

DIVER PROPULSION VEHICLES



PROCEDURES AND SKILLS GUIDE

Global Underwater Explorers - 2020 v1.0

Diver Propulsion Vehicles

Procedures and Skills Guide

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Contents

Introduction.....4

DPV anatomy and terminology6

Choosing a DPV8

Setting up your DPV..... 12

Procedures..... 14



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Diver Propulsion Vehicles (DPVs), also called scooters, have been used in diving for almost as long as scuba diving has been around – about 80 years.

Historically, as is often the case with high-tech diving equipment, DPVs first found their use in military diving. Various types of DPVs were used by Japanese and Italian marines, as well as the British Navy and U.S. Navy during the Second World War.

And, as with many other pieces of advanced diving equipment, the development of cave diving inspired a much more peaceful application of DPVs. Cave divers began developing, modifying, and using DPVs to extend the range of exploration, to save gas, to transport more cylinders and scientific equipment, all while reducing CO₂ accumulation.

From cave divers the use of DPVs precipitated to technical divers in the ocean. Scooters allowed divers to get more efficiently back to the up-line, and staying with the line in strong currents became a much easier task. Now, searching for missing sunken ships and exploring massive wrecks became a more realistic and even fun endeavor.

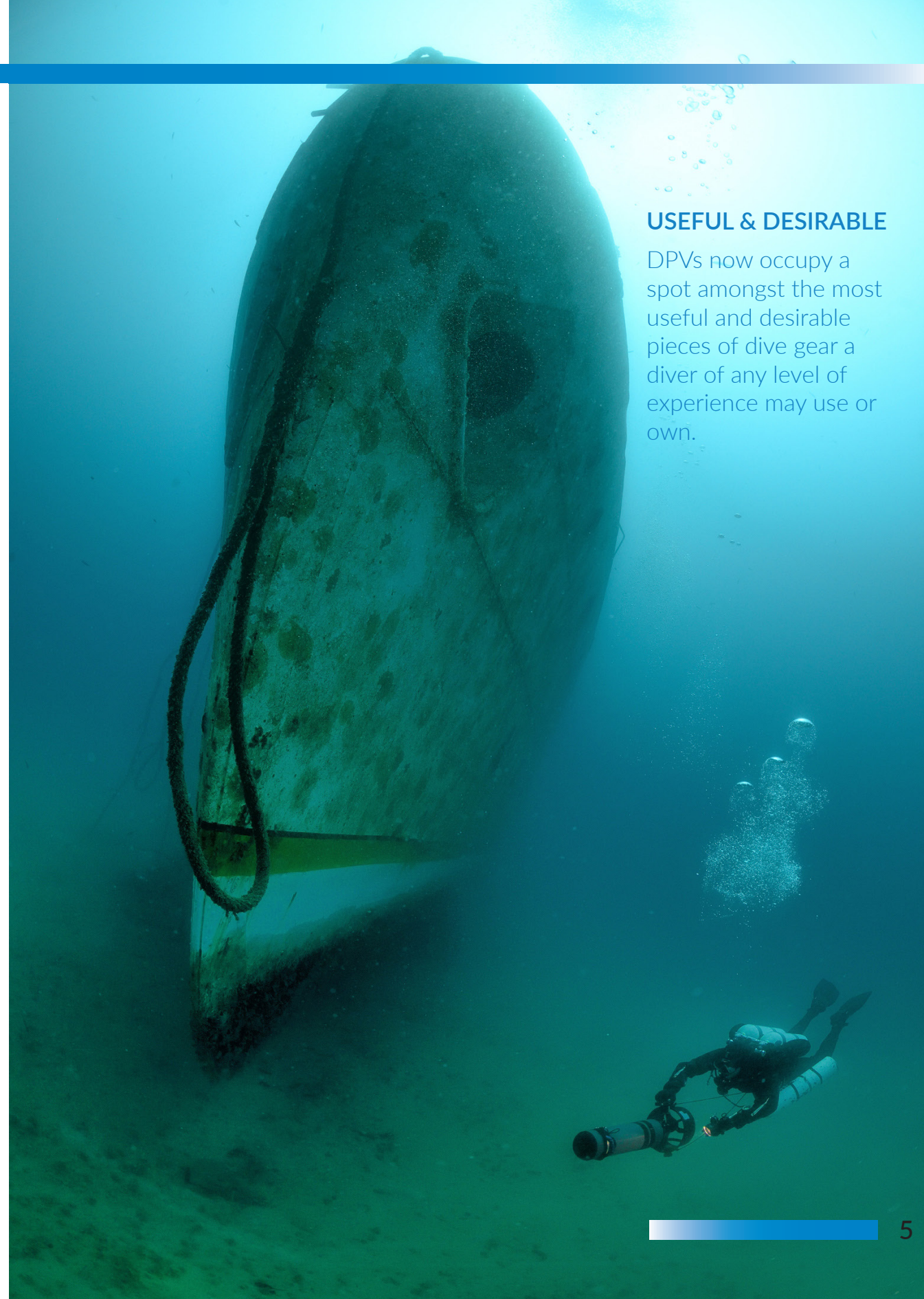
Soon, open water recreational divers also realized that scooters are a fun way to spend the time underwater. Scooters made it possible to explore a much larger area of a coral reef.

All in all, DPVs now occupy a spot amongst the most useful and desirable pieces of dive gear a diver of any level of experience may use or own. As with many other specialized pieces of diving equipment, DPVs require a good understanding of setup, handling, maintenance, and emergency management. This guide is intended to illustrate a range of skills required for safe DPV handling and usage in open water or in overhead environments, but in no way is it intended to replace a proper DPV class taught by a qualified and experienced instructor. It is meant to be a handy supplement to the class and a way to refresh your skills if you have been out of the water for a while.

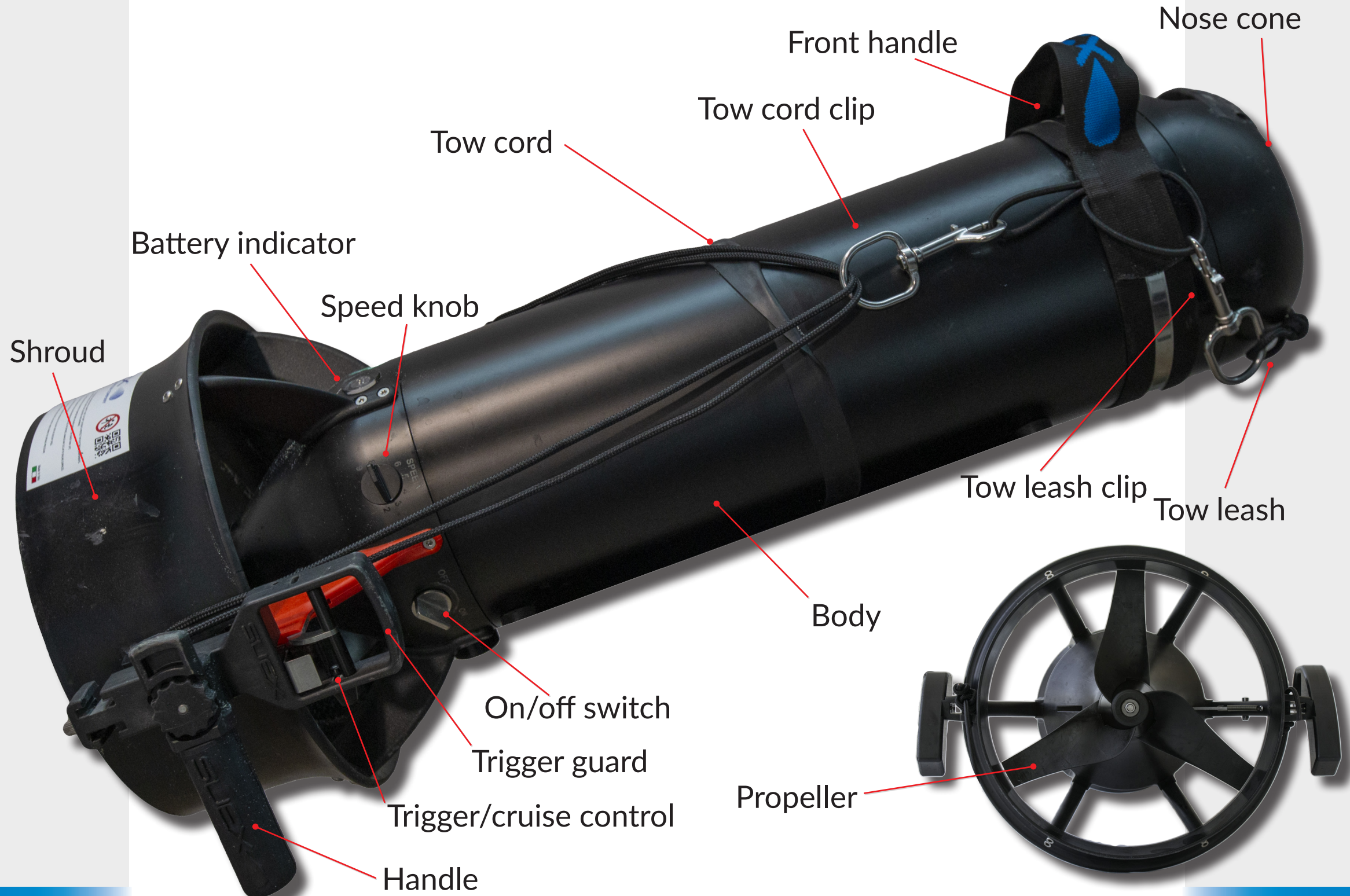
We sincerely hope that you will find this guide useful, easy to use, and fun.

USEFUL & DESIRABLE

DPVs now occupy a spot amongst the most useful and desirable pieces of dive gear a diver of any level of experience may use or own.



DPV ANATOMY AND TERMINOLOGY



CHOOSING A DPV

In the last thirty or so years, the DPV universe has expanded dramatically – from a few heavily modified, commercially available DPVs and even smaller amounts of hard-to-get home builds, we have moved into a world with a multitude of high quality and easy to use DPVs.

While most of the available DPVs will serve you well, there are a few features and technical specifications you want to look for.

Tow behind design

Tow-behind DPVs allow you to manipulate your scooter with one hand, leaving your other hand to adjust buoyancy, equalize, and handle additional equipment (reels, cameras etc.). This design helps to reduce arm fatigue, as most of the power will be applied to a D-ring on your crotch-strap. This type of DPV helps to reduce drag (which extends battery life) as it allows the operating diver a position in the DPV slipstream. Finally, important dive equipment (light cord and long hose) are kept away from the propeller, while allowing for constant visual control of the propeller in front of you.

Adjustable speed

With a DPV, you will move at a speed exceeding your swimming pace – which means the situation around you can develop much faster as well. Team unity becomes paramount for everybody's comfort and safety. Adjustable speed control will allow divers to match their speed and stay together throughout the dive.

Clutch

Despite our best efforts, every now and then we may find some seaweed, debris, or even a line that ends up in the blades of a DPV propeller. In this case, to



protect the propeller, motor, and line, the propeller should disengage after reaching a certain threshold of resistance. The scooter simply activates either a mechanical clutch or an electric fuse (or both).

Convenient tow cord attachment points

There are a few different ways to design and attach a tow cord to the DPV. We find it is more comfortable to use adjustable, non-removable tow cords that create a “vertical” right triangle while riding the DPV – allowing you to adjust the DPV trim slightly if needed.

Trigger lock

Unless your scooter has an electric on/off switch, you will need a way to secure the trigger and prevent the DPV from being activated while in a temporary stow or towing position. This can be achieved by installing a trigger pin or using a lock screw.

TRUSTWORTHY

A powerful DPV can bring you further away from a safe exit than your fins. You want to look for a dependable unit from a reputable manufacturer.

Additionally, there are a few other options that you might find useful.

Trigger guard

One of the most common reasons for a run-away DPV is a tow cord wrapping itself around and pushing the trigger.

While this is easy to resolve, it is still an event that will give you an adrenaline rush. There are a number of handle designs that will prevent this from happening, and they will be a good choice for your DPV.



On/off switch

Older scooters, for example the Gavin, were designed to be as simple as possible. The simplicity promoted easy field repairs and ease of handling. At the same time, managing certain emergencies on those scooters was less than optimal and possibly dangerous. Imagine having to push your hand into the propeller of a working DPV as the only way to stop a runaway. Modern designs, while more complex, allow you to resolve the same scenarios by simply turning your scooter off using the switch.



EFFICIENT AND FUN

Many diving activities will benefit from the use of DPVs. Scooter assisted dives are not only more efficient but also more fun.

SETTING UP YOUR DPV

Front handle

The front handle helps to transport your scooter on land, load it on and off the boat, and secure it in the car or on the boat. While underwater, you are going to use it to control the scooter when it is not being used (during ascents, descents, in the ready-to-go position, transitioning from ready-to-go to on-the-go position, and during crash avoidance maneuvers). You can either use a pre-manufactured handle or make one yourself using a stainless steel hose clamp (warm clamp) and a piece of 50 mm/2 in nylon webbing.

Tow leash

The tow leash is used to secure a broken or a backup scooter to your front or rear crotch strap D-ring, either directly or via a tow leash. The easiest way to make it is to use a piece of non-stretchable abrasion-resistant line and a stainless steel clip. The tow leash can be secured under the same stainless steel clamp that holds the front handle and positioned 180 degrees away from that handle so it will be in the lowest position of a towed DPV.



Tow cord

The tow cord will connect the DPV to your front crotch strap D-ring. It should be made using a length of non-stretchable line, 3-5 mm/1/8-3/16 in thick. It can be either permanently attached and be of adjustable length, or it can be removable with a fixed

length. The stainless steel clip can be sliding, semi-sliding, or fixed. It is really a matter of personal preference.

ADDITIONAL EQUIPMENT

Stage/DPV leash

The stage/DPV leash can be used both to extend a fixed length tow cord that is too short for your liking and to transport one or more scooters in tow, creating a comfortable distance between the DPV nose cone and the bottom of your cylinders.



Thumb loop

A thumb loop can be a very useful add-on to the Goodman handle on your primary light. The loop will allow you to comfortably control your light head with your right hand, while checking pressure, dumping gas, or manipulating the left cylinder valve while staying on the trigger.



PROCEDURES

1. Ready-to-go



The ready-to-go position is used during descents, ascents, and while being stationary during the dive. You hold the DPV with your right hand on the front handle. This allows you to control buoyancy and equalize with your left hand. In case of an OOG situation, you can quickly let go of the front handle and donate the long hose.

2. Adjusting the tow cord



Adjusting the length of the tow cord is crucial for diver comfort and control over the scooter. The length can be adjusted using sliding knots and/or by wrapping the tow cord around the second handle of the DPV. The tow cord should be tight, but long

enough to allow you to have your right arm almost fully extended and relaxed while controlling the drive handle. The upper segment of the tow cord must be slightly shorter than the bottom one, creating a right triangle with the DPV shroud.

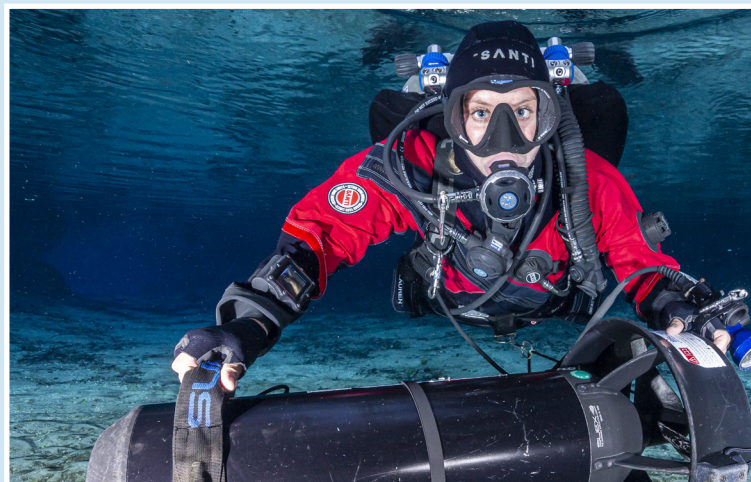
3. On-the-go



After achieving neutral buoyancy and stability, your team members exchange OK signals with their lights and move the DPVs into the on-the-go position by pushing the DPV forward, letting go of the front handle and catching the drive handle with their right hand. A properly balanced DPV will reposition itself while gliding forward.



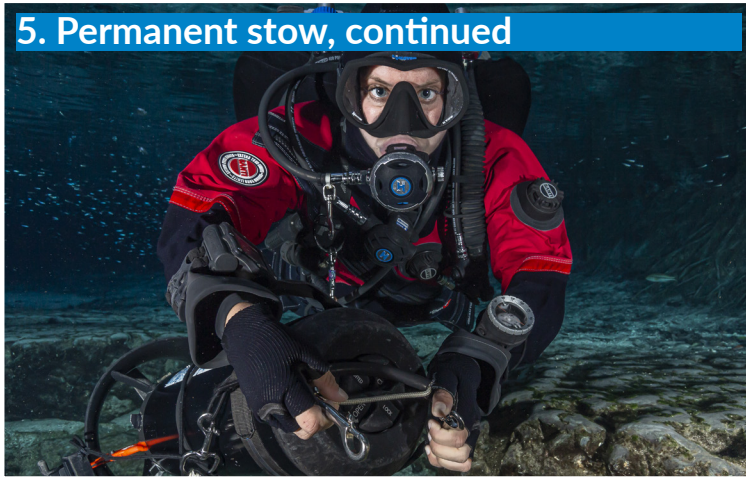
If you need to temporarily free your hands and you plan to go back to scootering right away, you can use the temporary stow position. Make sure the DPV is turned off (in the case of older DPVs, make sure the trigger is pinned and/or locked).



Rotate the DPV 180 degrees with the shroud pointing forward, and place it between your thighs, positioning it perpendicular to the bottom.



5. Permanent stow, continued



If your DPV is broken, if you are not going to use it anymore, or if you are towing a backup DPV, make sure it is turned off (or the trigger is pinned/locked). Unclip the tow cord and clip it to the bungee loop near the front handle.



Unclip the tow leash and clip it to the front crotch strap D-ring (directly or using an additional leash).



Push the DPV between your legs, and position your fins under the shroud/handles.

6. Retrieving a DPV



If you let go of the DPV and let it float by your side, you need to relocate and reposition it. Locate the front crotch D-ring, follow the tow cord from the D-ring to the scooter, push the side of your hand into the tail cone, and position your elbow on the edge of the shroud. Then push the DPV up and forward, making sure the nose cone does not hit the bottom or any features surrounding you. Reposition the DPV into the ready-to-go position, and make sure the tow cord is not entangled.



7. Beginning scootering
After repositioning the DPV from the ready-to-go to on-the-go position, verify that the tow cord is untangled and properly adjusted, move the shroud upwards (to avoid propeller wash hitting the bottom sediment), and press the trigger. As soon as you start scootering, extend your legs and keep your fins parallel to the bottom to decrease drag and increase stability.

8. Stopping



As soon as you let go of the trigger, let the inertia bring your body forward and get back into the ready-to-go position. Get into trim position by bringing your feet toward the bottom of your cylinder. Check and adjust buoyancy if needed.

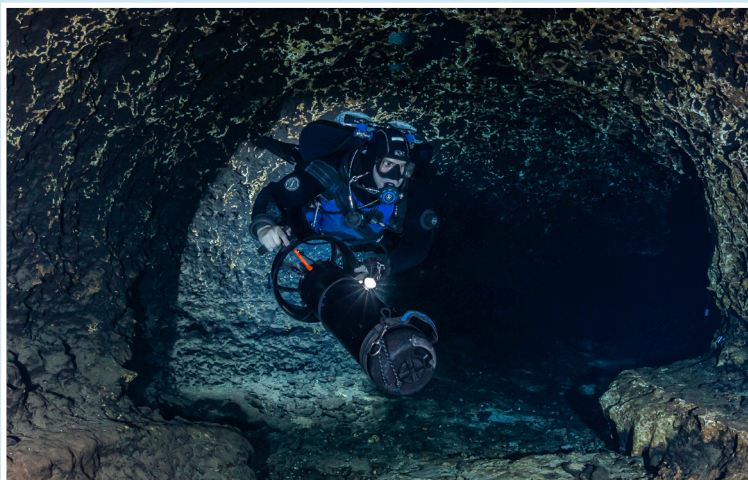
9. Turning



PRECISE TURNS If you want to adjust your course slightly, you can bring one fin-tip down, while tilting the opposite fin-tip up (for example: to shift slightly to the left, you will need to drop the left fin-tip down while raising the right fin-tip up). This is called fin yawning.



SLOW TURNS To perform a slow turn, you can rotate the DPV shroud clockwise (to perform a right turn) or counter clockwise (for a left turn). To speed up the turn, you may combine it with fin yawning.



QUICK TURNS For a quick turn, you may use your left hand. For a quick right turn, rotate the drive handle/shroud clockwise and simultaneously push the shroud with your left hand. For a quick left turn, rotate the drive handle/shroud counter clockwise while pulling on the shroud with your left hand. Again, this can be combined with fin yawning to speed up the turn.



10. Right hand/left hand operation

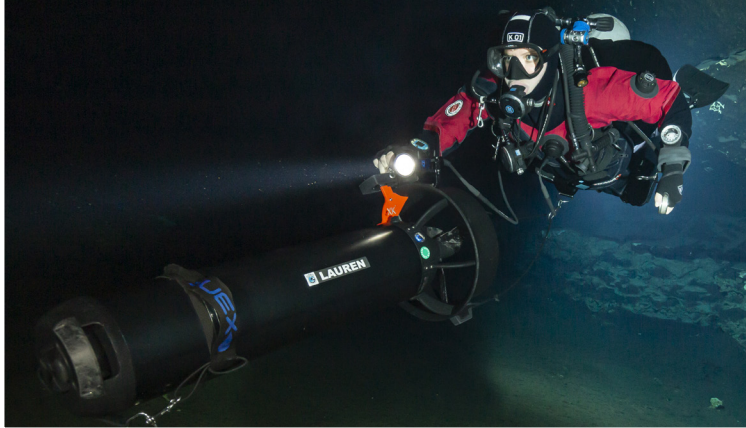
To manage equipment, or to rest your drive hand on a long DPV run, you may need to switch hands. To do so, reach toward the drive handle with your left hand (without removing the light) and replace the index finger of your right hand with the index finger of your left hand, without releasing the trigger.



10. Right hand/left hand operation, cont.



11. Repositioning light head



To check the position of your left valve knob, verify pressure, dump gas from your wing, or to reach into your left pocket, you will need to move the light head to your right hand. To do so, bring your left hand toward your right hand/drive handle and use your right thumb to hold the light using the thumb loop or the side of the rigid Goodman handle.

12. Flow checks on the move



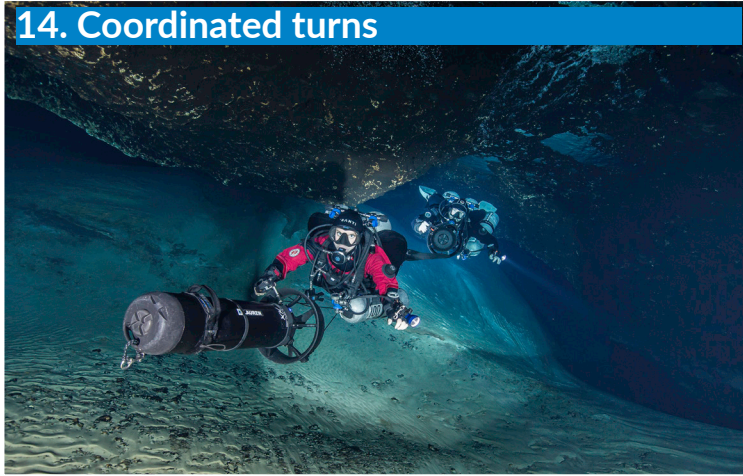
To verify the position of your valves while scootering, move the DPV to your left hand without stopping (as described in 10. Right/left hand operation), check your right valve and your isolator, return the DPV to your right hand, reposition the light head (as in 11. Repositioning light head), and check your left valve.

13. Speed matching



To maintain team unity, it is important to move with the same speed. Begin scootering. Establish the fastest unit. The diver with the fastest DPV will need to slow down using electronic speed control or changing the propeller pitch. If over-adjusted, the diver with the fastest DPV will need to bring the speed up again. The diver/divers with the slower/slowest DPV should remain at a constant speed.

14. Coordinated turns



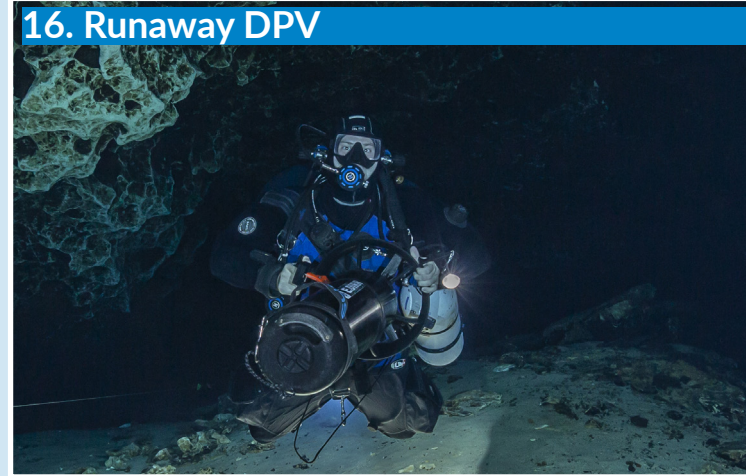
To turn left or right simultaneously, the diver on the inside of the turn will need to slow down, either by zig-zagging, by dropping fin-tips of both legs down, by raising shoulders slightly, or by using electronic speed control.

15. Light communication



To make sure your team stays together and maintains proper communication throughout the dive, make sure your light beam crosses the DPV body of your teammate if traveling side by side or is positioned within the field of vision if travelling single file.

16. Runaway DPV



There are a number of reasons for a runaway DPV scenario. Some of them includes a trigger being caught by the tow cord, a stuck cruise control knob, or a stuck trigger. In case of any of those three, slow down the DPV (see 17) and disengage the tow cord or release the cruise control knob. If you cannot easily locate the reason for the runaway, slow the DPV (see 17) and turn the DPV off (if possible) or de-pitch the DPV by pressing the palm of your hand to the tail cone of the propeller. Stow the broken DPV if you can start an immediate ascent, use a by-pass if possible and/or needed, or ask your teammate to tow you.

17. Slowing down a runaway DPV



17. Slowing down a runaway DPV, cont.

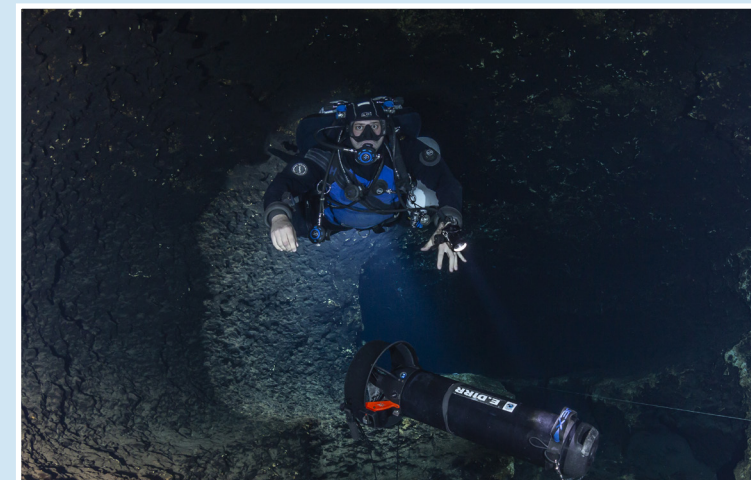
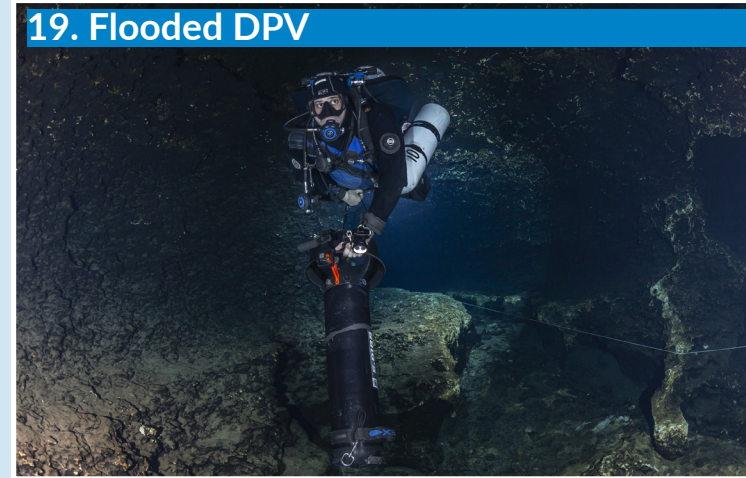
In case of a runaway scooter, you will first need to slow the DPV down to evaluate the situation. To slow down, stand up vertically in the water, make sure the DPV is perpendicular to your body. Make sure the propeller wash is directed toward your chest/stomach area. Bring the DPV as close to your body as possible without the long hose or light cord being pushed into the propeller. Increased drag will slow the DPV down sufficiently for you to evaluate the situation and come up with an action plan.

18. Crash avoidance techniques



While scooting in low visibility or in the case of a runaway scooter, you may need to take a quick action to avoid crashing into other divers, reefs, or walls. Without releasing the drive handle, reach forward with your left hand and grab the front handle of your DPV. Pull the DPV under your body and reposition it at 90 degrees (or more) relative to your body centerline and let it swing you around, away from the obstacle.

19. Flooded DPV



A completely flooded DPV will become fairly heavy, and in certain cases may lead to a runaway scenario, which makes the situation dangerous. This will require a quick response. You will need to pull the DPV toward your body to create some slack in the tow cord. Then unclip the tow cord and let go of the scooter. If the depth and the situation allow, use an SMB to bring the DPV to the surface. Otherwise, mark the location and return later with appropriate gases and a lift bag.



20. SMB deployment

To deploy an SMB during a DPV dive, stop, stabilize, move the DPV into a permanent stow position, place the light in a temporary stow position, get the spool and the SMB out of your left pocket, and follow the standard procedure for SMB deployment.

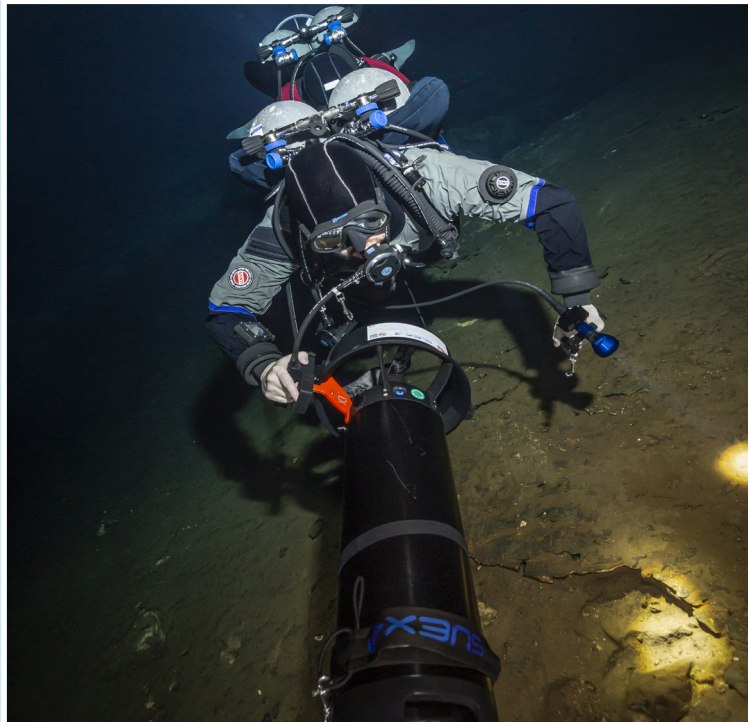
21. Out of gas



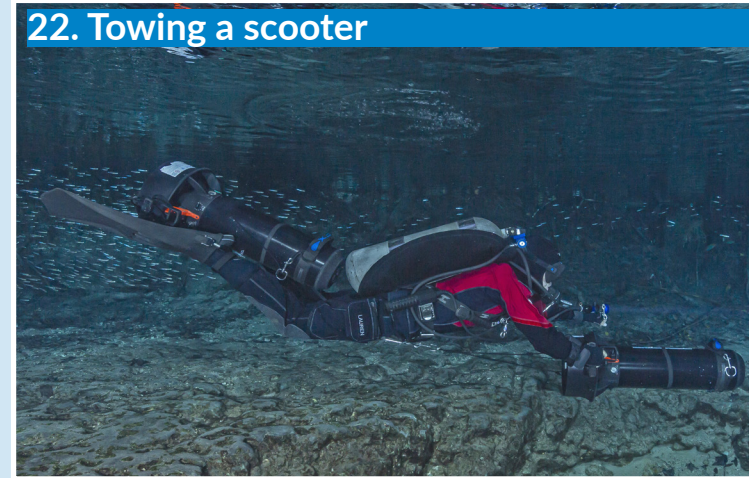
- a. In case of an OOG scenario, move toward your teammate while giving an OOG signal using your light. As soon as you are in the team's field of vision, let go of the DPV and make a cut-throat signal with your right hand to emphasize the OOG signal.
- b. The donor lets go of the DPV and uses their right hand to present the long hose regulator while using the left hand to switch to the backup regulator.
- c. Both donor and receiver stabilize, verify buoyancy, and make sure that the long hose is free and unentangled.
- d. If the dive allows for an immediate ascent, both donor and receiver move the DPVs into a permanently stowed position, deploy an SMB, and begin an ascent.

21. Out of gas, cont.

- e. In case the divers have to return to the up-line or a cave entrance, the donor will permanently stow the scooter, and the receiver will get into position for towing. The long hose is routed from the receiver's mouth to their right hand and will be controlled with the right hand positioned on the DPV drive handle. The long hose will be positioned under the receiver's chest/stomach, going toward the donor's right regulator.
- f. The donor will position their right hand under the receiver's crotch strap while their left hand will be positioned on the receiver's left thigh.
- g. With two firm pushes the donor indicates that the receiver can start scootering.
- h. The donor should try to minimize drag by hiding in the receiver's slip stream.



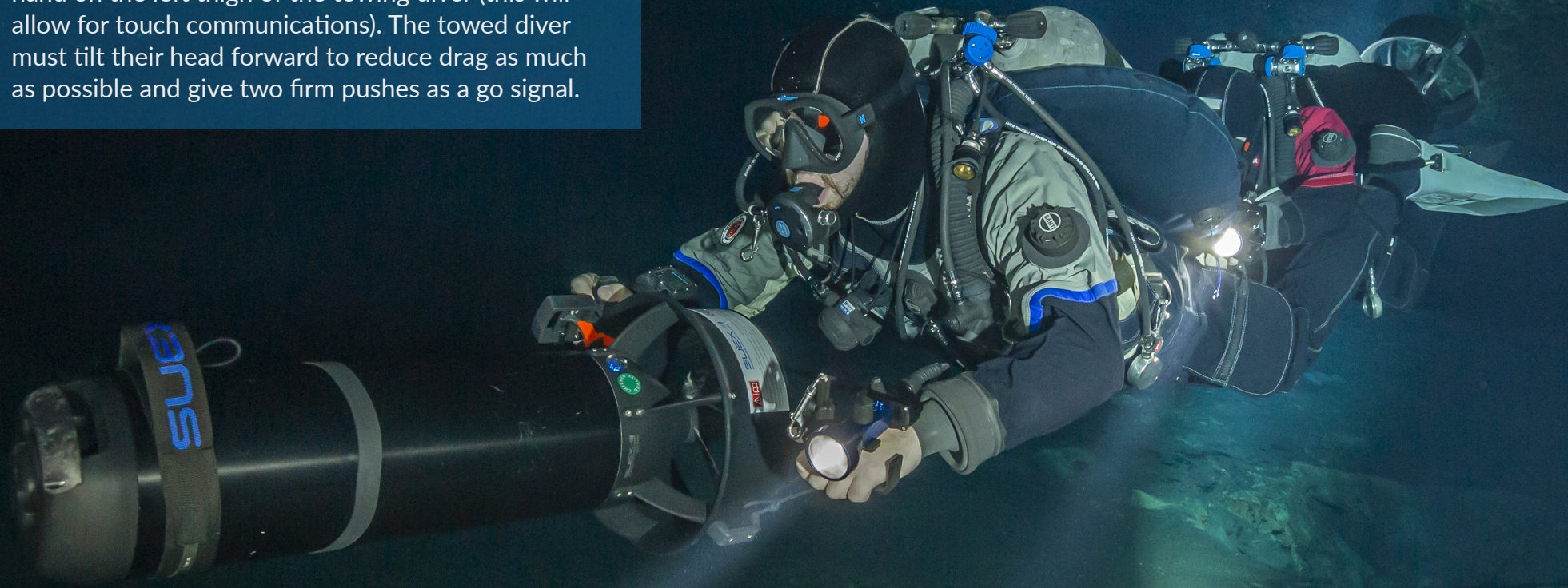
22. Towing a scooter



If you need to transport a broken or a backup scooter, start by making sure it is turned off and/or that the trigger is pinned/locked. Secure the tow cord using the bungee loop at/near the front handle and try to minimize the slack by adjusting the length of the tow cord. Unclip the tow cord and either clip it directly to a front crotch strap D-ring, or use an additional leash to create a longer distance between the nose cone and the bottom of the tanks. If you need to transport multiple scooters, it is usually easier to clip all of them to an additional leash. As you start scootering, use your left hand to push scooters up between your legs and make sure the nose cones are resting on your thighs while the shroud(s) are resting and being controlled by your fins.

23. Towing a diver

If one of the DPVs fails, or in an OOG scenario, it is necessary to tow your teammate. The diver to be towed will permanently stow the scooter. Next, the diver will need to take position behind the towing diver and securely hold on to the towing diver's crotch strap with their right hand while positioning the left hand on the left thigh of the towing diver (this will allow for touch communications). The towed diver must tilt their head forward to reduce drag as much as possible and give two firm pushes as a go signal.



24. Using bypass



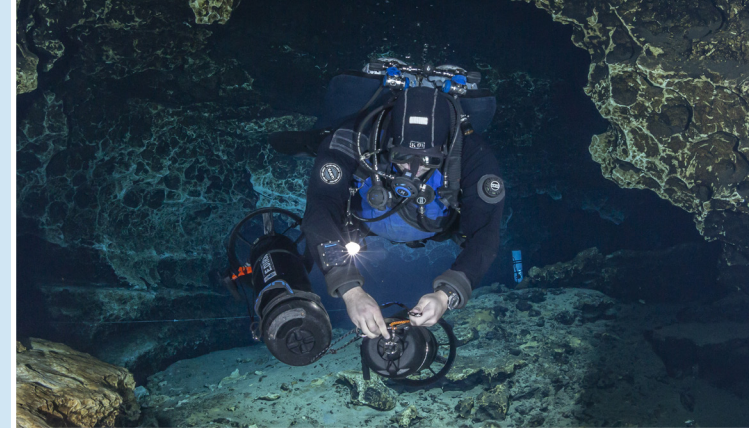
In case the primary electric/electronic circuit on your DPV fails while you still need to get back to the cave entrance or up-line, you may attempt to use a bypass switch. First, attract your team's attention and indicate that your DPV is broken. Then, indicate that you are going to engage the bypass switch. Make sure the propeller is clear of any equipment and pointing upward. Engage the bypass based on manufacturer recommendations. Use the on/off switch to start and stop the DPV. In many cases, you will not be able to use speed control, so use stopping and resuming movement to keep the team together.

25. Counting trigger time

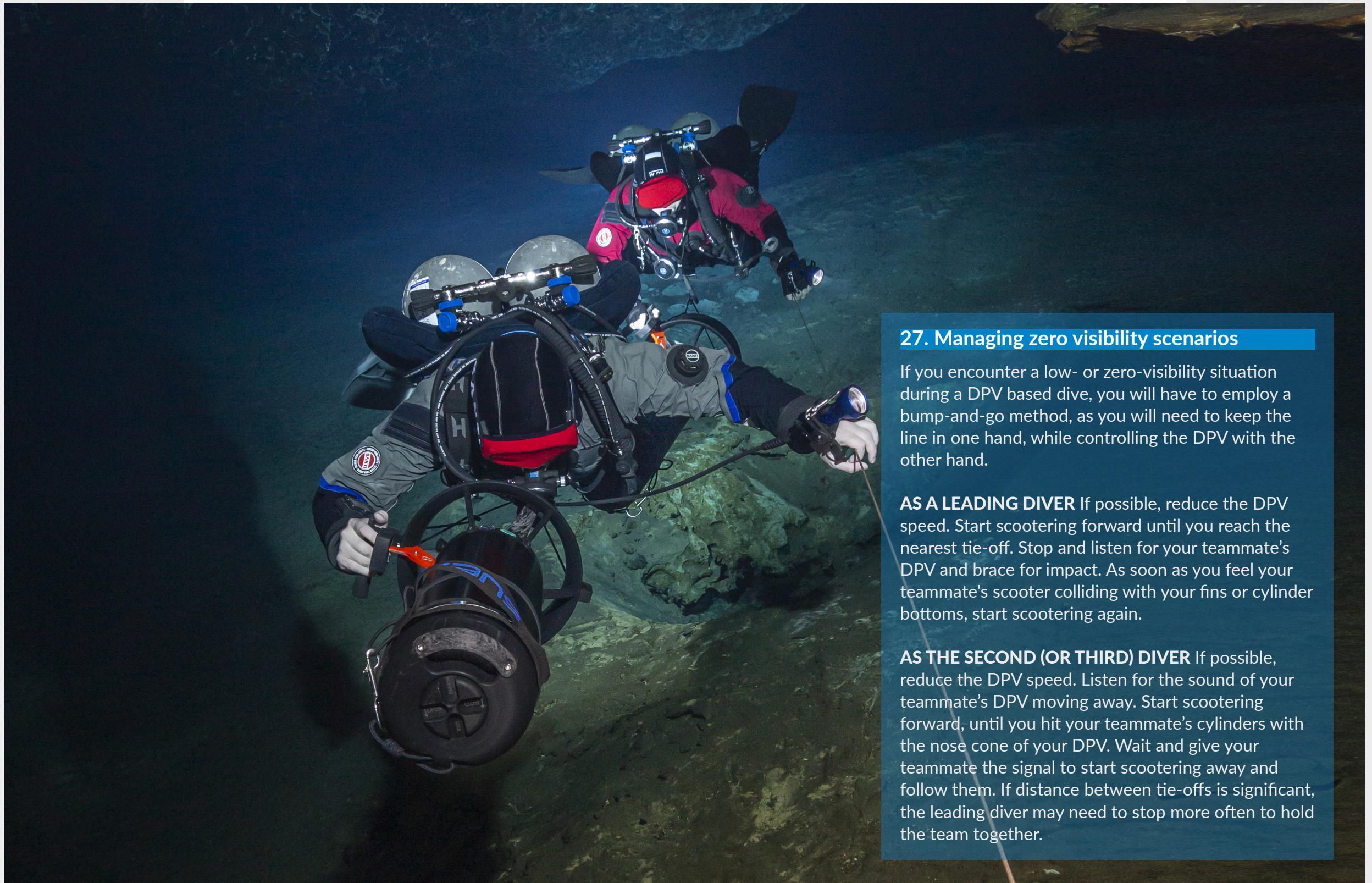


On a scooter-dependent dive where you are going to turn the dive or switch DPVs after having used a given amount of burn time, note the time on your bottom timer/computer every time you stop scootering. Note the time again after you finish the task at hand (setting up a jump, switching/dropping cylinders etc.). Attract your teammate's attention, point at the DPV, and use appropriate hand signals to indicate the time you have spent off the trigger. Keep counting time on and off the trigger throughout the dive.

26. Switching DPVs



On longer cave dives, you may need to rotate DPVs. First, attract your teammate's attention and indicate stop/hold. Then, point at your scooter and show the switch hand signal. Verify that your scooter is off and that the trigger is locked/not engaging the motor. Place the light in a temporary stow position, making sure the light cord is stowed under the long hose and the waist strap. Unclip the tow cord and secure it on the front handle/bungee loop. Unclip the tow leash and clip the scooter to the preferred crotch strap D-ring (or clip it to the line if needed). Deploy the new DPV, free the tow cord, and secure the tow leash. Clip the tow cord to the front crotch D-ring, deploy the light, turn the scooter on, and exchange OK signals with your team.



27. Managing zero visibility scenarios

If you encounter a low- or zero-visibility situation during a DPV based dive, you will have to employ a bump-and-go method, as you will need to keep the line in one hand, while controlling the DPV with the other hand.

AS A LEADING DIVER If possible, reduce the DPV speed. Start scooting forward until you reach the nearest tie-off. Stop and listen for your teammate's DPV and brace for impact. As soon as you feel your teammate's scooter colliding with your fins or cylinder bottoms, start scooting again.

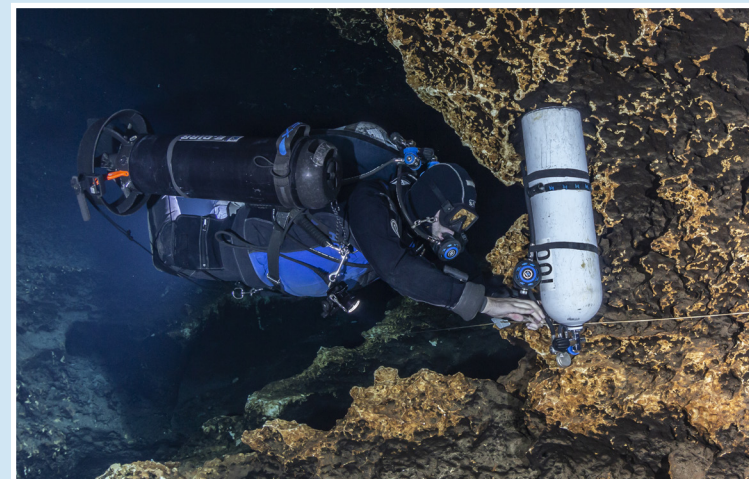
AS THE SECOND (OR THIRD) DIVER If possible, reduce the DPV speed. Listen for the sound of your teammate's DPV moving away. Start scooting forward, until you hit your teammate's cylinders with the nose cone of your DPV. Wait and give your teammate the signal to start scooting away and follow them. If distance between tie-offs is significant, the leading diver may need to stop more often to hold the team together.

28. Navigating restrictions/delicate passages



To minimize possible damage to the environment and/or equipment, it is prudent to stop using the DPV and push it in front of you while moving through narrow, restricted, or delicate areas. You must make sure the nose cone does not hit the walls, ceiling, or floor of the cave or wreck. If the restricted area is very complex, you may need to turn the DPV off, extend the tow cord, and use the shroud to manipulate the DPV ahead of you. Sometimes, it may be easier to unclip the DPV, secure the tow cord, and push the scooter while navigating restrictions.

29. Dropping/picking up stage/deco cylinder



Signal “stage drop/stage pick up”, place the light into temporary position, and turn off and stow the DPV. Switch to back gas, if needed, unclip the stage, and secure it to the line. Adjust buoyancy as needed. Deploy the DPV and the light, signal OK, and wait for team confirmation to start moving.

30. Managing guideline devices

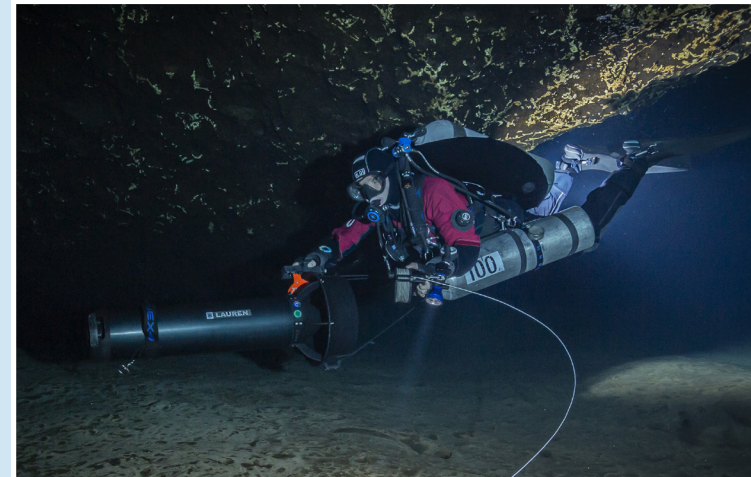
There are a number of ways to handle a primary reel, a jump spool, or an exploration reel on a DPV dive. Choices will be made based on the size of the cave, bottom composition, its fragility, and the strength of the flow.

In many cases, when the distances are short and the cave passage is relatively small, the easiest way to install a guideline will be by turning your DPV off and passing it to a teammate. This will slow the team down, but it will also ensure line quality and will protect equipment and the cave from possible damage.

Another similar option will be to turn the scooter off and stow it while dealing with the line.

A third option, more appropriate for exploration line or when laying a temporary line in a relatively big passage, is to lay line while on the trigger. To do so, get mid-water, extend the hand holding the reel perpendicular to your body (as far away from DPV and your personal equipment/stages as possible), and start scooting while maintaining tension on the reel using one or two fingers. Stop scooting before you reach the next tie-off and let inertia bring you to it. Secure the line, choose the next possible tie-off, check that the line is not too close to your DPV or stages – and start scooting, after getting confirmation from teammates. While making a tie-off, make sure your DPV is not damaging the cave and/or affecting the visibility.

To retrieve the line, undo the tie-off, ensure the line is free, and start scooting. When you have enough line free, stop and reel the line in, using water resistance to maintain some tension on the line. ■



DIVER PROPULSION VEHICLES



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