



Epifauna on blue mussel (*Mytilus edulis*) aquaculture  
in four fjords in NW Iceland:  
Patreksfjordur, Talknafjordur, Alftafjordur  
and Steingrimsfjordur

Funded by  
Westfjords Growth Agreement

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<b>ABSTRACT .....</b>	<b>3</b>
<b>INTRODUCTION.....</b>	<b>4</b>
<b>METHODS.....</b>	<b>4</b>
<b>Sampling sites.....</b>	<b>4</b>
<b>RESULTS .....</b>	<b>8</b>
<b>DISCUSSION.....</b>	<b>13</b>
<b>Anknowledgement .....</b>	<b>13</b>
<b>REFERENCES .....</b>	<b>13</b>
<b>Appendix: Pictures (5-9) from the fieldwork.....</b>	<b>14</b>
<b>Patreksfjordur .....</b>	<b>14</b>
<b>Talknafjordur .....</b>	<b>15</b>
<b>Alftafjordur .....</b>	<b>16</b>
<b>Steingrimsfjordur .....</b>	<b>17</b>

## Abstract

Here is reported the identification of the epifauna on blue mussel (*Mytilus edulis*) aquaculture lines in four areas in Westfjords, NW-Iceland. The project is managed by Náttúrustofa Vestfjarða (Vestfjords Natural History Institute) in cooperation with four blue mussel farming companies from four different areas (Vesturskel, ST2, Nýskel and Einherji), and funded by Westfjords Growth Agreement.

The four areas in Westfjords are: Steingrimsfjordur (N65°42.964-W21°38.396), Alftafjordur (N66°00.211-W22°59.884), Talknafjordur (N65°36.283-W23°47.820) and Patreksfjordur (N65°31.973-W23°47.927) (figures 1-4).

For export from new areas of blue mussel cultivation, a species inventory (SASI) for the areas has to be made. Methods for SASI are described in a report „Shellfish import monitoring and action protocol” (Gittenberger 2010). In Gittenberger (2010) it is recommended that sampling stations are distributed over a wide area and at least 10 stations are sampled. Only few lines are in these fjords in NW-Iceland except in Steingrimsfjordur. So sampling stations were fewer than recommended except in Steingrimsfjordur.

Sampling took place in the summer of 2012, in Alftafjordur on the 24<sup>th</sup> and 31<sup>st</sup> of July, in Talknafjordur and Patreksfjordur on the 31<sup>st</sup> of July and in Steingrimsfjordur on the 13<sup>th</sup> of August. Animals and algae were mainly identified in the field but samples were also taken for analyses.

Species names of animals are according to „The World Register of Marine Species (WoRMS: [www.marinespecies.org](http://www.marinespecies.org))“ and algae to the website [algaebase \(http://www.algaebase.org\)](http://www.algaebase.org). Some of the algae specimens were sent to the Marine Research Institute for identification.

The species that were found in these four areas are in table 2. Seventy one species were found in total: invertebrates (51), one vertebrate (lumpfish) and 19 algae species. The highest number of species was found in Alftafjordur but the reason for this could be that some of the lines had sunk down to the bottom and therefore more species of bristleworms were found than expected.

Only one species was found on the blue mussel and that was the bristleworm *Spirobranchus triqueter*.

## Introduction

Here is reported the indemnification of the epifauna on blue mussel (*Mytilus edulis*) aquaculture lines in four areas in Westfjords, NW-Iceland. The project is managed by Náttúrustofa Vestfjarða (Vestfjords Natural History Institute) in cooperation with four blue mussel farming companies from four different areas (Vesturskel, ST2, Nýskel and Einherji), and funded by Westfjords Growth Agreement.

## Methods

For export from new areas of blue mussel cultivation, a species inventory (SASI) for the areas has to be made. Methods for SASI are described in a report „Shellfish import monitoring and action protocol” (Gittenberger 2010). In Gittenberger (2010) it is recommended that sampling stations are distributed over a wide area and at least 10 stations are sampled. Only few lines are in these fjords in NW-Iceland except in Steingrimsfjordur. So sampling stations were fewer then recommended except in Steingrimsfjordur.

Samples were taken of mussel lines in the summer of 2012, in Alftafjordur on the 24<sup>th</sup> and 31<sup>st</sup> of July, in Talknafjordur and Patreksfjordur on the 31<sup>st</sup> of July and in Steinrimsfjordur on the 13<sup>th</sup> of August. Animals and algae that were larger than 1 mm were indentified in the field, but samples were also taken for analyses. Samples were sieved through 1 mm sieve in the laboratory. Smaller animals were indentified under a stereoscope (Leica MZ 6 and 12) but a microscope was used to indentify some of the algae specimens. Animals were kept in 70% isopropanol but algae in 2% formalin.

Species names of animals are according to „The World Register of Marine Species (WoRMS:<http://www.marinespecies.org/>) and algae to the website algaebase (<http://www.algaebase.org>). Some of the algae specimens were sent to the Marine Research Institute of Iceland for identification.

The software Primer 6 (version 6.1.15) was used to calculate a species accumulation plot with Michaelis Menton methods (max permutation 999).

## Sampling sites

Samples were taken in four fjords in Westfjords, NW Iceland (Figure 1): Patreksfjordur, Talknafjordur, Alftafjordur and Steingrimsfjordur.

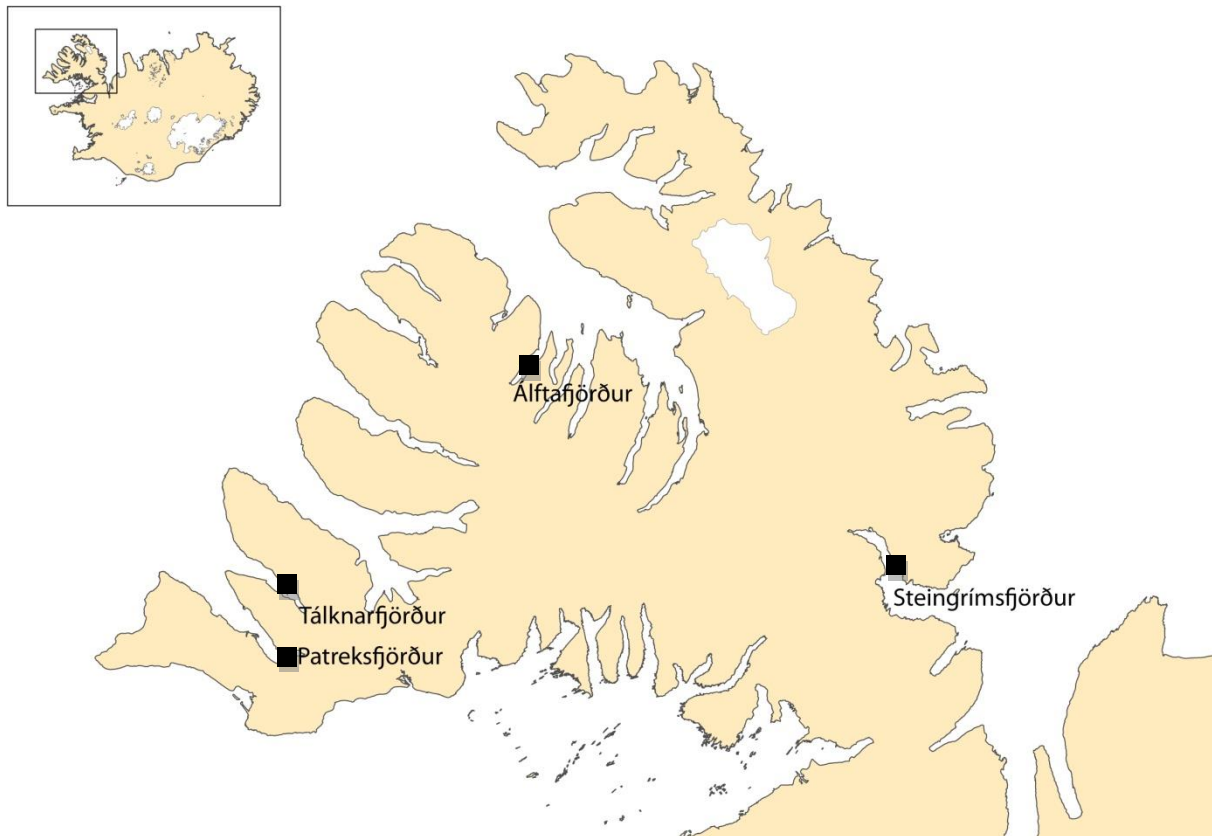


Figure 1. Sampling areas in Westfjords (NW-Iceland).

At the end of Patreksfjordur (figure 2) is one blue mussel line (200 m). On the line are “Godeep” socks. The line has both 1-yr and 2-yr old mussels. In Tálknafjordur (figure 2) are five lines and they have cotton nets (socks). Sampling took place in both of these fjords on 31<sup>st</sup> of July 2012.

In Alftafjordur (figure 3) two lines were sampled. On these lines were 1-4 yr old mussels. Most of these had “Godeep” socks. Sampling took place on the 24<sup>th</sup> of July 2012.

In Steingrímsfjordur (figure 4) sampling was done in 10 stations. Most common were 2-3 yr old mussels on these lines. On the lines were cotton nets (socks). Sampling took place on the 12<sup>th</sup> of August 2012.



Figure 2. Sampling areas (red squares) in Tálknafjörður and Patreksfjörður.



Figure 3. Sampling area (red square) in Alftafjörður.





Figure 4. Sampling area (red square) in Steingrímsfjörður.

In table 1 are location of sampling stations and depth.

Table 1. Locations of sampling stations and depth.

Station	Coordination	Depth m
<b>Patreksfjörður</b>		
A	N65°31.973 W23°47.927	15
B	N65°31.974 W23°47.893	15
C	N65°31.966 W23°47.946	15
D	N65°31.957 W23°47.970	15
E	N65°31.968 W23°47.876	15
F	N65°31.944 W23°48.031	15
G	N65°31.968 W23°47.876	15
<b>Talknafjörður</b>		
A	N65°36.283 W23°47.820	30
B	N65°36.556 W23°48.401	30
C	N65°36.627 W23°48.671	30
<b>Alftafjörður</b>		
A	N66°00.211 W22°59.884	35
AB	N66°00.206 W22°59.904	35
B	N66°00.189 W22°59.942	35

<b>C</b>	N66°00.177 W22°59.976	35
<b>CD</b>	N66°00.171 W22°59.996	35
<b>D</b>	N66°00.161 W23°00.032	35
<b>F</b>	N66°00.174 W22°59.990	35
<b>E</b>	N66°00.058 W23°00.268	35
<b>E1</b>	N66°00.029 W23°00.343	35
<b>Steingrimsfjordur</b>		
<b>A</b>	N65 42.964 W21 38.396	38
<b>B</b>	N65 42.928 W21 38.386	38
<b>C</b>	N65 42.864 W21 38.339	38
<b>D</b>	N65 42.748 W21 38.281	30
<b>E</b>	N65 42.691 W21 38.197	30
<b>F</b>	N65 42.666 W21 38.173	30
<b>G</b>	N65 42.106 W21 36.806	28
<b>H</b>	N65 42.104 W21 36.793	28
<b>I</b>	N65 42.082 W21 36.779	28
<b>J</b>	N65 42.047 W21 36.699	28

## Results

In total 71 species or higher taxa were found in the mussel cultivations in Westfjords, NW Iceland. Invertebrate species or groups were 51, one fish and 19 species of algae.

In table 2 is a list of species for each area.

Table 2. Species that were found on lines in Patreksfjordur (P), Talknafjordur (T), Alftafjordur (Á) and Steingrimsfjordur (S). x = present, (x) = species identification not confirmed (algae species).

Phylum	Species (latin)	English	P	T	Á	S
<b>Porifera</b>		<b>Sponges</b>				
	<i>Grantia cf compressa</i>				x	x
<b>Bryozoa</b>		<b>Moss animals</b>				
<b>Cnidaria</b>						
	<b>Hydrozoa</b>					
	<i>Obelia longissima</i>		x	x	x	x
	<b>Anthozoa</b>	<b>Sea anemone</b>				
	<i>Cf Actinia equina</i>		x		x	x
	<i>Cf Bolocera tuediae</i>					x
<b>Nematoda</b>		<b>Roundworms</b>		x	x	x
<b>Nemertea</b>		<b>Ribben worms</b>		x	x	
<b>Mollusca</b>						
	<b>Bivalvia</b>	<b>Bivalves</b>				



Phylum	Species (latin)	English	P	T	Á	S
	<i>Mytilus edulis</i>		x	x	x	x
	<i>Hiatella arctica</i>		x	x	x	x
	<i>Heteranomia squamula</i>		x	x	x	x
<b>Gastropoda</b>		<b>Snails</b>				
	<i>Buccinum undatum</i>				x	
	<i>Lacuna vincta</i>		x	x		x
		<b>Nudibranchia</b>				
	<i>Dendronotus frondosus</i>		x		x	x
	<i>Cuthona perca cf</i>				x	
	<i>Cf Tenellia adpersa</i>				x	x
	<i>Cf Eubranchus pallidus</i>				x	x
	<i>Cf Doto tuberculata</i>				x	
	<i>Doris pseudoargus</i>				x	
	<i>Onchidoris bilamellata</i>				x	
<b>Platyhelminthes</b>		<b>Flatworms</b>				
	Turbellaria		x		x	x
<b>Annelida</b>		<b>Segmented worms</b>				
	Oligochaeta	<b>Oligochates</b>			x	
	Polychaeta	<b>Bristle worms</b>				
	<i>Capitella capitata</i>					x
	<i>Amphitrite cirrata</i>					x
	<i>Euchone sp.</i>				x	
	<i>Eupolyornia nesidensis</i>				x	x
	<i>Harmothoe imbricata</i>		x	x	x	x
	<i>Harmothoe rarispina</i>		x		x	x
	<i>Kefersteinia cirrata</i>					x
	<i>Laetmonice filicornis</i>					x
	<i>Laphania boeckii</i>		x			x
	<i>Nereis pelagica</i>		x	x	x	x
	<i>Nereimyra punctata</i>					x
	<i>Phyllodoce maculata</i>			x		
	<i>Pholoe minuta</i>			x		
	<i>Proceratea prismatica</i>				x	
	<i>Scoloplos armiger</i>					x
	<i>Spirobranchus triqueter</i> <sup>1</sup>		x	x	x	x
<b>Arthropoda</b>						
	Amphipoda	<b>Amphipodes</b>				
	<i>Gammarellus homari</i>					x
	<i>Corophium bonelli</i>			x	x	x
	<i>Caprella septentrionalis</i>					x
	<i>Gammarus oceanicus</i>		x	x		
	<i>Ischyrocerus anguipes</i>			x		x
	Decapoda	<b>Crabs</b>				
	<i>Eualus pusiolus</i>			x	x	x
	<i>Hyas coarctatus</i>					x

Phylum	Species (latin)	English	P	T	Á	S
	<i>Hyas araneus</i>				x	x
	Maxillopoda					
	<i>Semibalanus balanoides</i>		x	x	x	x
	<i>Balanus balanus</i>					x
	<i>Balanus crenatus</i>				x	x
	Copepoda	<b>Copepods</b>		x		x
	Insecta	<b>Insects</b>				
	<i>Cricotopus</i> sp.			x		x
<b>Echinodermata</b>						
	<b>Asteroidea</b>	<b>Star fish</b>				
	<i>Asterias rubens</i>		x		x	x
	<b>Holothuroidea</b>	<b>Sea urchins</b>				
	<i>Cucumaria frondosa</i>				x	x
<b>Chordata</b>						
	Actinopterygii					
	<i>Cyclopterus lumpus</i>	Lumpfish		x		
<b>Chlorophyta</b>		<b>Green algae</b>				
	<i>Acrosiphonia arcta</i>		x <sup>kg</sup>	x <sup>kg</sup>		(x)
	<i>Acrosiphonia sonderi</i>			x <sup>kg</sup>		
	<i>Ulva (Enteromorpha) flexuosa</i>				x <sup>kg</sup>	(x)
	<i>Chlorochytrium willei</i> <sup>1</sup>				x <sup>kg</sup>	
	<i>Cladophora cf. glomerata</i>				x <sup>kg</sup>	
	<i>Percursaria percursa</i> <sup>2</sup>				x <sup>kg</sup>	
<b>Ochrophyta</b>		<b>Brown algae</b>				
	<i>Chorda filum</i>					x <sup>kg</sup>
	<i>Chordaria flagelliformis</i>		x <sup>kg</sup>	x <sup>kg</sup>		
	<i>Dictyosiphon foeniculaceus</i>			x <sup>kg</sup>	x <sup>kg</sup>	
	<i>Ectocarpus fasciculatus</i>		x <sup>kg</sup>			x <sup>kg</sup>
	<i>Ectocarpus siliculosus</i>		x <sup>kg</sup>	x <sup>kg</sup>	(x)	
	<i>Ectocarpus</i> sp.			x <sup>kg</sup>		x <sup>kg</sup>
	<i>Pylaiella littoralis</i>			x <sup>kg</sup>		
	<i>Pylaiella varia</i>			x <sup>kg</sup>	x <sup>kg</sup>	
	<i>Pylaiella</i> sp.		x <sup>kg</sup>			
	<i>Alaria esculenta</i>		x		x	
	<i>Laminaria saccharina</i>		x	x		x
<b>Rhodophyta</b>		<b>Red algae</b>				
	<i>Rhodomela lycopodioides</i>			x <sup>kg</sup>	(x)	
	<i>Polysiphonia stricta</i>		x <sup>kg</sup>			
	<i>Acrochaetium cf. microscopicum</i> <sup>3</sup>				x <sup>kg</sup>	
	<i>Palmaria palmata</i>		x	x	x	
	<i>Ptilota gunneri</i>		x			
<b>Fjöldi tegunda/ total number of species</b>			<b>26</b>	<b>29</b>	<b>41</b>	<b>45</b>

<sup>1</sup> *S. triqueter* Synonymis *Pomatoceros triqueter*<sup>2</sup> Green algae on *U. flexuosa*.<sup>3</sup> Red algae on *C. cf. glomerata*.

<sup>kg</sup> = Karl Gunnarsson from Marine Research Institute indentified the species.

Many species or higher taxa are smaller than 1 mm and should have gone through the sieve but have probably been tangled in algae. These are for example Nematodes, *Capitella capitata*, Copepods, etc.

### *Accumulation plot*

In Figure 5-7 accumulation graphs are presented (Michaelis Menton method) for Steingrimsfjordur, Talknafjordur and Patreksfjordur together, Alftafjordur and then for all the sites.

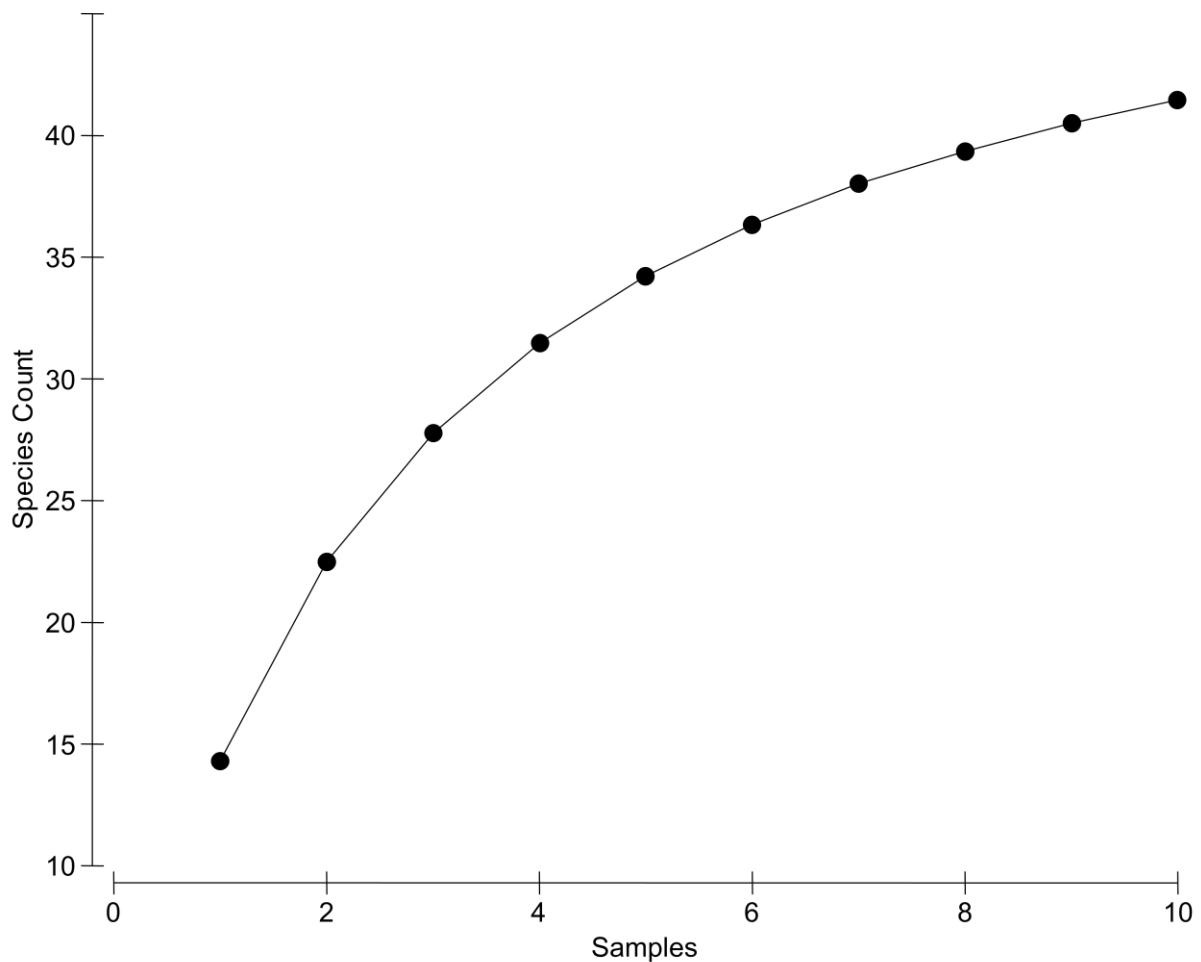


Figure 5. Accumulation graph for Steingrimsfjordur.

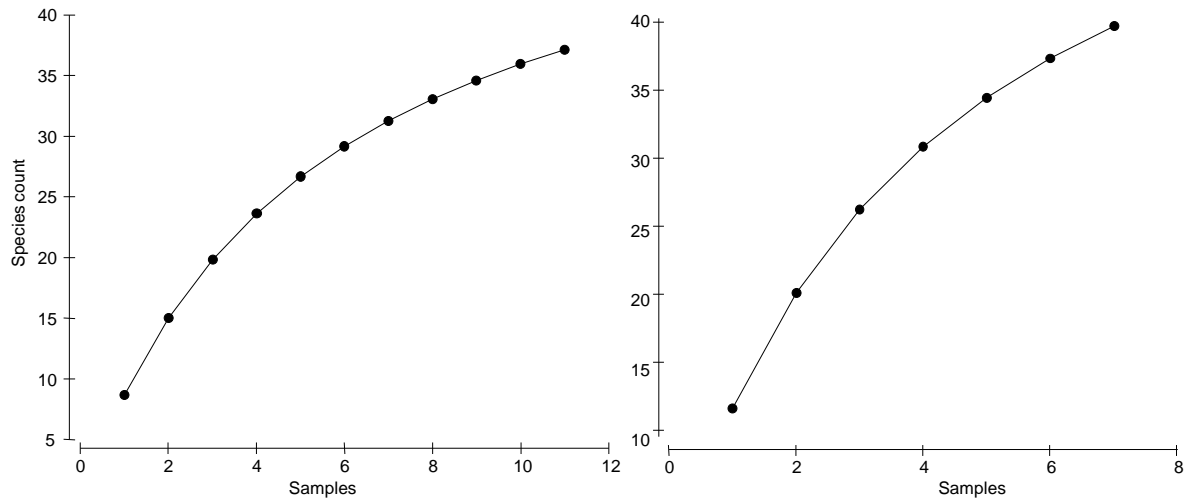


Figure 6. Accumulation graph for: a) Talknafjörður and Patreksfjörður together, b) Alftafjörður.

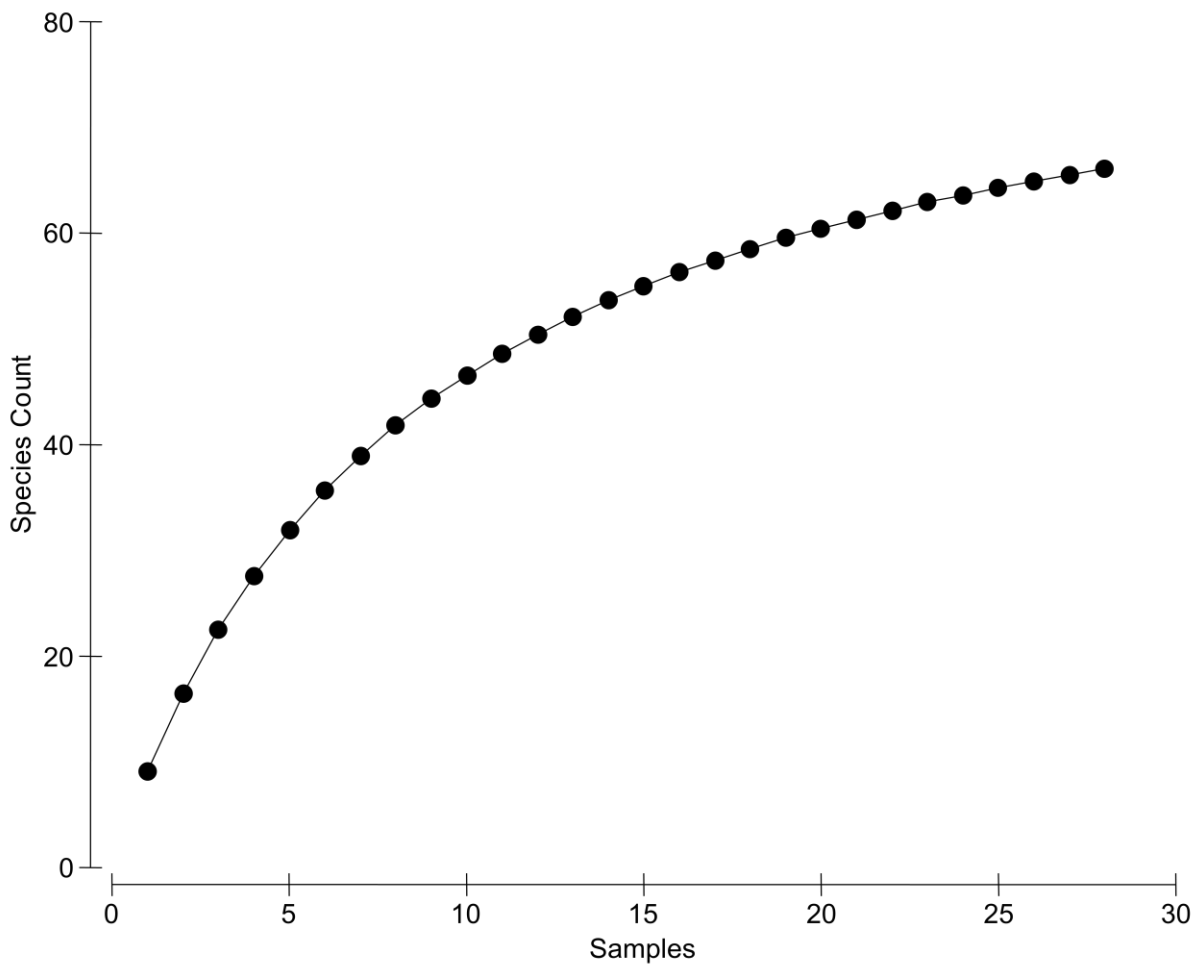


Figure 7. Accumulation graph for the four sites combined.

## Discussion

In Patreksfjordur, Talknafjordur and Alftafjordur are only a few blue mussel lines so it is difficult to sample over a wide area at every site and get 10 samples or more as is recommended in SASI (Gittenberger 2010, Gittenberger *et al.* 2010). There were also a few problems on the location as some lines had sunk and in others the mussels had released themselves from the lines. In total 28 samples were taken and 71 species or higher taxa were identified. The invertebrates (51) that were found have been recorded in surveys of benthic and/or in shores of Westfjords, NW Iceland (Eiríksson *et al.* 2012).

Only one species was found on the blue mussel shells and that was the bristleworm *Spirobranchus triqueter*.

## An acknowledgement

The Blue mussel companies assisted in the fieldwork. Guðrún Steingrímisdóttir at Westfjords Natural History Institute helped in the laboratory.

Karl Gunnarsson from Marine research institute identified many of the algae specimens and Guðmundur V. Helgason from University of Iceland (Institute of Life and Environmental Sciences) identified some of bristleworms specimens.

## References

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**Appendix: Pictures (5-9) from the fieldwork.**

**Patreksfjordur**



Figure 5. Mussel line with mass of algae in Patreksfjordur.



## Talknafjordur



Figure 6. Line in Talknafjordur.

## Alftafjordur



Figure 7. Mussel lines in Alftafjordur.

## Steingrimsfjordur



Figure 8. Mussel lines in Steingrimsfjordur. The boat Sigurey.





Figure 9. Biofouling on buoy: Hydrozoa (*Obelia longissima*), Keelworm (*Spirobranchus triqueter*) and barnacles (probably *Balanus balanus* and *Balanus crenatus*).