Fuel consumption monitoring in fishing vessels and its potential for different stakeholders

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The fishing sector world-wide accounts for about 1.2% of the global oil consumption; this entails approx. 134 million tonnes of CO_2 emission into the atmosphere (Tyedmers et al., 2005). Whilst fuel can account for as little as 15% of the annual costs of a troller, fuel costs for a trawler represents 40%-50% of the total annual costs, and for tropical tuna purse seiners the amount can be as high as 70% (Basurko et al., 2013; Parker et al., 2015). Commercial fisheries management needs to evolve to address current energy challenges.

Energy consumption in fisheries depends upon the structure and size of the vessel, the engine conditions and use patterns; the fishing gears employed; the fishing and trip patterns; the distance to the fishing ground; target species and their migration routes; and the traditions onboard (Basurko et al., 2013). Considering such differences, the first step in any energy related study must commence with the definition of the activity pattern (time spent in each of the activities the vessel endures during a trip) and the energy pattern (fuel consumed by such activities during a trip). As a result, the patterns will provide insight on the real fuel consumption reduction potential of the vessel. For example, a tuna purse seiner operating in tropical waters dedicates the 42% of their trip to cruising, which involves the 56% of the total fuel consumption of a fishing trip. On the other hand a trawler consumes most of the fuel (i.e. the 68%) during fishing activity, which implies sailing at 4 kn. Hence, the first (tuna purse seiner) will mostly benefit from energy saving measures improving the propulsion, and the second (trawler) from drag and forward resistance reduction derived from optimising the fishing gear, such as using pelagic or semi-pelagic trawl doors. The second step after defining the patterns for each of the fishing gears employed during a year is to undertake an energy audit that will be complemented by the energy share of the energy consuming equipment/machinery onboard. All this information will be used for defining the potential of energy efficient measures onboard and their return of the investment.

Different approaches are being developed for the fishing sector targeting fuel consumption, but few have been widely implemented. One of the successful measures is the usage of qualified monitoring solutions for high precision data collection. In that sense, AZTI has developed two fuel monitoring devices: the GESTOIL ("an onboard fuel consumption measurement and management system") addressed for larger trawlers and purse seiners, and the SIMUL (low cost Open Source monitoring system) for artisanal fleet. The GESTOIL has been so far installed in 7 vessels, and the SIMUL in 9 vessels. Both devices monitor fuel consumption and register the vessel positioning with data collection frequency of 1 sample every 10 seconds. In order to see the effect of these fuel monitoring devices on the skippers, the devices were installed and the registered data were not displayed in the devices onboard. After some time, the fuel consumption values were displayed onboard. The result of this experiment showed that in most of the vessels the first reaction was to reduce the speed in order to reduce the fuel consumption; and the reduced speed was kept in the time as a normal practice. Annual fuel savings between 7 to 20% were achieved in these vessels. Likewise, the fuel consumption monitoring devices has also served to define the fishing grounds of the vessels and the fishing effort, by discriminating the steaming period of the trip.

The results also discuss the potential of these indices for fishery managerial strategies. The fuel monitoring devices represent a “win-win” business model, where scientific community could assess the carbon footprint of a regional fishing fleet and ship owners would decrease fuel expenses (Table 1). Thus, the sustainability of the fisheries will be also improved considerably.

Table 1 Potential use of fuel monitoring for different stakeholders

Stakeholder	Potential use
Skipper	• Real time information regarding vessel performance • Energy and activity patterns • Possibility for reducing fuel bill
Shipowner	• Historical data of a vessel’s fuel consumption and performance • Historical registry of fishing grounds
Administrations	• Fishing effort / incentives • Good for spatial planning
Scientists / Researchers	• Energy and activity patterns • Energy audits • Energy efficiency indices • Carbon footprint studies • Energy saving measures

Furthermore, the regulatory framework for energy efficiency in the fishing sector is unclear. The International Maritime Organization (IMO) has intensified the regulations on energy efficiency for ships to guarantee greenhouse gas emission reduction from shipping (IMO, 2009a; IMO, 2009b). However, the fishing sector is exempted from such measures. In contrast, energy efficiency in fisheries has been mainly approached by presenting their Fuel Use Intensity (FUI) index (Tyedmers, 2001; Tyedmers, 2004). The index measures the fuel consumption to catch 1 tonne of target species, and is commonly expressed in litres of fuel per tonne of fish landed (L/t). The present contribution provide a preliminary EEDI value of the Basque fishing fleet (Fig 1) as an aim to show the energy efficiency scores of the vessels design and to bridge the gap for vessels < 5000 GT. Likewise, it is also shown that the EEOI and FUI scores fail to provide the same ranking of operational energy efficiency of fishing vessel (Table 2), which highlight the need to define a standard index for fishing vessel.

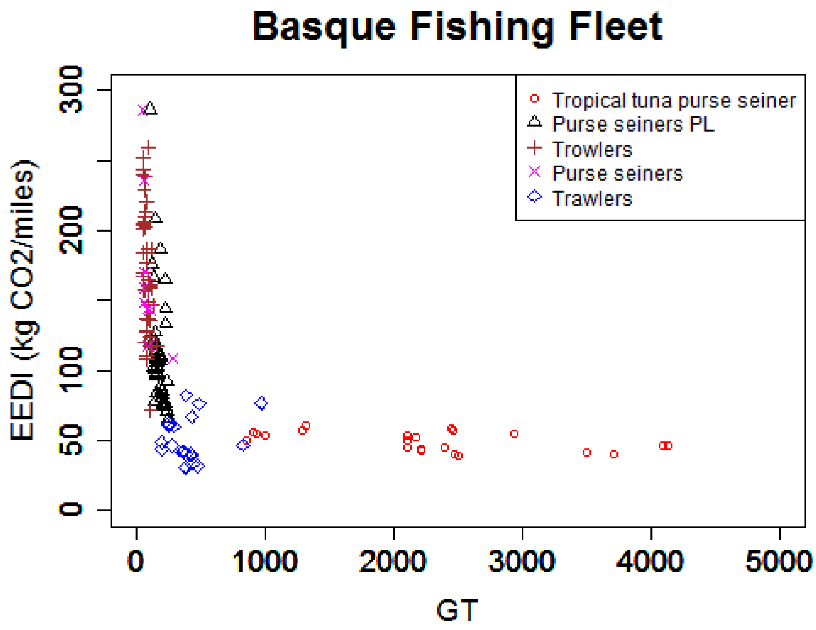

Figure 1 Estimated EEDI for the Basque Fleet

Table 2 EEOI for several fishing vessel types

Fishing gear	EEOI (g CO_2/tnm)	Fuel Use Intensity "FUI" (L/t)
Pole and liner	166	90 (=)
Tuna purse seiner	330	492 (↑)
Stern trawler	883	1646 (↑)
Hand liner	1585	60 (↓)
Troller	1753	1131 (~)
Gillnetter	2775	677 (↓)

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