RESULTS OF
THE 2024 BIMCO BIOFOULING SURVEY

Contents

Executive summary

The 2024 BIMCO biofouling survey confirmed there is a high level of engagement with biofouling management from shipowners. Nearly all participants reported using antifouling systems (AFS) selected based on ship profile and service period, with nearly 97% adoption. Other common measures include having ship-specific Biofouling Management Plans (BMP) (77%), using performance monitoring (77%), and conducting regular inspections (74%). Only 39% of companies considered cost and availability when selecting AFS, indicating that reliability and longevity remain the primary drivers.

As seen in previous BIMCO surveys, biocidal coatings (eg Self-Polishing Copolymer) dominate the market, used by over 80% of respondents, while fouling-release coatings and hybrid coatings are less common. A more concerning statistic was that 45% of companies reported at least one AFS-related failure in the past five years – up from only three cases in the 2021 survey. Improper application was identified as the leading cause (78%), followed by environmental conditions (50%) and degradation over time (35 %). This, of course, may amount to only a small number of actual failures given the number of ships represented in the survey so should be considered with caution and it highlights the need to gather further information on this in future

Reactive cleaning remains the dominant cleaning strategy, but proactive cleaning is gaining traction. 12 companies reported using both cleaning approaches, six relied solely on proactive cleaning, and 10 on reactive cleaning. Most ships perform the first hull cleaning within three years of AFS application, with a quarter cleaning within one year, which might suggest a trend toward earlier intervention compared to 2021 as companies strive to realise greater efficiency gains. Propeller polishing is widely practiced, with two-thirds of respondents performing it at least once per year.

Operational and regulatory challenges are present across all cleaning types. Port approvals and regulatory restrictions are the most common barriers to cleaning, especially for proactive cleaning and propeller polishing. Poor weather, high costs, and limited availability of divers and cleaning companies also feature prominently. Technology readiness and effectiveness are currently significant obstacles for proactive cleaning. Crew burden is an emerging issue – averaging 2.33 on a 1–5 scale, with proactive-only cleaning strategies showing the highest workload (2.6) compared to reactive-only (2.0). In-water cleaning between dry-dockings further increases crew burden, underscoring the resource implications of more intensive management regimes.

The findings highlight strong industry commitment to biofouling management and whilst likely to be driven by economic gains for example by regular propellor polishing the adoption of management measures for niche areas demonstrates that the reduction of IAS is also playing a central part. More timely, however, is that the findings reveal some challenges that are likely to arise in the development of any legal-binding framework in future.

Introduction

In July 2024, BIMCO launched its third biofouling management survey, aiming to provide awareness on the current state of biofouling management and industry practices. This edition of the survey was the first since the introduction of the 2023 Guidelines for the control and management of ships biofouling (herein, “the Guidelines”, and this survey aimed to provide some insight into the level of their adoption by the shipping industry.

The results of this survey provide a high-level overview of the current state of biofouling management. This survey builds on the BIMCO surveys conducted in 2018 and 2021 by further investigating the specifics of how inspections and in-water cleaning are performed, along with analysing the uptake of the concepts within the Guidelines.

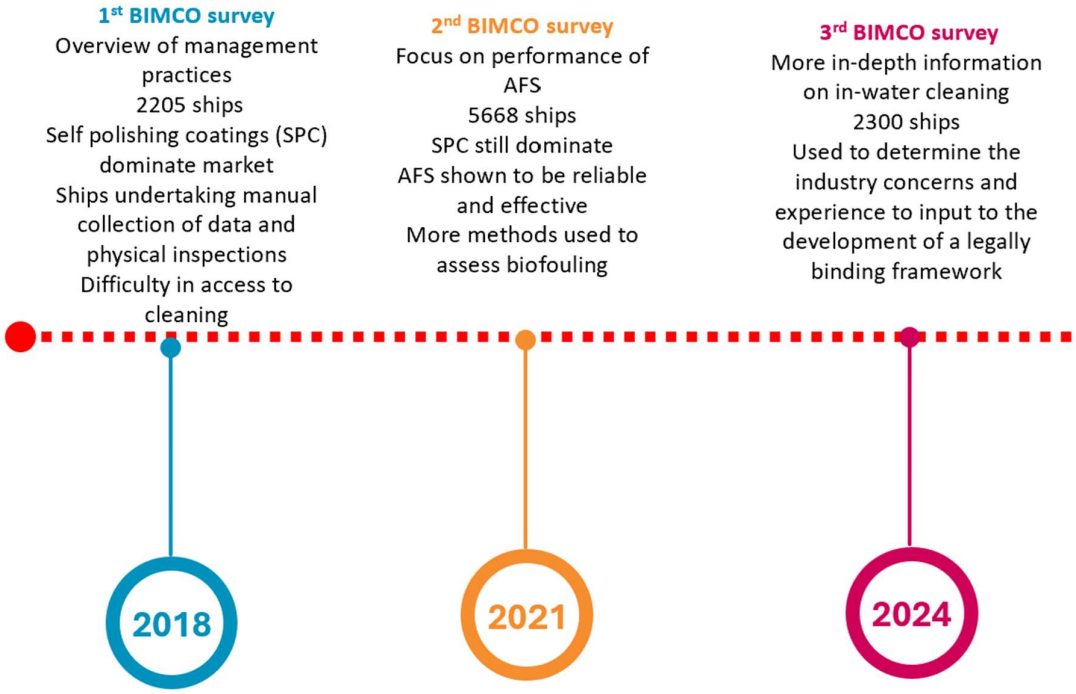


Figure 1 — Overview of BIMCO biofouling management surveys and major findings

Data composition and selection

Input was received from owners and operators with varying fleet sizes and with fleets composed of varying ship types. Some of the responses provided were either lacking in essential data or provided inconsistent answers. Though careful consideration, the information obtained from such responses was omitted from the analysis to ensure reliability and coherence of the results. The final sample used in the analysis consists of 30 companies, representing a total 2233 ships, roughly 4% of the global merchant fleet over 1000GT.

Fleet characteristics

Out of the 30 responses that met the selection criteria, the largest participant by size owns or operates 728 ships, three participants own or operate just a single ship. The was around 73 ships.

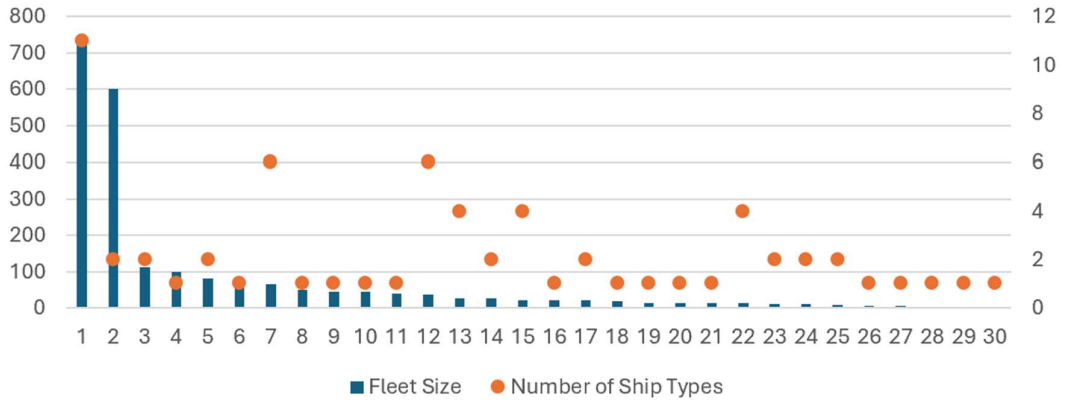


Figure 2 — Overview of fleet sizes and number of ship types as indicated by participants (n=30)

According to the data, the average company consists of around two to three ship types, with the most diverse consisting of 11 ship types. Nevertheless, it is important to note that accurate distribution of ships by ship type could not be directly inferred from the information provided and Figure 2 provides an overview of proportional frequency of ship types, based on how often such were mentioned in the description of the fleet composition.

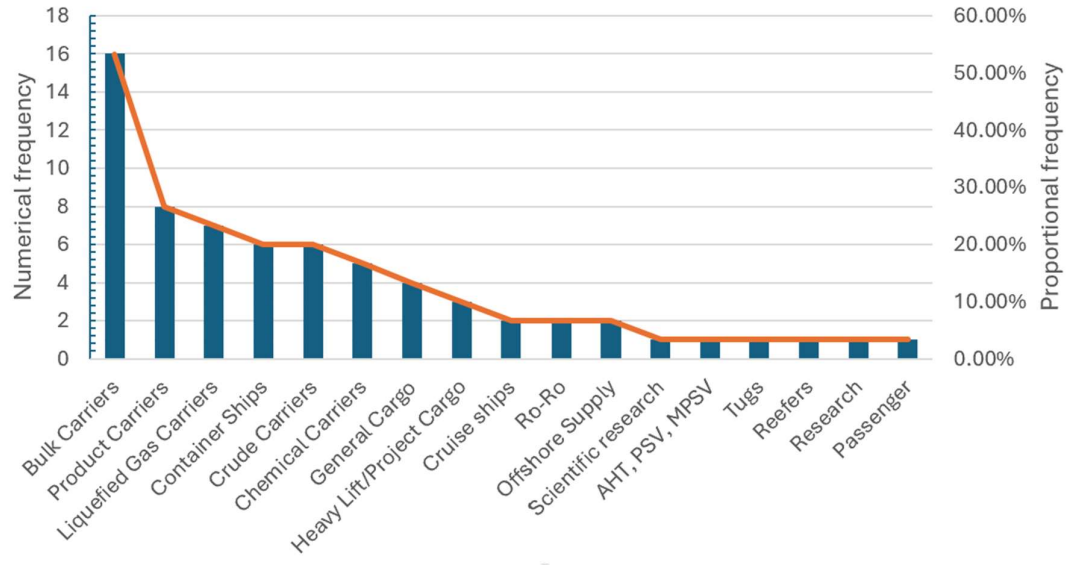


Figure 3 — Occurrence frequency of ship types in sampled fleets (Legend: Blue – numerical frequency; Orange – proportional frequency)

Biofouling management

The participants were asked about the high-level biofouling management they conduct as a company to gain a satellite view of the commonality of practices.

Adoption

Overall, the survey participants expressed a high level of maturity of biofouling management, nearly universally declaring the use of an antifouling system (AFS) selected based on ship profile and service period.

Management Practice	Adoption Rate (%)
AFS selected based on ship profile and service period	*97%*
Ship-specific Biofouling Management Plan (BFMP)	*77%*
Undertake performance monitoring	*77%*
Conduct regular inspections	*74%*
Maintain Biofouling Record Book (BFRB)	*68%*
Specify coating thickness and application methods	*65%*
Conduct biofouling risk assessments	*48%*
AFS selected based on cost and availability	*39%*

Table 1 — Adoption rate/breakdown of biofouling management practices

The least applied management action was the installation of an AFS selected on cost and availability, with less than 40% of companies considering cost and availability as a decisive factor.

Coating Selection

Figure 4 — Visualisation of the proportional use of various coating types reported by the survey participants (Note: Orange not true to scale, enlarged for visual purposes)

Data from the 2024 survey suggests that the most used types of AFS are biocidal coatings (~67%), and fouling release coatings with biocide (20%), followed by regular fouling release coatings (13%). Hard coatings (0.4%) are the least common AFS choice in the selected sample and are represented only by approximately nine ships across four companies. These align with findings from previous surveys.

The number of ships with each type of AFS is estimated through deriving from the proportionate data information about the use of particular coating types reported by individual participants. That is, the share of each reported coating use was multiplied by the total number of ships owned or operated by the company. In the six cases (combined number of ships = 165) where the proportionate distribution of coating types was reported with inconsistencies, ie the sum of all individual proportions equalled over 100%, such entries were not taken into consideration when calculating the overall distribution. This decision was made to allow more complete transparency and reliability of the data, even though such cases of "misreporting" cannot be all attributed to error and may have a rational explanation. For example, one participant clarified they use a differential coating strategy using several coating types on different areas of the same ship.

Identified coating products

Many of the participants referenced specific brands and coating manufacturers when asked about the use of coating technologies for newbuilds or re-coating in the past 24 months. These results are not included here due to commercial sensitivities.

Several participants also provided nuanced commentary on coating strategies and application practices. As previously mentioned, one noted that "ships often use multiple types of AFCs for different areas of the ship (eg, vertical sides)", while another highlighted a potential risk factor in shipyard practices stating that: "many shipyards are now only applying AFS up to ballast waterline rather than full load waterline as standard spec". In general, shipyard-related practices were indicated in several responses, with one participant stating that "no shipyards are willing to apply silicon coatings at newbuild (for dry bulk)". This highlights an area for later consideration where shipyards may be influencing or even hindering the adoption of some solutions that could otherwise be preferred by the industry.

One company mentioned that they often lack control over coating selection for chartered ships, but seek collaboration with owners to upgrade to higher-performance coatings during re-coating opportunities.

Inspection and monitoring

In the same manner as for the 2021 survey, respondents were asked about the different methods used to check the condition of biofouling growth.

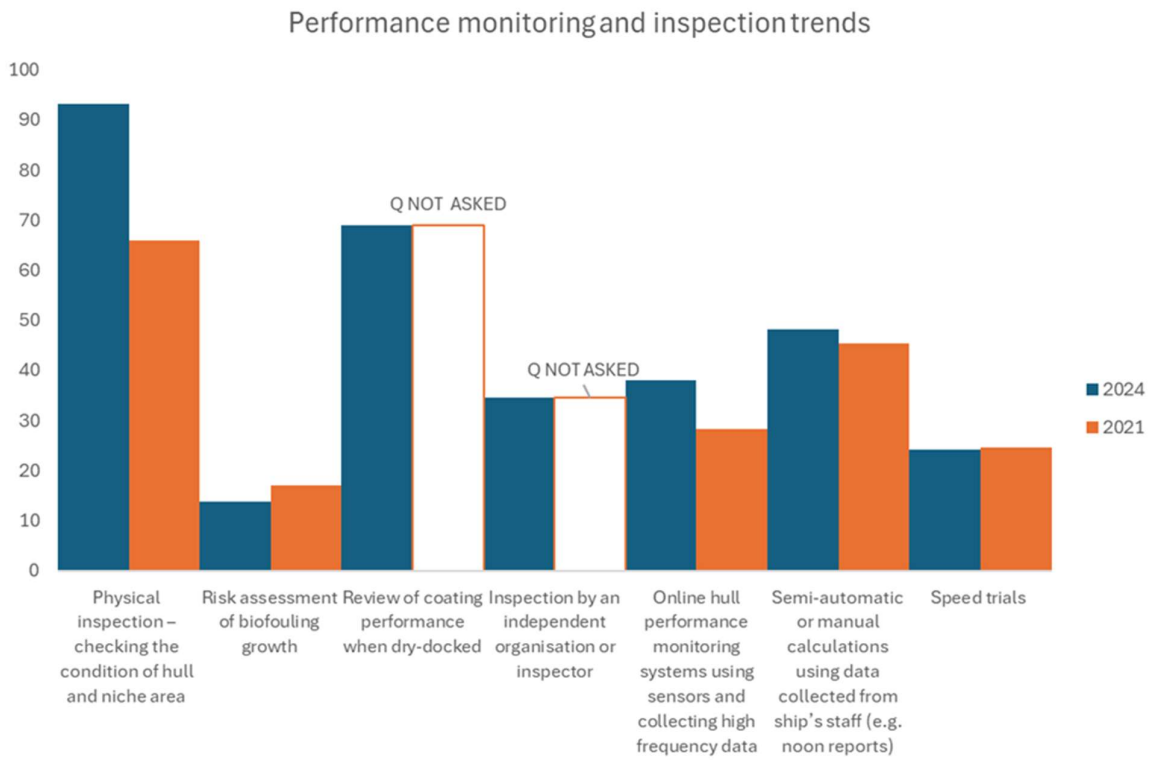


Figure 5 — Commonality of inspection and monitoring methods between 2021 and 2024

Of all the survey participants in 2024, only one company with a small offshore supply fleet did not specify any methods for checking the AFS, condition of the hull and niche areas and the accumulation of biofouling. For the remaining participants, the most popular method was review of coating performance when dry-docked. This was followed by physical inspection, on both fixed and non-fixed schedules. Risk assessments using software tools was the least popular method to check condition of the AFS and accumulation of biofouling.

Technology that can be used to infer that there might be changes to the condition of the hull appears to be coming more widely adopted. When all the different methods that apply technology or, for example, fuel usage measurements are summed over 77% of ships are doing what might be considered some kind of performance monitoring. It is likely that the uptake of this technology will continue to emerge as further energy efficiency gains are sought.

Compared to the 2021 survey, the number of methods used by companies to assess whether their ships have biofouling has increased from an average of around 2.5 to slightly over 3. Although, it

should be noted that due to the small sample size it cannot be definitively considered an industry-wide trend.

To determine, conclusively, the condition of the AFS or whether the ship has biofouling (as a follow up action to for example noticing a drop in performance) most companies rely on the use of in-water inspections, with only 13 companies not undertaking them.

Participants were asked to list all methods they usually employed for such in-water inspections. The use of divers was mentioned in all but one case. Quayside visual inspection was the next most popular method (61% of responses), followed by the deployment of a Remotely Operated Vehicle (ROV) (44 % of responses).

Methods of in-water inspections	Number of companies	Share of companies
Using divers	*17*	*94%*
Quayside visual inspection	*11*	*61%*
Deploying an ROV	*8*	*44%*
Crew use of Cameras	*2*	*11%*

Table 2 — Commonality of methods for in-water inspection

The triggers for in-water inspection include noticeable performance degradation which may indicate biofouling (around 44% of responses), risk assessments indicating possible biofouling (around 19% of responses) and prolonged idle periods (around 15% of responses). Other less frequent (two or fewer) responses mentioned triggers such as: scheduled inspections as per the BFMP, statutory or class surveys, entry into sensitive environmental areas, or mobilisation for a new contract.

Most companies, especially larger ones, rely on independent inspections by a third-party, whilst internal inspections are more often noted by either companies with smaller fleets or as a part of routine checks.

Outcome of inspections

The survey also explored situations in which an inspection led to a cleaning. Companies that use sensor-based monitoring and software risk assessments often triggered cleaning based on performance degradation. Manual inspections triggered cleaning based on visual fouling or scheduled intervals.

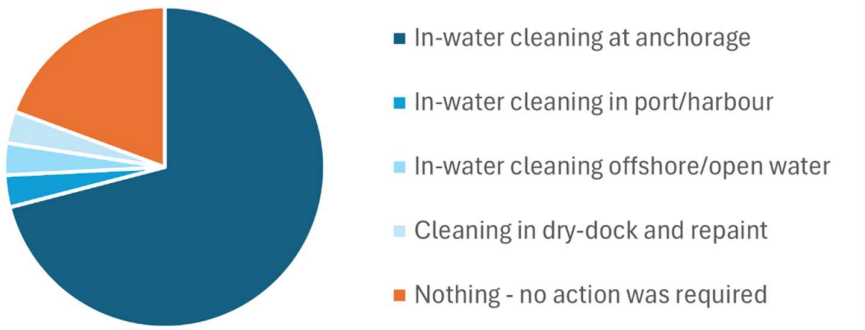


Figure 6 — Breakdown of consequences of inspections

Most participants suggested that inspections that identified a need to clean resulted in in-water cleaning at anchorage.

Cleaning regimes, practices and method

Figure 7 — Overview of cleaning regimes by proactive or reactive, and propeller polishing

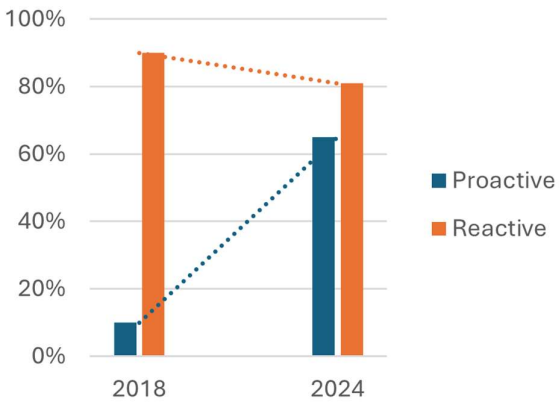


Figure 8 — Indicative estimated trend showing the development in the distribution between proactive and reactive cleaning methods

The data shows that this in-water cleaning is done by a relatively diverse range of different cleaning regimes and methods. Participants were asked whether they undertake, or have undertaken, proactive or reactive cleaning practices as part of their management strategies. Six companies listed themselves as only using proactive cleaning practices, 10 companies listed themselves as only using reactive cleaning practices, and 12 companies listed themselves as using both proactive and reactive cleaning practices. Three companies did not respond to this question.

This implies that most companies still rely on reactive cleaning should biofouling accumulation occur, however proactive approaches seem to also be gaining traction. Figure 8 shows an approximate trend towards proactive versus reactive cleaning strategies between the 2018 and 2024 biofouling surveys. The approximation was necessary because the earlier surveys did not directly ask about proactive or reactive regimes in the same format. The 2021 survey was omitted because it did not have appropriately commensurable datapoints.

To estimate these values, responses were classified based on trigger descriptions, where responses featuring cleaning “regularly at preselected intervals” were treated as proactive, while triggers like “after inspections,” “following idle periods,” or “performance drop” were treated as reactive. For 2018, this yielded an estimate of around 10% proactive and around 90% reactive. For 2024, actual reported data shows overlapping adoption of a combination of these methods (in total around 46% mention both reactive and proactive), with roughly 65% of responses mentioning proactive and roughly 81% mentioning reactive.

Please note that these figures should be interpreted with caution because the classification relies on subjective interpretation of open-text responses. Moreover, the question wording, survey design and response options differed significantly between surveys. Therefore, while the trend toward more proactive cleaning is evident, the exact percentages are indicative rather than precise.

Aligned with this observation the survey also showed that in-water cleaning is carried out between dry-dockings by more than three-quarters of companies for an average ship.

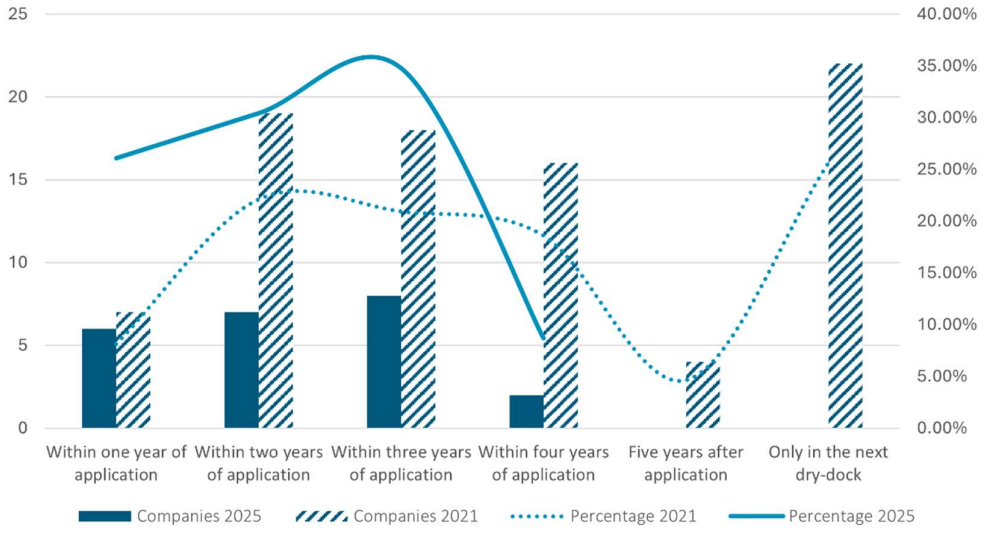


Figure 9 — Time of first cleaning after AFS application, comparison between 2021 and 2025 data. (Note: orange lines refer to percentages shown on the secondary axis on the right side)

Figure 9 provides information on occurrence of cleaning following the application of the AFS. 35% of participants performed the first cleaning within three years of AFS application. The data likely also suggests a generally proactive maintenance approach, where owners and operators are aiming to cleaning before significant fouling impacts efficiency. These cleanings are also likely to correspond with the intermediate surveys or inspection at the end of a time charter for example. A correlation analysis between coating type and time of first cleaning shows no meaningful connection between the two, with same variability present across coating types.

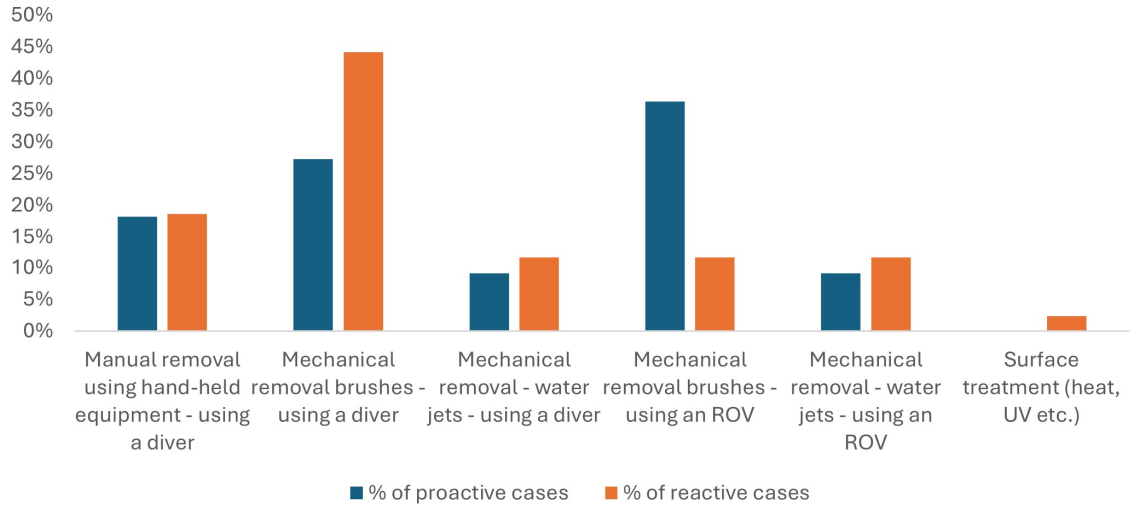


Figure 10 Comparison of proactive and reactive cleaning methods

There is a noticeable difference in cleaning methods depending on whether such is conducted on a proactive or reactive basis. In general, reactive cases had a larger reliance on divers, especially when using mechanical removal brushes. Even in cases where ROVs were used for cleaning the data suggests that there would also be a diver in the water performing additional cleaning duties. For those companies employing proactive cleaning strategies there is a clear preference towards using ROV technologies.

Capture systems

When respondents were asked whether cleaning procedures were conducted with or without capture of waste materials, the majority did not provide a definitive answer. Only three participants addressed this aspect directly – two indicated that cleaning was performed without capture, while one reported using capture. Although this limited data does not allow for reliable conclusions, it highlights the need for future surveys or studies to more thoroughly investigate capture practices during cleaning – to determine the availability of systems that use capture, the need for capture and to more broadly understand the potential barriers companies face which prevent them to widely adopt cleaning with capture.

Propeller polishing

Around 65% of participants reported that they conduct propeller polishing at least once a year. Most companies report performing propeller polishing once or twice per year, though some do it less than once per year. A few companies, especially those with proactive hull grooming strategies, polish propellers more frequently.

Frequency	% of Companies
Less than once/year	*~30%*
Once per year	*~40%*
Twice per year	*~25%*
Never	*~5%*

Table 3 — Reported propeller polishing frequency

Niche area management

Out of the 30 total respondents, four did not list a niche area management strategy. The remaining 26 respondents listed Marine Growth Prevention Systems (MGPS) as the preferred management option offering special protection or differential management method, for niche areas. Nearly half of companies employed multiple niche area management strategies.

Niche Area Management Strategy	Total number of companies using	% of companies using[1]
Marine Growth Prevention Systems (MGPS)	*23*	*88*
Cleaning regimes	*13*	*50*
Differential Coatings	*7*	*27*
Ultrasonic Transducers	*1*	*4*
Foul release coating + protected with ultrasonics	*1*	*4*
Other ultrasonic AF systems	*1*	*4*

Table 4 — Reported niche area management strategies

[1] excluding companies with no strategy

Difficulties, challenges and failures

The survey reveals that cleaning as a biofouling management action is far from straightforward. Respondents consistently report significant operational and technical barriers, ranging from regulatory restrictions and port approval delays to adverse weather conditions and limited availability of qualified cleaning teams. High costs, time constraints during commercial operations, and risks of coating damage further complicate maintenance planning. These challenges appear across both reactive and proactive cleaning strategies and often lead to disruptions, increased fuel consumption, and, in some cases, premature coating failures.

Burden on crew

Burden score	Count	Share
1	*6*	*20.0%*
2	*10*	*33.3%*
3	*12*	*40.0%*
4	*2*	*6.7%*

Table 5 — Estimated average burden on crew from biofouling management activities rated 1 through 5

In the responses provided the estimated crew burden clusters around two to three on a one to five scale. Overall, the survey indicates a moderate crew burden for biofouling management (mean 2.33, median 2). Companies that lean more towards reactive-only biofouling management display a lower average burden of 2.0, whereas proactive-only companies show an average burden of 2.6, whereas companies that have a combination of reactive and proactive show a score around 2.5. Companies reporting in-water cleaning between dry-dockings also show a slightly higher average burden (2.43) than those that do not (2.12).

Despite the numbers being based on subjective interpretation it might be representative of the expected possible connection between more proactive cleaning and burden on crew. For companies, this means that adopting proactive regimes or frequent in-water cleaning may require additional work hours, coordination, and procedural oversight, which should be factored into resource planning and training programs.

AFS failures

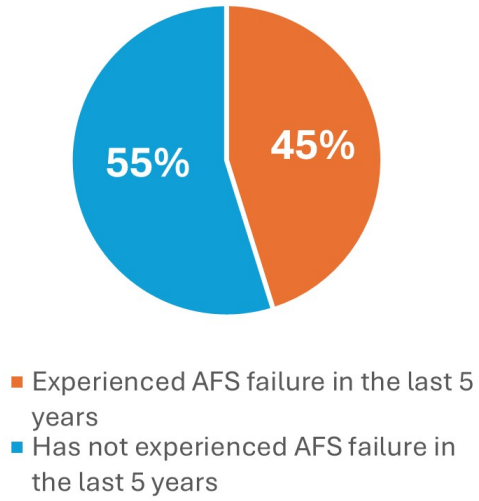


Figure 11 — Percentage of companies experiencing at least one AFS failure in the last 5 years

Among all respondents, 13 (44.83%) experienced at least one AFS related failure in the last five years, on any of their ships. These 13 companies account for 1,807 ships, yet the question asks whether any failures were experienced, irrespective of how many instances of failures and on how many ships occur. Therefore, these results should be understood to be just an illustration of the sample data.

The BIMCO survey conducted in 2021 only three incidents of failure were reported. So, although this does not statistically represent a trend it might warrant consideration or future investigation.

Compared with companies with no failures, the failure group reported weaker procedural discipline on a few fronts: only 50% maintained a Biofouling Record Book (BFRB) (vs 82% for non-failures), 57% specified coating thickness/application methods (vs 71%), and 43% conducted biofouling risk assessments (vs 53%). At the same time, companies with failures were more likely to have changed their management approach recently, 64% cited adopting the 2023 IMO biofouling guidelines (vs 24% among non-failures).

The survey results show no distinctive correlation between particular coating types and the likelihood of failures. It is more likely that the likelihood of failures is closely associated with application quality and other biofouling management related practices. Improper application was deemed the most probable cause of failure, suggesting that the AFS manufacturer's required conditions of application in the shipyard are not being met across these cases.

Challenges related to hull cleaning and propeller polishing

	Reactive cleaning	Proactive cleaning	Propeller Polishing
High costs	*Common*	*Common*	*Less common*
Port approvals/regulatory environment	*Common*	*Very common*	*Very common*
Poor weather or visibility	*Common*	*Very common*	*Common*
Availability of divers	*Less common*	*Less common*	*Less common*
Availability of cleaning company	*Less common*	*Less common*	*Common*
Port logistics	*Less common*	*Less common*	*Common*
Areas of ship not accessible	*Less common*	*Common*	*Not common*
Not enough time to undertake cleaning	*Less common*	*Less common*	*Common*
Coating damaged during cleaning	*Less common*	*Common*	*Not applicable*
Availability of dry dock	*Not common*	*Not common*	*Not common*
Mechanical failure of ROV	*Not common*	*Not common*	*Not common*
Technology readiness	*Not common*	*Very common*	*Not common*
Reliability of technology	*Not common*	*Very common*	*Not common*
Crew training	*Not common*	*Common*	*Not common*

Table 6 — Challenges with cleaning- based on cleaning regime

The survey highlights that both hull and propeller cleaning face persistent and often overlapping challenges that complicate maintenance planning and execution.

For hull cleaning, the most frequently cited barrier is port approvals and regulatory restrictions. Many operators reported that obtaining permission for in-water cleaning is complex and time-consuming, with requirements varying significantly between ports.

When noting constraints related to propeller polishing, respondents often cite port approvals and regulatory constraints as their biggest hurdles. This constraint is followed by availability of divers and cleaning companies as close second, and time constraints. These challenges mirror the ones faced in hull cleaning, suggesting that the various logistical and regulatory issues share the same causes.

Fuel use impact

Propeller polishing is consistently linked to measurable fuel savings. Survey responses indicate reductions ranging from 0.5% to 25% in fuel consumption per ship after polishing. However, this information is not validated and so should be used with caution with significant savings likely to be

related to more than just the act of polishing. Companies who employ a strategy of polishing propellers twice per year reported up to five to seven percent fuel savings. Polishing done once per year yielded two to four percent savings. Less than once per year showed minimal or no savings.

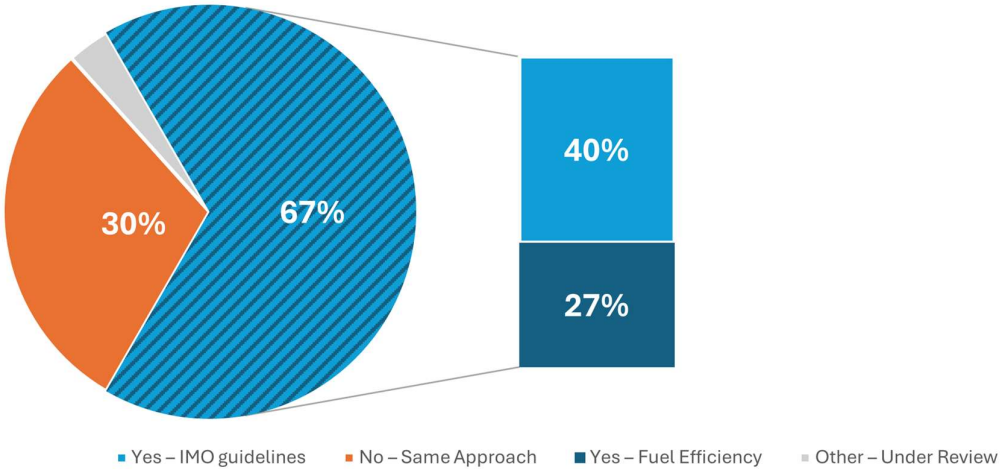


Figure 12 — Changes in the approach to biofouling management in the past 24 months

An important new element of the 2024 survey was asking participants whether they have changed their approach to biofouling management in the past 24 months (See Figure 12). This is particularly useful in creating a picture of to what extent the 2023 IMO biofouling guidelines have been adopted.

A significant proportion of companies (~42%) reported changing their approach specifically to align with the 2023 IMO Biofouling Guidelines. Another ~26% of respondents cited improvements in fuel efficiency as the primary motivation for change, highlighting the overlapping nature of these issues. 29% of companies stated that their approach has remained unchanged, suggesting either the sufficiently advanced nature of existing practices or potential barriers such as a lack of perceived benefit. Additionally, one respondent indicated that they are currently in the process of revising their approach, marked grey in Figure 12.

Conclusion

The drive to decarbonise and enhance energy efficiency coupled with an increased focus on the impact of shipping on marine biodiversity, has heightened the recognition of the benefits of effective biofouling management for ships.

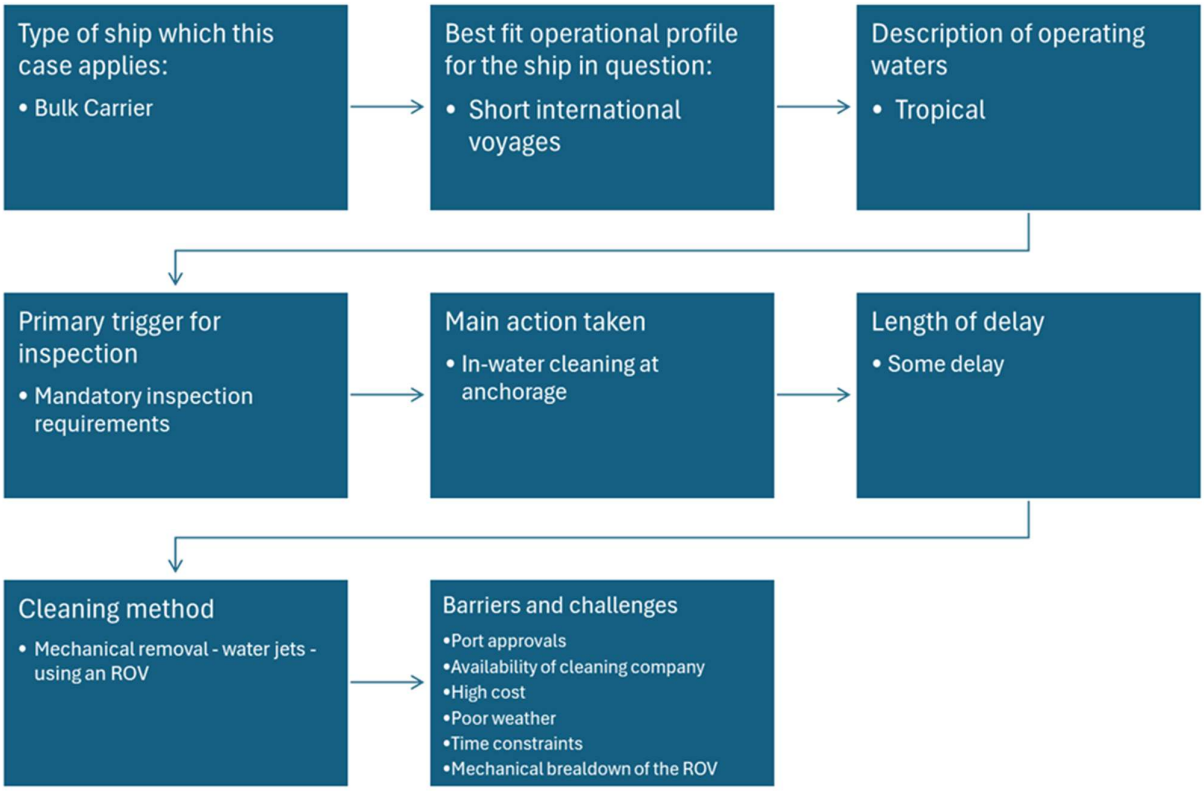
Biofouling surveys conducted by BIMCO in 2018 and 2021 yielded vital insights into the practical aspects of biofouling management and industry practices. This ranged from exploring the efficacy of antifouling systems and their claimed versus actual lifetimes through to inspection practices and the use of performance monitoring to detect fouling. The results from the 2024 survey highlighted in this report show the importance of continuously gathering such information to assess the levels of adoption and effectiveness of the IMO's 2023 Guidelines and/or other management measures. This becomes of increasing importance as the IMO works to develop a legally binding framework on biofouling management.

Nonetheless, the early indications from industry are positive. There is clearly more interest in biofouling management, and the tools and techniques used to manage it. Many shipowners are adopting multiple biofouling management measures across fleets to manage both hull fouling and fouling of niche areas. Performance monitoring and self-inspections are carried out routinely and the resulting actions show that in-water cleaning is becoming more of an integral part of a management plan. Proactive cleaning is increasingly being seen as a useful tool, and more shipowners are now exploring this option. The biggest challenge will be to remove some of systematic barriers to in-water cleaning and to ensure it is accessible to ships where and when needed.

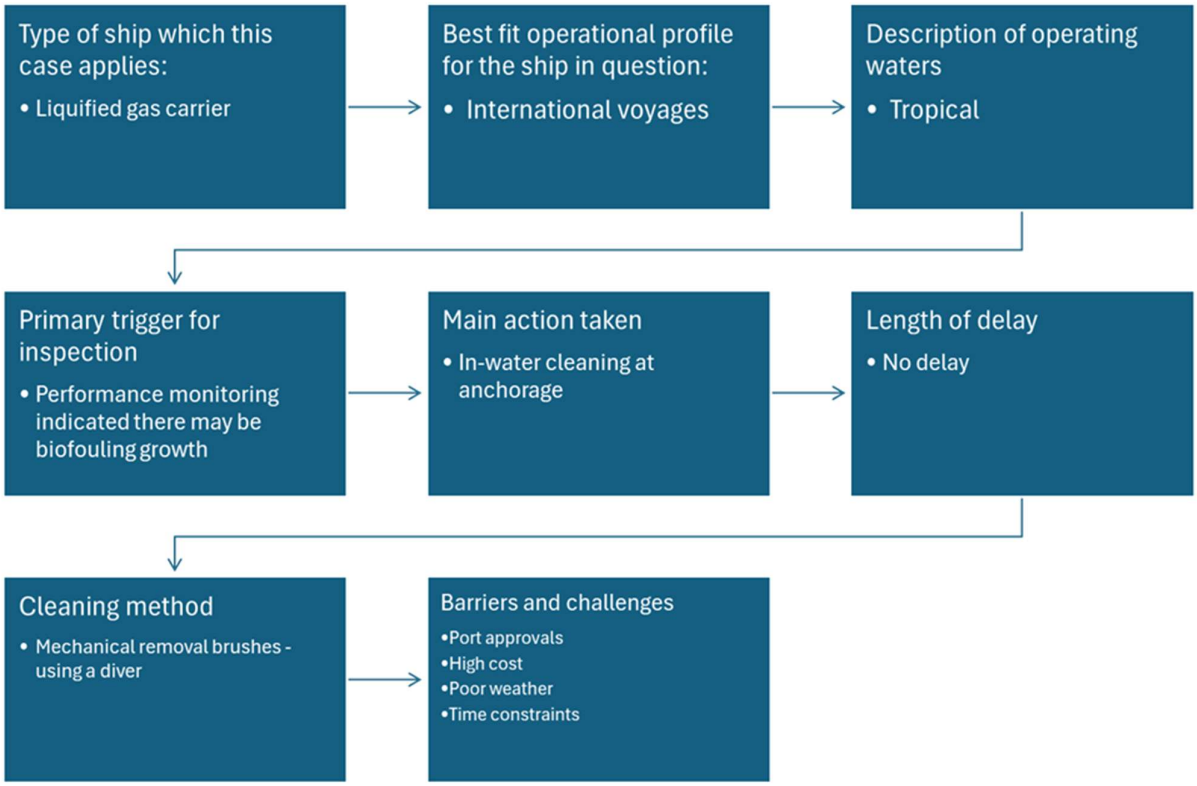
Appendix I – Case Studies

The following figures illustrate several examples of responses from both reactive and proactive case studies which highlight the significant differences in how individual ships and companies approach biofouling management, inspection and cleaning. These flow charts provide just a snapshot and visualise the process four difference companies undertook in relation to cleaning. Over 30 case studies were provided each having its own individual characteristics.

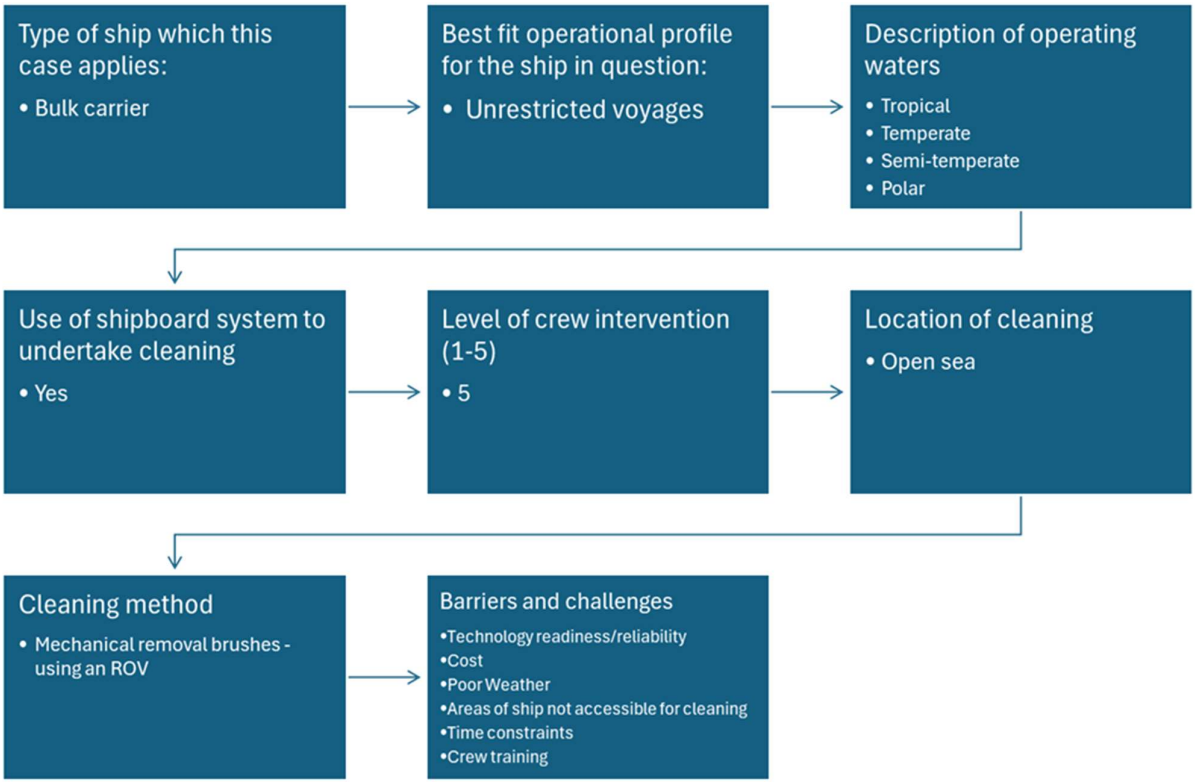
Reactive Cleaning – Case 1



Reactive Cleaning – Case 2



Proactive Cleaning – Case 1



Proactive Cleaning – Case 2

Type of ship which this case applies:
- Passenger

→ **Best fit operational profile for the ship in question:**
- International voyages

→ **Description of operating waters**
- Temperate
- Polar

Use of shipboard system to undertake cleaning
- No

→ **Level of crew intervention (1-5)**
- 1

→ **Location of cleaning**
- Open sea

Cleaning method
- Mechanical removal - water jets - using a diver

→ **Barriers and challenges**
- Port approvals
- Coating damaged during cleaning
- Crew training

About

BIMCO

Facilitating trade is at the very heart of our business, and since 1905, we've helped our members keep world trade moving. We make it our business to help our members with theirs.

BIMCO members cover 64% of the world's tonnage and consist of local, global, small and large companies. We are an organisation and global shipping community of 2,100 members in 120 countries.

From our offices in Athens, Brussels, Copenhagen, Houston, London, Shanghai and Singapore we aim to help build a resilient industry in a sustainable future whilst protecting world trade. We do this by finding practical solutions for our members to help them manage risk in a changing world.

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