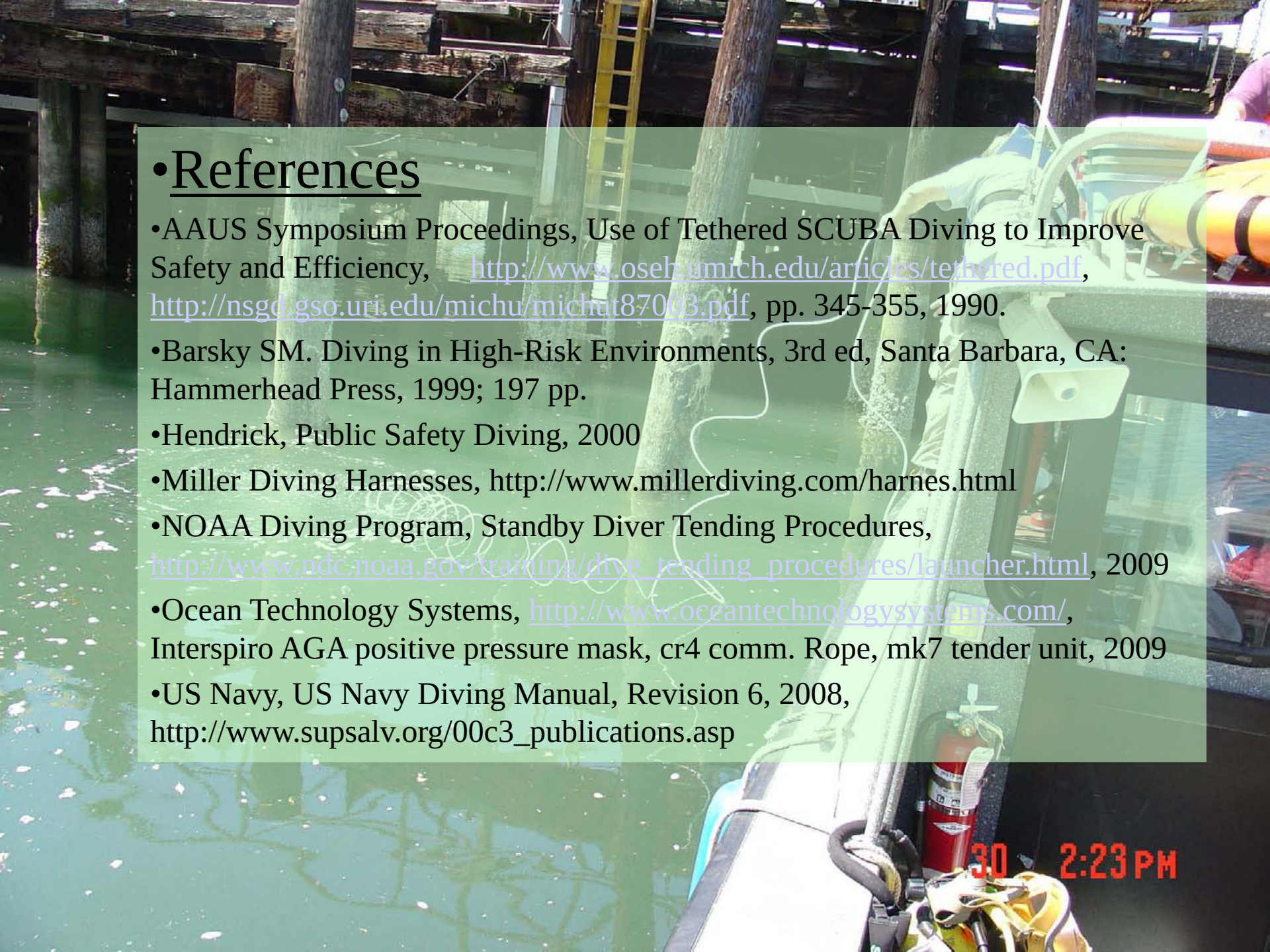
- Tethered SCUBA provides a valuable tool for scientific data collection to both increase efficiency and safety of the diving mission for areas with **currents**, **entanglements**, a need to **relay live video**, **ability to clearly communicate with and monitor the diver,** and for **lighter crewing** requirements (3) and diver offgassing safety factor.
- Some drawbacks include: added **limited mobility** and **limited air supply.**
- Adoption of tethered diving standards by AAUS members and AAUS will further the usage, safety, and consensus on the approach(es) to tethered SCUBA for scientific data collection.

How To Contact the EPA Dive Team and For More Information

- *On the web* **http://www.epa.gov/region10/dive**

or GOOGLE, “EPA DIVE TEAM”

- sheldrake.sean@epa.gov
- Humphrey.alan@epa.gov



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