Sustainable “green boat” practices for water taxi operators in the Grenadines

Best practices for a cleaner marine environment through improved boating operations

By:

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Cover photo: A water taxi in Saltwhistle Bay, Mayreau, preparing to take a group to the Tobago Cays.

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AWARENESS AND EDUCATION

All it really takes for water taxi operators to become well informed stewards of their environment is the initiative to learn and to share information with those who need to know. All water taxi operators should continue to make every effort to inform their customers about the surrounding marine environment, environmental impacts and the best environmental practices that can be exercised routinely. In becoming a responsible boater, the water taxi operators can:

- Learn about products and practices which are environmentally safe
- Share the information with other boaters
- Obey laws governing speeding, littering and discharge
- Support the water taxi associations to promote being environmentally responsible
- Encourage the water taxi associations to provide garbage cans and recycling bins.
- For each of the issues explained, inform customers about the possible impacts of bad environmental practices.

Operators Remember:

- Listen to talk shows (to become informed) – and be on talk shows to inform
- Refer to water taxi associations
- Workshops are helpful
- Internet research
- Check brochures
- Contact suppliers and distributors for information (especially specification sheets) relating to their products

ABOUT THIS BEST PRACTICES BOOKLET

Who is this booklet for?

This booklet has been produced for the water taxi operators in the Grenadines with substantial input from the water taxi operators themselves. The information in this booklet is therefore by the water taxi operators, and for them. It details some of the “best practices” that operators can follow to become better stewards of the marine environment through improved boating operations.

This booklet is also useful for:

- Other boat owners,
- Operators of boatsheds, slipways and marinas,
- Local environmental officers, and
- The public in general.

How was this booklet prepared?

This booklet was drafted by Dominique Lizama during her graduate studies research at the Centre for Resource Management and Environmental Studies of the University of the West Indies (CERMES of UWI). Dominique found, while surveying individual water taxi operators, that they displayed knowledge about good environmental stewardship that could be augmented by information from other sources.

The responses of water taxi operators to Dominique’s survey on existing practices, informed her as she began by compiling and adapting information about the best practices for boat operations from several organizations and agencies in the United States and Europe. These organizations encourage boat operators across the globe to maintain a healthy environment while enjoying the pleasures of boating and providing excellent customer services.

A draft booklet was prepared and a checklist of good environmental practices was drafted by Dominique as a guideline for good practices.

Two workshops called, “Greening Water Taxi Operations and Services” were subsequently held in the Grenadines, and these built-upon the foundation that had been prepared by Dominique and the water taxi operators. The workshops brought operators

from Carriacou and Petite Martinique, Mayreau and Union Island, together with other members of the community to express their visions of good environmental stewardship and refine the checklist of activities. The workshops were facilitated by Susan Mahon.

This final booklet includes the refined checklist (pages 2-7) -- as the focal and most practical part – as well as explanatory text and references. Sections of the text are named and included, in the same order as those in the checklist – for ease of reference.

Why do we need a best practices booklet?

This booklet, especially its check-list, is a reminder to practice caring for our environment. It can encourage the following:

- Widespread adoption of cleaner operation in boating
- Improvement in the environmental performance of operators, and other managers-users of boatsheds and slipways.
- An increase in environmental awareness and knowledge

What are some benefits to becoming environmentally friendly?

- Our livelihoods improve with caring for our environment
- Less potential for environmental fines and prosecutions
- A better public image
- Increased confidence within the boating community
- Long-term cost savings
- Increased “green customer” patronage
- Improved environmental conditions for everyone

What are the key environmental issues?

- Water quality including waste water and storm water
- Waste management (oil bottles, paint strips), especially hazardous materials (paints, cleaning agents)
- Air quality management (sanding, paint fumes)
- Noise management (boat building, sanding, engine operation)
- Energy and water use (electrical appliances, wash water)
- Maintenance equipment (paint, cleaning agents, engine repair kit)

Operators Remember:

- Use the tilt always in shallow water
- Drift dive
- Have anchor lines on board
- Proper anchors – certified by the US navy
- Drift anchor is preferable
- Have dive flag on board
- If mooring buoys are present, use them!

SETTING A GOOD EXAMPLE

Every day, water taxi operators come in contact with other people from all walks of life, including local people from the Grenadines and visitors. This provides a great opportunity to set a good example in terms of good environmental stewardship. Water taxi operators take their passengers from one place to another and can simultaneously interpret the nature and culture relating to their journey. Much can be conveyed by the operators as they go about their daily duties including good maintenance of their boats and engines, cleaning and maintaining their vessels so that poisonous substances are not released into the environment, reducing waste and reusing items whenever possible, caring for nature and conveying pride about their culture.

Operators Remember:

- Seek help on how to become more environmentally friendly operators.
- Share information with passengers about boats, negative impact of activities and safety tips
- List for visitors – “Do’s and Don’ts”
- Use laminated Guidelines – Information inside boats
- Pick-up damaged fishing nets/pods
- Watch for dive flags
- Floating objects
- Read and educate – research info on topics, e.g. scientific research, brochures

Anchoring

Anchoring is destructive as it causes extensive damage to near-shore marine ecosystems, especially coral reefs. Anchors and the chains attached to them often crush corals and other organisms on which they fall. Likewise, as the boats swing while attached to anchors, ropes or chains they often damage marine habitats. Repeated anchor drops over time will damage the integrity of the reef causing widespread scarring and leaving the injured corals open to infection (CELB, TOI and CORAL, 2001). Anchoring can also disturb sediments which eventually smother corals, and decrease water clarity causing the release of the symbiotic algae required by corals for photosynthesis. A reef may take years to recover from physical damage, but if an area is repeatedly damaged, it is unlikely that the reef will ever make a full recovery. As a result then, the diversity of the reefs will be reduced and some species may be lost forever, thus affecting the economic basis of marine recreation. Some impacts of coral damage include fewer living corals, increased algal growth and decreased numbers of fish species.

Since there are few moorings available throughout the Grenadines, most boat operators must rely on anchoring. Anchoring is very effective in securing a boat from drifting, but it must be done with care. Some best environmental practices when securing a vessel are:

- Where mooring buoys are provided, use them!
- Carry enough chain and line for the depth you want to anchor in.
- Check out the area before anchoring.
- Use the appropriate type of anchor for the substrate you are anchoring in.
- Anchor in sand or mud away from corals.
- Motor in the direction of the anchor when hauling it in.
- Consider drift dives instead of anchored dives when no moorings are present.

INTRODUCTION

The Grenadine island chain is situated between mainland St. Vincent and Grenada and lies across the boundary between St. Vincent and the Grenadines and Grenada. The 30 islands and cays that comprise the Grenadine Islands are among the most popular cruising grounds in the Caribbean, surrounded by coral reefs and clear blue waters ideal for diving, snorkeling and boating (www.lonelyplanet.com).

Residents in the Grenadines have traditionally relied on the sea for their livelihoods; they use it for fishing, traveling, recreation and other activities. For the residents of the Grenadines, tourism and fishing are the major activities and income earners. The beaches, land and marine water quality have, however, all been degraded, while the food resources of the land and sea have been depleted.

The islands are isolated and it is therefore difficult to enforce laws and regulations regarding fishing, boat operation, waste disposal, and other aspects relating to environmental stewardship It is critical, therefore, that water taxi operators in the Grenadines and other users and managers of the marine environment are aware and understand the value of environmentally-sound practices relating to boat operations, sustainable use, and the need for immediate conservation of natural resources.

"GREEN BOAT" PRACTICES IN THE GRENADINES

This booklet covers key aspects concerning environmentally-sound "green boat" practices of water taxi operators in the Grenadines. Practices include vessel and engine maintenance, cleaning, fuelling, waste disposal, anchoring, setting a good example, and awareness about boating activities that could harm the environment.

The checklist (next pages), as well as the following explanations, and additional information about various aspects relating to environmental stewardship, reflect the order of priorities expressed by water taxi operators during the workshops on "greening" of their operations and services.

Table 1: Checklist for Good Environmental Stewardship and Boating Practices Developed by Water Taxi Operators – For Water Taxi Operators

CHECK	HAVE YOU DONE THIS?	√	WHY?
Engine Maintenance	• Periodic Maintenance (every 2, 4, 6 months) depending on boat usage • Daily routine check • Tidy • Clean fuel filter, carburetor • Clean cooling system		• Maximize operating capacity and minimize fuel consumption http://eartheasy.com/play_ecofriendly_boating.htm
Vessel Maintenance	• Do maintenance far on land (not at sea, or very near sea) • Scrubbing brush, squeezy – no bleach • No toxic materials • Use non-toxic antifouling paints and primers especially on the hull of the boats • Use non-toxic, biodegradable cleaning agents • No oil spilling • Clean bottom • Keep basic tools on board/ tool kit and accessories • Hose • Spare plugs • Bucket/bailer		• Boatyards away from the sea lessen effects of runoff • Bleach is poisonous to sea life • Phosphates encourage growth of algae which may smother corals • Paint primers and paints for boats may contain poisonous biocides and heavy metals that may affect human health as well as the marine environment • Fuel and oil leaks from small craft may accumulate over time (esp. if in popular marine site or bay with poor current flow) • In case of emergencies

Since fishing is the second major income earner for water taxi operators in the Grenadines, improper waste disposal while fishing can also be a problem. This includes improper disposal or loss of gear, which can continue 'fishing'/drifting after it is lost and destroy many fishes. Lost fishing gear can also become entangled in coral reefs, endangering divers and snorkelers, or become snagged in boat propellers.

Best practices concerning waste disposal are:

- Do not let garbage get thrown or blown overboard,
- If garbage blows overboard, retrieve it,
- Pack food in reusable containers or use paper products (paper cups, plates, etc.),
- Purchase refreshments in recyclable containers,
- Properly dispose of all garbage onshore,
- Do not toss cigarette butts overboard; they are made of plastic,
- Recommend that passengers use land-based restrooms before boat excursions,
- Do not discard fish waste in poorly flushed areas,
- Dispose of fish scraps in deep water,
- Always retrieve fishing gear later if it must be abandoned in an emergency,
- Pick up discarded fishing gear or lines cut away from propellers.

Operators Remember:

- Avoid using plastic cups
- Avoid Styrofoam
- Substitute reusable containers and cups
- Keep our garbage on board
- Go to bathroom before leaving
- Don't urinate at sea or on board
- Avoid pumping oil into sea
- Keep a sponge on board to soak up spilled oily bilge water.
- Return garbage to land
- Avoid using emulsifiers and detergents as bilge cleaners.

- VHF, radio
- Lighters
- Safety tip brochures
- Torch
- Oars
- Drinking water – one gallon per person, per day trip
- Non-perishable foods e.g. biscuits, canned stuff

Waste Management

The proper management of waste – from the time it is created to the time that it is disposed – is one of the greatest challenges that face us today. The best approach is to first reduce the amount of waste that is generated. Ask yourself the question, "Do I really need this?" before taking anything on board with you. For example, it is unnecessary to take items such as plastic cutlery, Styrofoam cups, and paper napkins on day-trips if you own one set of metal cutlery, hard reusable plastic cups, and cloth napkins that can be washed and re-used time and time again! Try to re-use containers and packaging as much as possible, so that, "Nothing goes to Waste".

Sometimes, however, the creation of waste is unavoidable and we must practice responsible disposal. Many people are deeply concerned about improper waste disposal throughout the world and it is no different for the Grenadines. Not surprisingly, they are concerned about waste disposal from boat operators and visiting tourist yachts. Solid waste including oil bottles, paper, and garbage collected from yachts, may be thrown overboard by irresponsible boat operators. Vessels may release human waste filled with nutrients, pathogens and viruses into the water; which eventually cause algal blooms in near-shore marine environments, and can make people sick.

Solid waste disposal of plastics and Styrofoam in the water is not only unsightly, but often dangerous to marine life. Marine organisms (turtles, birds, corals) can be killed by marine debris. These materials are not biodegradable and stay in the marine environment for extended periods of time causing repeated damage.

CHECK	HAVE YOU DONE THIS?	√	WHY?
Fuel and Engines	• Readiness • Carry extra fuel and oil • Use diesel fuel (if possible) • Mix fuel • Leave space in the tank for expansion when heated • Clean tank (see above) • Clean and shady storage for tanks • Preferred, built-in tank • Use the tilt always in shallow water • Pull-up the engine manually if the tilt is not working • NOTE: 2 stroke direct fuel injected engines or 4 stroke engines are most environmentally friendly engines		• Could mean difference between life and death • Diesel is cheaper than gasoline and more environmentally friendly when used with engines that are designed to reduce the emission of nitrous oxides. • So that it does not have to be mixed at sea • Prevents overflow. • Maximize operating capacity and minimize fuel consumption • Avoids damage to the engine propellers and the environment (scarring, damaging corals etc.) • They require less fuel and operate more efficiently. http://www.mass.gov/CZM/boatenginesfs.htm http://www.smalloutboards.com/4stroke.htm www.wartsila.com/Wartsila/docs/en/service/Leaflets/LowNox_conversion_package.pdf

CHECK	HAVE YOU DONE THIS?	√	WHY?
Safety equipment	• First aid kit on board always • Mirror • Spare rope • Distress flares and radios on board always • Bilge pump • (Tool kit –see above) • Whistle • Life jackets/float • VHF, radio • Lighters • Safety tip brochures • Torch • Oars • Drinking water – One gallon per person, per day trip • Non-perishable foods e.g. biscuits, canned stuff		for emergencies • Not having any first aid kit on board increases health risk of customers and operators • Not having any basic emergency tools for repairs out at sea may leave occupants stranded in open waters Food and water may be necessary to stay alive! http://www.rya.org.uk/Cruising/solas/default.asp?contented=1316297

Operators Remember:

- Be prepared for emergencies
- Carry extra fuel and oil
- Use diesel fuel (if possible)
- Mix fuel before departing
- Leave space in the tank for expansion when heated
- Clean tank (see above)
- Clean and easy change of tanks
- Clean and shady storage for tanks
- Preferred, built-in tank
- Use the tilt always in shallow water
- Pull-up the engine manually if the tilt is not working

NOTE: 2 stroke direct fuel injected engines or 4 stroke engines are most environmentally friendly engines

Safety Equipment

Attention to safety equipment is considered a priority by water taxi operators in the Grenadines. The checklist therefore includes a requirement to carry items such as flares and life vests, as well as items such as sponges for mopping up oily water. In best practices, therefore, caring for the environment is linked with caring for people.

Operators Remember:

- First aid kit on board always
- Mirror
- Spare rope
- Distress flares and radios on board always
- Bilge pump
- (Tool kit –see above)
- Whistle
- Life jackets/float

- Do not treat oily water with detergents. Soaps pollute the marine environment and make clean-up difficult.
- Do not remove drain plugs and allow the wash water, bilge water, or water mixed with oil and fuel to be released into the nearby water body.
- Dry and reuse absorbent pads that are saturated with oil or fuel.

Marine engines, especially two-stroke outboard engines produce the highest level of hydrocarbon exhaust emissions (with the exception of lawn and garden equipment). These contribute to ground level ozone, which is a known health risk. To operate the engine as efficiently as possible and reduce emissions, note the following.

Use the gas to oil ratio recommended by the engine manufacturer. Too much oil can foul spark plugs and too little can lead to increased engine wear or even failure.

Use premium two-cycle engine oil (TC-W3 or TC 4). Premium oils improve engine performance and reduce pollution because they burn cleaner, contain more detergents and prevent formation of carbon deposits.

Figure 6. Refueling portable gas tank at pump station on the jetty, Petite Martinique, Grenada

Figure 7. Adding oil to the gas (premix), Petite Martinique, Grenada

CHECK	HAVE YOU DONE THIS?	√	WHY?
Waste disposal	• Avoid using plastic cups • Avoid Styrofoam • Substitute reusable containers and cups • Keep our garbage on board • Go to bathroom before leaving • Do not urinate at sea or on board • Avoid pumping oil into sea • Keep a sponge on board to soak up spilled oily bilge water. • Return garbage to land • Avoid using emulsifiers and detergents as bilge cleaners.		• Disposal of plastics and Styrofoam in the water is not only unsightly, but also often kills many marine organisms (turtles, birds, corals etc.) The materials are also often not biodegradable therefore stay in the marine environment for extended periods causing repeated damage. • The disposal of human wastes in the water is very unpleasant, but more importantly, induces algal blooms. • Ghost nets and lines get caught up in the propellers • There are currently no bathroom facilities on most boats or on the cays • Damaged fishing nets or lines can damage propellers and the environment • Avoid pumping oily bilge water (which kills sea life) into the sea unless in an emergency situation, particularly near the reef. http://www.gbrmpa.gov.au/corp_site/key_issues/tourism/waste_disposal.html

CHECK	HAVE YOU DONE THIS?	√	WHY?
Anchoring	• Use the tilt always in shallow water • Drift dive • Have anchor lines on board • Proper anchors – certified by the US navy • Drift anchor is preferable • Have dive flag on board • If mooring buoys are present, use them!	•	• Anchoring damages corals and causes sedimentation which kills both coral and other marine organisms • http://www.gbrmpa.gov.au/corp_site/key_issues/tourism/anchoring.html
Set an Example	Seek help on how to become more environmentally friendly operators. Share information with passengers about boats, negative impact of activities and safety tips • List for visitors – "Do's and Don'ts" • Use laminated Guidelines – Information inside boats • Pick-up damaged fishing nets/pods • Watch for dive flags • Floating objects • Read and educate – research info on topics, eg scientific research, brochures		• Operators, tourists, coastal managers, teachers and members of the general public can learn from each other • Learning occurs best while in the boat and as soon as people enter the water to swim, snorkel, or dive.

throw the empty oil bottles over board. The remaining oil in the bottles is not only toxic, but the plastic bottles add to marine pollution. Other operators haul their boats ashore and change the oil in the engines, burying the used oil in the sand on the beach. As the tide rises or erosion occurs, the oils are eventually washed out to sea. Floating petroleum is harmful and destructive because it reduces light penetration and the exchange of oxygen at the water's surface. Floating oil also contaminates the micro layer (uppermost portion of the water column), which is home to thousands of species of plants, animals and microbes. There are several animals (for example, birds) that feed on the abundant food in the micro layer and thus pollution of this layer has the potential to poison much of the aquatic food web. Because fuel and oil are very toxic to marine life, extra precautions should be taken when dealing with them.

The best practices when dealing with fuel and oil are:

Fuel

- Fill tanks to no more than 90% capacity, because gas that is drawn from a cool storage tank will get heated and will expand as the engine warms up.
- Rather than filling your tank upon your return to port, wait and fill just before leaving on the next trip. This practice will reduce spills due to thermal expansion because the fuel will be used before it has a chance to warm up.
- Fill portable tanks ashore where spills are less likely to occur and easier to clean- up.
- Use oil absorbent pads to catch all drips.
- Slow down at the beginning and end of fuelling.
- In case of a spill, stop the flow and try to contain the spill.

Oil

- Keep your engine well tuned to minimize the amount of oil that is released
- Be sure there are no leaking seals or hoses.
- Place an oil absorbent pad under the engine.

- Mix and use small amounts of cleaning agents and paints at any one time
- Use non-toxic, biodegradable cleaning agents
- No oil spilling
- Clean bottom
- Use scrubbing brush, squeezy – no bleach
- No toxic materials
- Use non-toxic antifouling paints and primers especially on the hull of the boats

Fuel and Oil

The most efficient types of fuel and oil are those that are specific to each type of engine, boat, and to the use of the boat. Some boats require diesel and others require gas fuels. Diesel is more environmentally friendly, but diesel engines are unpopular with most water taxi operators in the Grenadines because they are relatively costly to purchase and maintain[5]. Diesel engines do not accelerate as fast as gas engines, and. there is little that the owner himself can repair. Diesel engines also do not tolerate neglect and lack of maintenance like gas engines, and are also more easily damaged than gas engines (www.yachtsurvey.com/GasNdiesel.htm).

Negative impacts of fuel can occur on a daily basis, if caution is not exercised. Fuel may be spilled during fuelling through backsplash, or as overflow out of the vent-fitting. A break in the hose coming from the pump station on the jetty may also cause leakage (Figure 6). Most water taxi operators have portable gas tanks, but a few do fill their tank(s) while the boat is in the water rather than refueling ashore. The potential damages are great and extreme caution should be exercised. Spills such as these harm aquatic life, waste money, and can result in stains on the hull.

Figure 7 shows a water taxi operator adding the oil to the gas (premix) in the portable gas tanks. Too often water taxi operators

[5] www.yachtsurvey.com/GasNdiesel.htm

CHECK	HAVE YOU DONE THIS?	√	WHY?
Awareness and Education	• Listen to talk shows (to become informed) – and be on talk shows to inform • Refer to water taxi associations • Workshops are helpful • Internet research • Check brochures • Contact suppliers and distributors for information (especially specification sheets) relating to their products		Operators and tourists having limited knowledge or lack thereof, of their activities, negatively impact the environment http://www.boatus.org/onlinecourse/ReviewPages/BoatUSF/PDF_files/info4e.pdf http://eartheasy.com/play_ecofriendly_boating.htm
Doing it!!!	**USE THIS CHECKLIST EVERY DAY**		**IT WILL HELP ALL OF US TO CARE FOR OUR COASTS AND OUR FUTURE!!!**

Engine Maintenance

Figure 1. Engine maintenance on the beach

Vessels require a great deal of attention. The engines in particular must always be well maintained – and engine maintenance was the "Number One" priority identified by water taxi operators in the Grenadines. Good engine maintenance maximizes capacity and minimizes fuel consumption thereby increasing reliability at sea and reducing the chances of polluting the environment.

Because the boats and engines are heavy, they are difficult to transfer inland. So many operators in the Grenadines haul the boats onto the beach and carry out engine maintenance (Figure 1). It is possible that engine oil, fuel, and lubricants could enter the marine environment.

Operators Remember:

- Do maintenance far on land (not at sea, or very near sea)
- Conduct periodic maintenance (2-6 months) depending on boat use
- Daily routine check
- Tidy
- Clean fuel filter, carburetor
- Clean cooling system
- Keep basic tools on board/ tool kit and accessories; e.g.
    - Hose
    - Spare plugs
    - Bucket/bailer
- Use non-toxic, biodegradable cleaning agents
- No oil spilling
- Use squeezy – no bleach
- No toxic materials

- Use non-toxic coatings whenever possible, as these have limited negative impact. The two non-toxic paints recommended are soft silicone "foul releasing" paints and hard copper epoxy paints.
- Use water based paints whenever practical, but avoid the soft ablative paints.
- While the boats are in the water, limit painting to small jobs; do all substantial paintings on land over a ground cloth. If painting must take place on the water, transfer paint to the vessel in a small tightly covered container.
- Pour out only the amount of paint that is needed for a given job; small containers mean small spills.
- Do all mixing of paints and solvents in a designated area preferably under a shed and far from shore.
- Note how much paint was used for a given job to prevent over-mixing in the future.
- For those who use spray paints, all spray painting should be done on land and preferably in a booth or under a tarpaulin.
- Enquire about the type of spray guns used. High volume, low pressure (HVLP), air-atomizer and gravity-feed spray guns are some of the best choices as they use less paint, less paint fumes enter the air, less volatile organic compounds are released and clean-up is easier and cheaper.
- Use the minimal amount of paint strippers and thinners (if needed) for a given job.

Operators Remember:

- Do maintenance far on land (not at sea, or very near sea)
- Conduct periodic maintenance (every 2, 4, 6 months) depending on boat usage
- Daily routine check
- Tidy
- Dispose of garbage and liquid wastes properly
- Perform maintenance in a shed, or use tarpaulins on the ground and overhead if possible

hull, is of special interest and importance with respect to good environmental stewardship. Environmentally friendly bottom paints are highly desirable, but some operators do not purchase these types of paints because they are too expensive. Instead, they use regular less expensive house paints or others that are harmful to the environment (e.g. antifouling paints because it makes cleaning easier).

Antifouling paints protect the hull from barnacles, algae and other organisms that interfere with vessel performance. But pesticides within these paints harm fishes and other non-target species, as these slowly release chemicals like cuprous oxide (Cu_2O), which is a copper compound. Metals like copper are very toxic and persist in the marine environment.

There are three types of antifouling paints namely, leaching paints, ablative paints and non-toxic coatings. Leaching paints are most harmful. They are solvent based and slowly dissolve as the boat moves through the water. Because the depleted leaching paints must be removed before repainting, the dust particles are a health concern for both humans and marine organisms. Ablative paints also leach toxic chemicals into the water but are less harmful than leaching paints because the active ingredient is leached out and the underlying film weakens and polishes off as the boat moves through the water (www.dnr.state.md.us/boating). Since most ablative paints are 97% water based, having fresh antifouling paint exposed as the upper layers gradually deplete is not as harmful as the solvent-based paints. The non-toxic coatings such as Teflon, polyurethane and silicone all deter fouling with hard, slick surfaces. Other paints such as epoxy paints are about 1,000 times less toxic to algae, shellfish and fishes than the conventional hull paints based on organic tin compounds[3].

The recommendations for reducing the impacts of the paints and painting operation include the following[4].

[3] www. mst.dk/project/NyViden/2000/05170000.htm

[4] http://dnrweb.dnr.state.md.us/download/cleanmarina/BottomPaint.pdf

There are two types of gasoline engines utilized by boaters in the Grenadines ---- 2-stroke and 4-stroke. Each type may be either inboard or outboard. Most water taxi operators though have relatively small boats with outboard engines. The most popular type is the two-stroke engine and there are many reasons why this type is more abundant; however, the decision to purchase an outboard engine is getting more selective as technology improves (http://www.smalloutboards.com/4Stroke.htm). There are several options to choose from when deciding which outboard engine will best suite the owner/operator, but the number one factor lately, is whether to buy a new or used two-stroke or four-stroke engine. The pros and cons for two-stroke and four-stroke outboard engines are listed in Table 2 and 3 respectively.

Table 2: Pros and cons for two-stroke* outboard engines

PROS	CONS
Purchase price is less expensive	Smoke emissions
Easy to repair	Must mix gas with oil
Very strong used market	Noisy
High resale value (parts availability)	Harder to start
Accelerate fast	Carburetors seize up if not used often
	Releases about 50% oil back into the water
	High fuel consumption

*Not for 2-stroke direct fuel injection engines

Source: http://www.smalloutboards.com/4Stroke.htm

Table 3: Pros and Cons for four-stroke outboard engines

PROS	CONS
Quiet (excellent trolling motor)	Heavy-harder to transport or position w/out a stand
Good fuel economy	Expensive to repair
No physical hassling with gas/oil mixture	Very limited used market
Less hydrocarbon exhaust emissions are released	Not as powerful as two-strokes of the same horsepower
Very reliable	Not as many trained mechanics
	More parts that can malfunction
	Expensive to purchase

Source: http://www.smalloutboards.com/4Stroke.htm

The question of whether to buy a two-stroke or a four-stroke engine depends on each boat operator's boating situation.

Some reasons why/when you should purchase a two-stroke engine are:

- Limited budget to spend on a motor and repair costs.
- Familiarity with engine repairs.
- Hard usage and abuse and you want something that can be modified, repaired and adjusted easily.
- Interest in finding a good deal on a used motor. There are more used two-stroke outboard engines available.
- Most mechanics are more familiar with two-stroke engines.

Some reasons why/when you should purchase a four-stroke engine are:

- When you are required to operate in a "four-stroke only" body of water.
- Larger budget to spend on an engine/motor.
- When weight of the engine is not an issue.
- When you want an engine that is quiet under operation
- When you feel that smoke is a serious factor in your purchasing decision.
- If you don't want the hassle of mixing gas and oil.

Figure 4. Boat cleaning on the beach – Not good!!

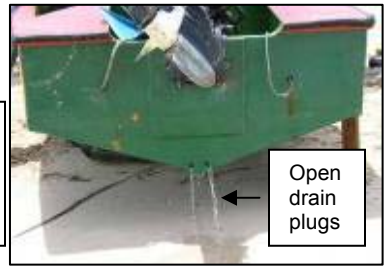

Figure 5. Draining water from the boat

Some best practices for cleaning are:

- Use a non-abrasive pad when washing a boat because this removes less paint from the boat, and as a result less toxic chemicals enter the water.
- Use plain water to remove salt as opposed to other toxic-cleaning agents.
- Use "elbow grease" to remove stains.
- If detergents are necessary, make an effort to use those that are phosphate free, biodegradable and non-toxic. All soapy detergents however, should be used sparingly, because even non-toxic products can be harmful to marine life.
- Avoid detergents that contain ammonia, sodium hypochlorite, chlorinated solvents (bleach), lye etc.
- Exercise extreme care when doing under-water hull cleaning (use appropriate safety equipment and non-toxic products).
- Clean-up carefully and properly dispose of all waste from cleaning.

Painting

Water taxi operators take pride and deep interest in having their boats painted, as they can be creative with the designs for the names and colours of the boats.

The painting of the entire boat is of interest, but the painting of the

to read product labels as they often give information about the degree of hazards associated with a particular product.

Boats should be cleaned with environmentally friendly alternatives. Some commonly used cleaning agents are listed in Table 4.

Table 4. Alternative products to commonly used toxic cleaning agents

CLEANING AGENTS/ PRODUCTS	ALTERNATIVE CLEANING PRODUCTS
Bleach	Borax
Detergent and soap	Elbow grease
Fiberglass stain remover	Baking soda paste
Mildew remover	Paste with equal amounts of lime juice and salt; or vinegar and salt
Wood polish	Olive oil (interior walls only)
Hand cleaner	Baby oil or margarine
Chrome cleaner/polish	Apple cider vinegar to clean and baby oil to polish
Stainless steel cleaner	Vinegar to remove spots and baking soda or mineral oil for polishing
General cleaner	Baking soda and vinegar, or lemon juice combined with borax paste
Floor cleaner	One cup vinegar and two gallons of water
Scouring powder	Baking soda or place half a lime dipped in borax and rub the area, then rinse

* While baking soda, vinegar, lemon juice, and vegetable oils are far less harmful than bleaches, scouring powders or detergents, they are still toxic to marine life. Always remember to use cleaning products sparingly and minimize the amount of discharge into the water. Never dispose of any cleaning products down through the hull-drain; dispose of these products on shore.

Adapted from Buller, Pat.1995 Clean Marina+Clean Boating+Clean Water Partnership. Seattle, WA: Puget Soundkeeper Alliance

Source: http:dnrweb.dnr.state.md.us/download/cleanmarina/ts1vesselm.pdf: Clean boating Tip Sheet- Vessel Maintenance

Both types of engine have their advantages and limitations. It is however, safer to purchase a four-stroke engine in most places and not have to worry about being restricted from boating. There are certain countries in the world that require only four-stroke engines, but few have adopted such regulations to date. St. Vincent and the Grenadines and Grenada do not have such regulations; hence water taxi operators in the Grenadines will continue to purchase two-stroke engines for years to come, as this choice is more economical.

Vessel maintenance

Most water taxi operators in the Grenadines agree that a well-maintained vessel is necessary for good customer service, safety, aesthetics and releases less pollution to the marine environment.

Vessels require a great deal of attention and maintenance; for best results, they must be scraped, cleaned and painted. Paints, oils, and grease may harm aquatic life and affect water quality if they are accidentally released into the water. The damage caused will often be greater by build-ups of chemicals from scraping, cleaning and painting of vessels being serviced in one location. Some paints contain heavy metals such as copper and tin which poison marine systems and people. Oil and grease can damage the sensitive gills, eyes and internal organs of fish and the soft parts of corals. Detergents and bleaches on-the-other-hand destroy the natural oils on fish gills, and other soft parts of many organisms leading to slow or rapid deaths.

Work Area

There are several best/sustainable practices concerning the work area that can be adopted in relation to boating practices. As a general consideration, water taxi operators should try to manage all sanding and painting activities to prevent abrasives, paint chips, and overspray from reaching the receiving water or storm sewer system (www.dnr.state.md.us/boating).

Throughout the Grenadines, there are few “designated boatyards” where water taxi operators can conduct the necessary vessel maintenance in environmentally safe conditions. Ashton Village, Union Island, has one boat yard, but because of its proximity to

the sea it is possible that engine oil, paint chips, and fiberglass, have washed into the sea over a period of time (Figure 2). Most water taxi operators find it convenient and easy to just haul their boat(s) up on the beach or a slipway (e.g. in Clifton, U.I) and do the necessary maintenance and cleaning as opposed to hauling the boat further inland. Figure 3, shows a water taxi operator re-furbishing his boat on the beach during the low season. He is applying fiberglass to the bow of his boat, which has minor damages.

Some best practices for the work area are:

- Perform all major repairs such as stripping, fiberglassing and painting in designated areas (preferably inland), and minimize extensive maintenance outside these areas[1].
- Collect all maintenance debris, paint chips, and other garbage, and dispose of it properly.
- If possible, use an area that has a smooth hard ground surface and a roof. Having a shelter will reduce the amount of debris that enters the water with rain runoff.
- If having an impermeable surface is not practical, then the use of a tarpaulin or canvas on the ground is recommended to trap some of the debris/sediments.
- When washing/cleaning boats with ablative paint/antifouling paint, use the least amount of pressure necessary and a soft cloth to remove the marine growth, but not the paint.
- Try not to let dust fall on the ground, water or become airborne. Use damp cloths to wipe off small amounts of sanding dust. The best equipment, however, would be a vacuum sander.

Source: http://dnrweb.dnr.state.md.us/download/cleanmarina/5VesselM.pdf

[1] The Grenadines water taxi associations could consider developing general maintenance areas (boatsheds) that are environmentally friendly and water taxi operators could use these areas.

Figure 2. Boat yard, Ashton Village, Union Island.

Figure 3. Boat refurbishing, Carriacou, Grenada

Cleaning/Scrubbing

Maintaining clean boats is essential because they are used to transport customers. Since water taxi operators also use their boats for fishing, keeping the boat clean and odour-free when transporting passengers is important.

Water taxi operators recognise that frequently washing the hull of the boat(s) enhances the vessel's performance. The cleaner the hull of the boat, the faster it goes through the water because there is less resistance. Caution is necessary when choosing the cleaning products and methods of cleaning as both can cause serious negative impacts. Water taxi operators should not haul their boats on the beach, spray Clorox and scrub the hull of the boat, or leave the gas tanks on the beach while cleaning (Figure 4). There are many less toxic cleaning products readily available that operators can use as alternatives, but since these alternatives may also be toxic to the environment, they should also be used sparingly[2]. Also, water taxi operators should not open the drain plugs at the stern of the boat and allow the accumulated water to drain out while they are cleaning the boat (Figure 5).

Water taxi operators should be conscientious consumers when purchasing materials for their boats. This involves making an effort

[2] http:dnrweb.dnr.state.md.us/download/cleanmarina/ts1vesselm.pdf