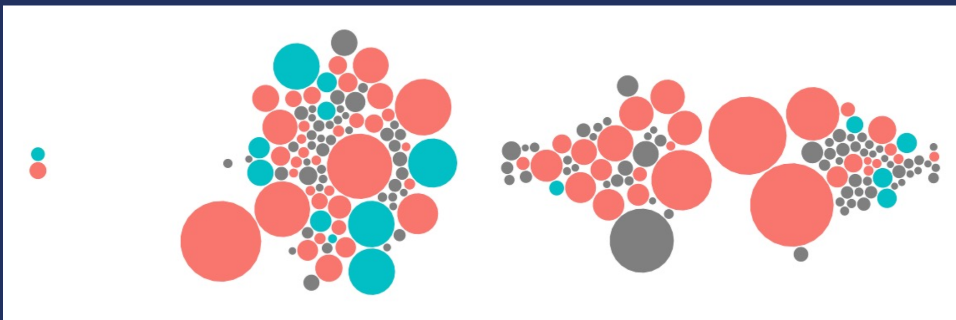

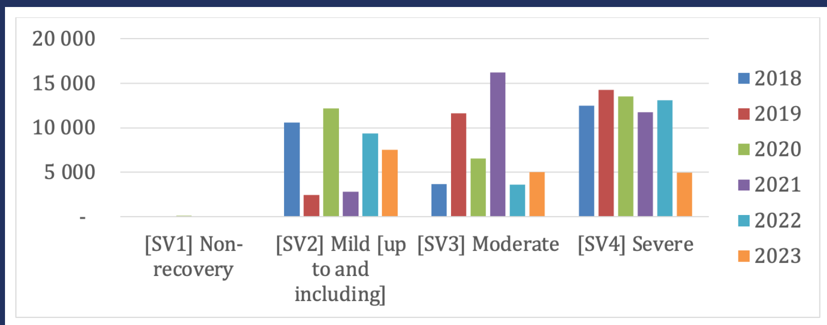

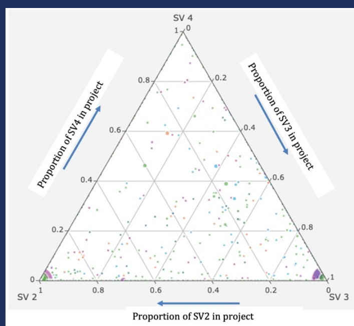

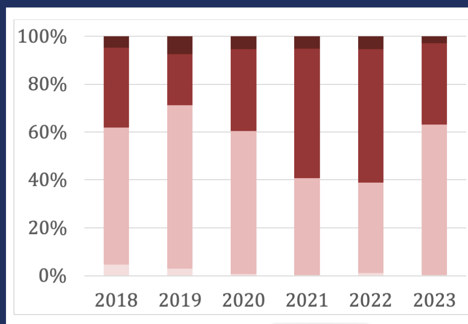

Research animal use in Norway from 2018 to 2023:
A presentation of the official statistics, with emphasis on large studies

Antoine Champetier, Adrian Smith & Stéphanie Vuille

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13 March 2025

Research animal use in Norway from 2018 to 2023:

A presentation of the official statistics

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More information is available at **https://norecopa.no/statistics**

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Champetier A. & Smith A. (2023): *Research animal use in Norway from 2018 to 2021: A preliminary report with emphasis on severity and purpose*.
26 pages. ISBN: 978-82-693192-0-0.

Table of Contents

1. Sammendrag

Denne rapporten samler de offisielle tallene fra Mattilsynet for bruken av dyr til vitenskapelige formål i årene 2018-2023.

Integrering og presentasjon av tallene ble foretatt av Antoine Champetier ved Swiss 3R Competence Centre (3RCC)[3], i samarbeid med uavhengig forsker Stéphanie Vuille som analyserte legsammendragene (Non-Technical Summaries) av forsøkene som brukte 20.000 dyr eller mer.

Hovedfunnene var:

- I gjennomsnitt brukte Norge 1,5 millioner dyr i året i denne perioden (1.281.595 – 2.008.625), i totalt 3.104 forsøk.

- Det er ingen konsistente trender over de seks årene for det totale antallet dyr brukt i Norge, eller for den relative forekomsten av de fire belastnings-kategoriene.

- Enkelte store forsøk på fisk er hovedfaktoren som påvirker den nasjonale statistikken, noe som gjør det vanskelig å identifisere reelle trender. Disse variasjonene fra år til år på flere hundre tusen prosedyrer ble drevet av tidspunktet for forsøkene, og var oftest knyttet til Atlantisk laks og dens kommersielle produksjon, spesielt i forhold til håndtering av lus.

- Halvparten av prosedyrene i de 6 årene fant sted i de største forsøkene (som inneholdt 100.000 prosedyrer eller mer, og som utgjorde 0,6% av totalantallet forsøk). Derimot utgjorde forsøk med under tusen prosedyrer i hver 79 % av forsøkene i perioden – det var 2.459 slike forsøk.

- Det var store variasjoner fra år til år i belastningsgrad. Også disse ble drevet av svært store forsøk med laks og annen fisk. For laboratoriearter hadde belastningsgraden en tendens til å være høyere for sebrafisk enn for mus, og disse to artene er de mest brukte laboratorieartene i Norge.

- Antallet mus som ble brukt til akuttforsøk (terminale forsøk) viste en jevn nedgang i perioden. Mattilsynet opplyser at dette er et resultat av korrigeringer de har gjort, på grunn av feilrapportering.

- Antallet mus som ble brukt til de mest alvorlige prosedyrene er lite, mens antallet mus som ble brukt til prosedyrer definert som mild og moderat belastende varierte, med en tendens de siste tre årene i retning kategorien mild.

- Rapporten beskriver også inndelingen i de 8 hovedkategoriene som er definert av EU-kommisjonen. Den største kategorien som ble brukt var «Translational and Applied Research", som utgjorde ca. 600.000 – 1,4 millioner dyr årlig. To kategorier viste en jevn økning i det totale antallet dyr som ble brukt i perioden: "Preservation of species" (fra 9.497 til 430.620 dyr), og "Maintenance of GM colonies" (fra 4.186 til 17.185 dyr). Kategorien «Basic Research» gikk ned fra 859.179 til 111.628 dyr i perioden. Mattilsynet opplyser at dette hovedsakelig skylds korreksjon av feilrapportering. Når det gjelder belastningen, har store forsøk som involverer laks og annen fisk stor innflytelse på tallene. De relative andelene i disse kategoriene har imidlertid vært svært lik de siste tre årene, dominert av Translational and Applied Research (61-69 %) og Preservation of species (23-27 %).

- Batchtesting og andre regulativ- og kvalitetskontrollprosedyrer er blant bruksområdene hvor belastningsgraden er høyest for fisk. Statistikken for 2021 og de to påfølgende årene viser tegn til en nedgang i absolutte tall, men ikke til en generell nedgang i belastningsgrad.

- De aller fleste (96 %) av de 9 millioner dyrene som ble brukt i Norge i perioden var ikke genetisk endret på noen måte. Totalt 332.949 dyr ble genetisk endret uten en skadelig fenotype, mens 54.207 dyr viste en skadelig fenotype. Mus, sebrafisk og Atlantisk laks (i den rekkefølgen) dominerte statistikken for genetisk endrede dyr.

- Det er svært begrenset gjenbruk av forsøksdyr i Norge, i tråd med intensjonene som er uttrykt i EU-direktivet og norsk lovgivning.

- En innledende analyse ("text mining") ble utført på legsammendragene (Non-Technical Summaries) av alle de største forsøkene i perioden (definert som de som involverte minst 20.000 dyr). Dette ble gjort ved å analysere et sett med emneord som brukes i mange av forsøkene i Norge, med språkprogrammet ChatGPT 3.5. Ulike måter å uttrykke funnene på ble testet. ChatGPT 3.5 viste seg å være av begrenset verdi i denne sammenhengen.

- Det er laget en samlefil i Excel av alle tallene fra Mattilsynet for de 6 årene omtalt i denne rapporten. De fleste tabellene og figurene er laget fra den filen. Mattilsynet vil få tilsendt filen, som kan oppdateres med fremtidige års data.

- Arbeidet med å studere bruken av dyr til vitenskapelige formål i Norge bør fortsette, i nært samarbeid med brukerne, for å høste større innsikt i mulighetene for å fremme «de 3 R-ene» (Replacement, Reduction, Refinement).

2. Summary

This report collects and summarises the official data from the Norwegian Food Safety Authority (Mattilsynet) for the use of animals for scientific purposes for the years 2018-2023.

Integration and presentation of the data was performed by Antoine Champetier of the Swiss 3R Competence Centre (3RCC)[3], in collaboration with independent researcher Stéphanie Vuille who performed an analysis of the Non-Technical Summaries of projects using 20,000 animals or more.

The main findings are:

- On average, Norway used 1.5 million animals per year in this period (range 1 281 595 – 2 008 625), for a total of 3 104 projects.
- There are no consistent trends over the six years for the total number of animals used in Norway, or for the relative occurrence of the four categories of severity.
- Single large projects on fish continue to be the main factor affecting the national statistics, making it difficult to identify real trends. These year-to-year variations of several hundreds of thousands of procedures were driven by the timing of the projects, and were most often related to Atlantic Salmon and its commercial production, especially in relation to the management of lice.
- Half of the procedures in the 6 years of data took place in the largest projects (which included 100 000 procedures or more, and which comprised 0.6% of all the projects in the period). In contrast, 2 459 projects with less than a thousand procedures accounted for 79% of all the projects in the period.
- There were large year-to-year variations in the severity of procedures. These too were driven by very large projects involving salmon and other fish. For laboratory species, the severity of procedures tended on average to be higher for zebra fish than for mice, these two species being the main laboratory species in Norway.
- The number of mice used for non-recovery (terminal) experiments decreased during the period. The Norwegian Food Safety Authority states that this is the result of corrections they have made, due to errors in reporting.
- The number of mice used for the most severe procedures is small, while the numbers of those used for mild and moderately severe procedures fluctuated, with a tendency during the last three years towards the mild category.
- The report also describes the division of animal use between the 8 main categories of use defined by the EU Commission. The largest category used was "Translational/Applied research, which accounted for approx. 600 000 – 1.4 million animals yearly. Two categories showed a steady increase in the total number of animals used: "Preservation of species" (from 9 497 to 430 620 animals), and the "Maintenance of GM colonies" (from 4 186 to 17 185 animals). The category "Basic research" declined from 859 179 to 111 628 animals during

the period. The Norwegian Food Safety Authority reports that this is primarily due to correction of errors in reporting. As for severity patterns, large projects involving salmon and other fish exert a large influence on these figures. The relative proportions of animal use in these categories have, however, been very similar during the last three years, dominated by Translational/Applied Research (61-69%) and Preservation of Species (23-27%).

- Batch testing and other regulatory and quality control procedures are among the uses where severity is highest for fish. The statistics for 2021 and the following two years show signs of a decline in absolute numbers, but not of a general decline in severity.
- The vast majority (96%) of the 9 million animals used in Norway in this period were not genetically altered in any way. A total of 332 949 animals were genetically altered without a harmful phenotype, while 54 207 animals exhibited a harmful phenotype. Mice, zebra fish and Atlantic salmon (in that order) dominated the statistics for genetically altered animals.
- There is very limited reuse of research animals in Norway, in keeping with the conditions expressed in both EU and Norwegian legislation.
- An initial text mining analysis was performed on the Non-Technical Summaries (NTS) of all the largest projects in the period (defined as those involving at least 20,000 animals). This was carried out by analysing keywords that are used in many of the large projects in Norway, and by using the Large Language Model ChatGPT 3.5. Various ways of expressing the data achieved by these analyses were tested. ChatGPT 3.5 proved to be of limited reliability.
- An Excel file was compiled of all the official statistics for the six years covered by this report. Most of the Tables and Figures in this report are generated from that file. The file will be submitted to the Norwegian Food Safety Authority for their use, and which may be updated with future years' data.
- The work of studying the use of animals in Norway for scientific purposes should continue, in close collaboration with the scientists, to gain more insight into possibilities for further implementation of the Three Rs (Replacement, Reduction, Refinement).

3. Introduction

Information about the use of animals for research purposes in Norway is relatively sparse. Norecopa has collected the annual reports from the Norwegian Animal Research Authority (*Forsøksdyrutvalget*) which had responsibility for this until 1 July 2015, and from the Norwegian Food Safety Authority (*Mattilsynet*) which took over the regulatory function from that date[1]. This report concerns the period 2018-2023.

Currently, annual reports from the Norwegian Food Safety Authority consist of a table depicting the numbers of animals used, with some graphics and 1-2 pages of text.

The three figures in the Authority's report for the most recent year available (2023) that depict animal numbers are depicted below (Figure 1):

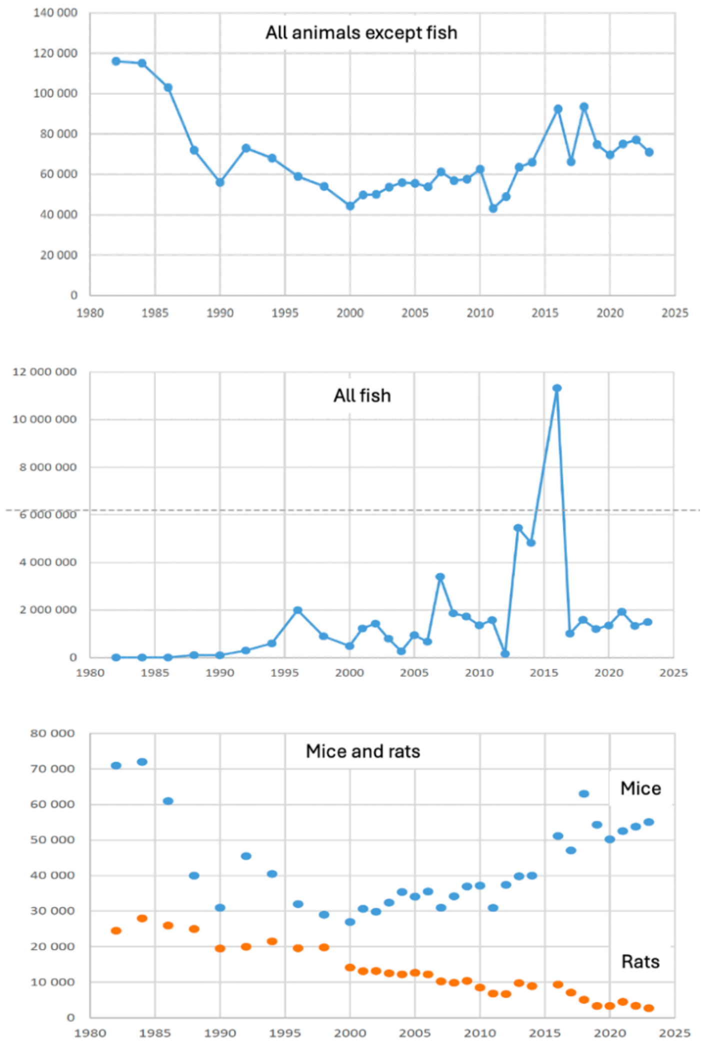


Figure 1: The use of research animals in Norway (figures from the Norwegian Food Safety Authority's report for 2023)[2]

[1] https://norecopa.no/legislation/statistics

[2] https://mattilsynet-xp7prod.enonic.cloud/_/attachment/inline/def3bff7-05c8-45b6-8ba1-34b961a41aa4:500ee9faf7e1f52a696792207d7564c2230fd5e1/Bruk%20av%20dyr%20i%20forsøk%20i%202023.pdf

The apparent long-term trends in Figure 1 (and later in this report) must be treated with caution, for several reasons:

- Changes in the definition of what constitutes a scientific procedure, following Norway's implementation of EU Directive 2010/63/EU in 2015.
- The effects of single large projects in recent years, particularly those using farmed salmon and wild fish.
- The growth of the fish farming industry, with its special needs for medicines, vaccines, new technology for fish husbandry and research into fish welfare in general. These needs may vary considerably from year to year, and they may also be related to projects abroad (e.g. vaccine needs).
- Doubts about the accuracy of reporting. This can have affected, in particular, allocation of scientific purpose and severity category when reporting animal research.

This report covers a period after implementation of the EU Directive, but it is still beyond the report's scope to discuss the underlying reasons for the apparent trends observed when the data from the 6 years were collated. The effects of other possible factors than the ones mentioned above, such as changes in animal use due to the COVID-19 pandemic, variations in the general level of preclinical research activity in Norway, and the implementation of alternative methods to animal use, are also currently unknown.

One noticeable feature of Figure 1 which can be mentioned is the spike in numbers in 2016. In that year, over 11.6 million animals were reported used in Norway for scientific purposes. Over 10.6 million of these were in just two field studies, on methods to combat salmon lice[3].

This report describes the official statistics for the years 2018-2023, when the number of animals used ranged from 1.28 million to 2.01 million.

While 2021 was the year with the largest number of animals, there is no clear trend over these six years. Single projects, particularly those on Atlantic salmon, continue to have the most effect on total numbers and tend to mask any possible trends.

The numbers in this report are the statistics provided to us by the Norwegian Food Safety Authority. We have collated them in one Excel file containing all the data for 2018-2023, which will be offered to the Authority for their own use, and to enable the addition of future years' data.

3 https://www.mattilsynet.no/dyr_og_dyrehold/dyrevelferd/forsoksdyr/bruk_av_dyr_i_forsok_2016.28918/binary/Bruk%20av%20dyr%20i%20forsøk%202016

These data can be summarised as follows (Figures 2-4):

	2 018	%	2 019	%	2 020	%	2 021	%	2 022	%	2 023	%	Total	Average
Fish *(other than Zebra fish)*	1 554 973	92.2	1 165 641	91.0	1 313 565	92.4	1 903 937	94.8	1 312 835	92.8	1 470 451	93.0	8 721 402	**92.7**
Zebra fish	38 218	2.3	41 148	3.2	38 867	2.7	29 574	1.5	24 813	1.8	38 985	2.5	211 605	**2.3**
Birds	14 853	0.9	12 754	1.0	12 733	0.9	13 859	0.7	14 943	1.1	10 202	0.6	79 344	**0.9**
Mice	63 058	3.7	54 350	4.2	50 222	3.5	52 554	2.6	53 817	3.8	55 187	3.5	329 188	**3.6**
Rats	5 106	0.3	3 324	0.3	3 355	0.2	4 498	0.2	3 397	0.2	2 740	0.2	22 420	**0.2**
All other species	10 441	0.6	4 378	0.3	3 299	0.2	4 203	0.2	4 932	0.3	3 520	0.2	30 773	**0.3**
Total	**1 686 649**		**1 281 595**		**1 422 041**		**2 008 625**		**1 414 737**		**1 581 085**		**9 394 732**	**1 565 788**

Figure 2: Animals used for scientific purposes in Norway from 2018 to 2023 (data from the Norwegian Food Safety Authority)

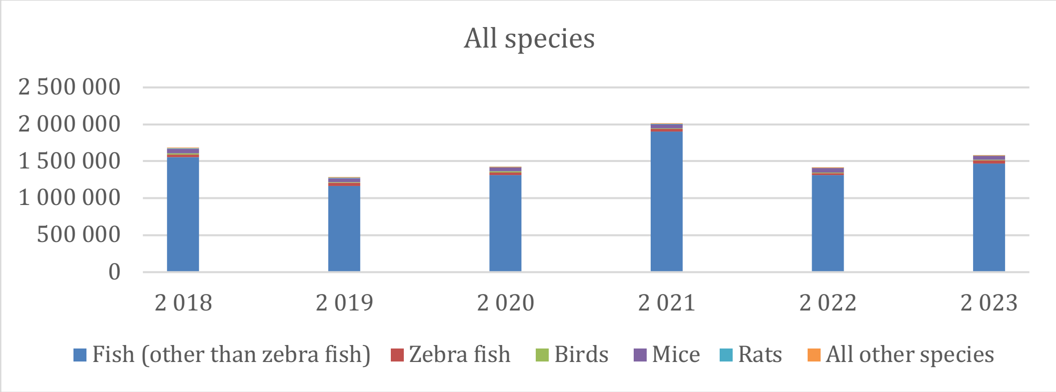
If all fish other than zebra fish are excluded from this table, the data are as follows:

excluding other fish	2018	%	2019	%	2020	%	2021	%	2022	%	2023	%	Total	Average
Zebra fish	38 218	29.0	41 148	35.5	38 867	35.8	29 574	28.2	24 813	24.3	38 985	35.2	**211 605**	**31.4**
Birds	14 853	11.3	12 754	11.0	12 733	11.7	13 859	13.2	14 943	14.7	10 202	9.2	**79 344**	**11.9**
Mice	63 058	47.9	54 350	46.9	50 222	46.3	52 554	50.2	53 817	52.8	55 187	49.9	**329 188**	**49.0**
Rats	5 106	3.9	3 324	2.9	3 355	3.1	4 498	4.3	3 397	3.3	2 740	2.5	**22 420**	**3.3**
All other species	10 441	7.9	4 378	3.8	3 299	3.0	4 203	4.0	4 932	4.8	3 520	3.2	**30 773**	**4.5**
Total	**131 676**		**115 954**		**108 476**		**104 688**		**101 902**		**110 634**		**673 330**	**112 222**

Figure 3: Animals, excluding all fish except zebra fish, used for scientific purposes in Norway from 2018 to 2023 (data from the Norwegian Food Safety Authority)

As can be seen from Figure 3, mice comprise around 50% of the approx. 110 000 animals used when all fish (except zebra fish) are excluded from the statistics. Zebra fish comprise the second largest group (approx. 30%).

The data are summarised graphically in Figure 4.



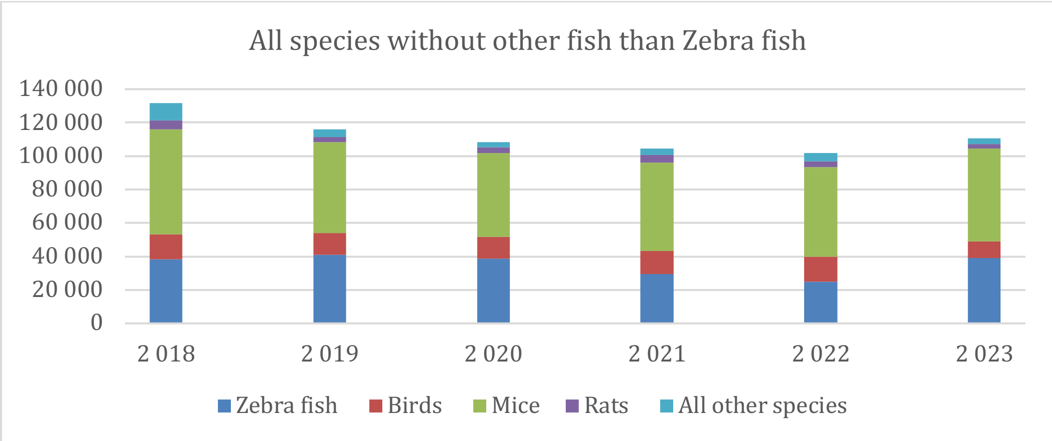


Figure 4: Animals used for scientific purposes in Norway from 2018 to 2023 (data from the Norwegian Food Safety Authority)

Terminology

In this report, we have as far as possible used terminology that is defined in the EU Directive 2010/63/EU[4].

Article 3 of the Directive defines a **Project** as 'a programme of work having a defined scientific objective and involving one or more **procedures**'.

The same Article defines a **Procedure** as 'any **use**, invasive or non-invasive, of an animal for experimental or other scientific **purposes**, with known or unknown outcome, or educational **purposes**, which may cause the animal a level of pain, suffering, distress or lasting harm equivalent to, or higher than, that caused by the introduction of a needle in accordance with good veterinary practice'. In this report, we use **procedure** and **use** interchangeably.

In addition, the **actual severity** experienced by animals in procedures is reported retrospectively, using four categories defined in Article 15 and Annex VIII (see Table 1 in this report). The severity which animals experience within one and the same procedure can vary from animal to animal, and is therefore reported separately.

[4] https://norecopa.no/legislation/eu-directive-201063

Many projects comprise multiple species and categories of severity. Each of these are given separate entries in the Excel file which we have compiled, and in the statistics sent to the EU Commission.

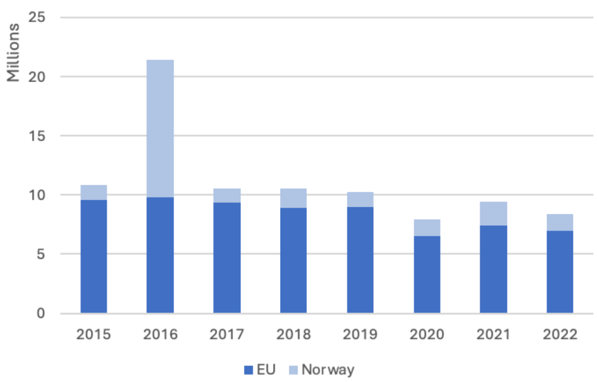
We have used the term "zebra fish" (rather than "zebrafish") in this report, in keeping with Directive 2010/63/EU.

4. Norwegian statistics compared to the EU

The use of animals for research, testing and education is regulated by EU Directive 2010/63/EU[8], which Norway has implemented, and by national legislation.

The EU maintains the ALURES Statistical EU Database[5], which is compiled from data collected by the Member States and submitted to the European Commission. Section 1 of ALURES gives the number of animals used for the first time for experimental purposes, while Section 2 gives the number of all uses, their severity and the animals' genetic status. Section 3 reports the number of animals use for the creation and maintenance of genetically altered colonies.

Norway currently uses a number of animals corresponding to approximately one fifth of the total number used in the EU (range 12-118% in the period 2015-2022), see Figure 5.
Norwegian data have been included in the official EU statistics since the report for 2018. EU Commission reports[6] are currently available up to and including the year 2022. Figures from 2020 and onwards do not include the UK, following their withdrawal from the EU in January that year. Both Norway's inclusion, and the UK's withdrawal, have had large effects on the European statistics. See also Appendix A2.



	Norway	EU	%
2015	1 230 832	9 590 379	12.8
2016	11 606 168	9 817 946	118.2
2017	1 159 667	9 388 162	12.4
2018	1 686 649	8 885 656	19.0
2019	1 281 595	8 979 227	14.3
2020	1 422 041	6 516 023	21.8
2021	2 008 625	7 397 608	27.2
2022	1 414 737	6 970 660	20.3

Figure 5: Total number of animals used in Norway (light blue) compared to the EU (dark blue) from 2015 to 2022
From 2020, the EU consists of 27 countries, due to the withdrawal of the UK that year[7].

[5] https://webgate.ec.europa.eu/envdataportal/content/alures/section1_number-of-animals.html#
[6] https://environment.ec.europa.eu/topics/chemicals/animals-science_en#implementation
[7] https://webgate.ec.europa.eu/envdataportal/content/alures/section1_number-of-animals.html

Caution must be taken with infographics that compare countries and regions. Some display the number of *experimental procedures* (uses) conducted in a given year, while others focus on the number of animals. See for example Appendix 2. One animal may undergo several procedures within the same application, and animals may be reused (for one or more procedures) – although in Norway the number of reused animals is low.
In addition, the use of animals to create and maintain genetically altered colonies may be reported separately, as they are in the ALURES database, where the animals in Section 3 are not included in Sections 1 & 2.

5. Severity of uses

Directive 2010/63/EU defines four categories of severity (see Appendix A1 for more details):

SV1: Non-recovery *(terminale forsøk)*

SV2: (up to and including) Mild *(t.o.m. lett belastende forsøk)*

SV3: Moderate *(moderat belastende forsøk)*

SV4: Severe *(betydelig belastende forsøk)*

For the sake of simplicity, they are often referred to as SV1-SV4 in this report.

All procedures in a project application must be prospectively assigned a severity category, based on the highest severity likely to be experienced by an animal undergoing that procedure, after considering all elements that may increase or reduce the severity, in line with Annex VIII of the Directive[8].

In contrast, the severities reported in the statistics are retrospective, based on actual experienced severities as recorded during monitoring of the individual animals during the procedure. This means that a project which was initially assigned one severity category may end up in a report as two (or more) entries with different severities.

The following tables and figures present retrospective Norwegian data for 2018-2023.

a. All species

Table 1 shows the number of uses by severity degree, for all species together. The total number of uses shows no consistent trend over the six years with an average of 1.57 million uses per year. The year 2021 is considerably higher than average, reflecting the impact of the timing of projects involving very large numbers of fish. very large projects on fish.

[8] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0063#d1e32-76-1

Table 1: Number of uses by severity per year (all species)

Severity	2018	2019	2020	2021	2022	2023
[SV1]	79 855	38 232	8 992	5 142	16 262	3 659
[SV2]	962 928	873 629	849 358	814 514	532 232	995 782
[SV3]	562 178	274 838	486 963	1 083 420	791 053	535 360
[SV4]	81 688	94 896	76 728	105 549	75 190	46 284
Total	**1 686 649**	**1 281 595**	**1 422 041**	**2 008 625**	**1 414 737**	**1 581 085**

SV1: Non-recovery
SV2: Up to and including Mild
SV3: Moderate
SV4: Severe

Figure 6 and Table 2 show the relative occurrence of the four categories of severity degrees across the six years of data for all species. The apparent tendency in the period 2019 to 2022 for the proportion of moderately severe procedures (SV3) to increase has now been reversed in 2023. The relative occurrence of the highest severity degree (SV4) decreased from 2019 to 2023, but this trend does not reflect the absolute number of animals in this category - the largest number of animals in SV4 was in 2021 (see Table 1).

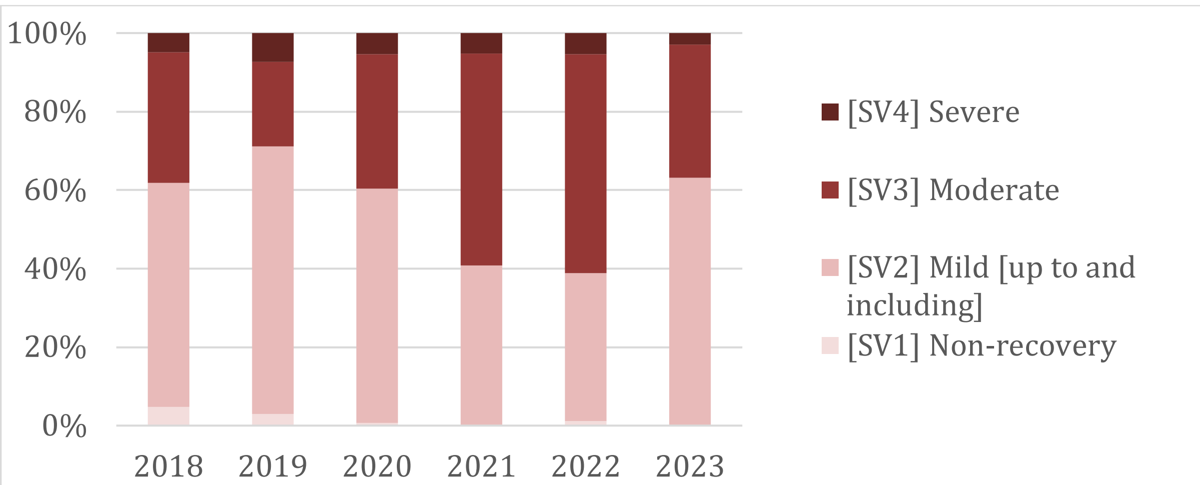


Figure 6: Percentage of uses by severity category by year (all species)

Table 2: Percentage of uses by severity: average for 2018-2023

	Proportion of total uses	Range	
[SV1] Non-recovery	**1.6%**	0.2%	4.7%
[SV2] Mild [up to and including]	**53.5%**	37.6%	68.2%
[SV3] Moderate	**39.7%**	21.4%	55.9%
[SV4] Severe	**5.1%**	2.9%	7.4%
Total	**100%**		

b. Salmon and other fish (excluding zebra fish)

Atlantic Salmon are the dominant species in animal use in Norway. The trends observed in salmon almost always drive the overall trend across all species. Figure 7 shows the number of salmon used by year and severity degree.

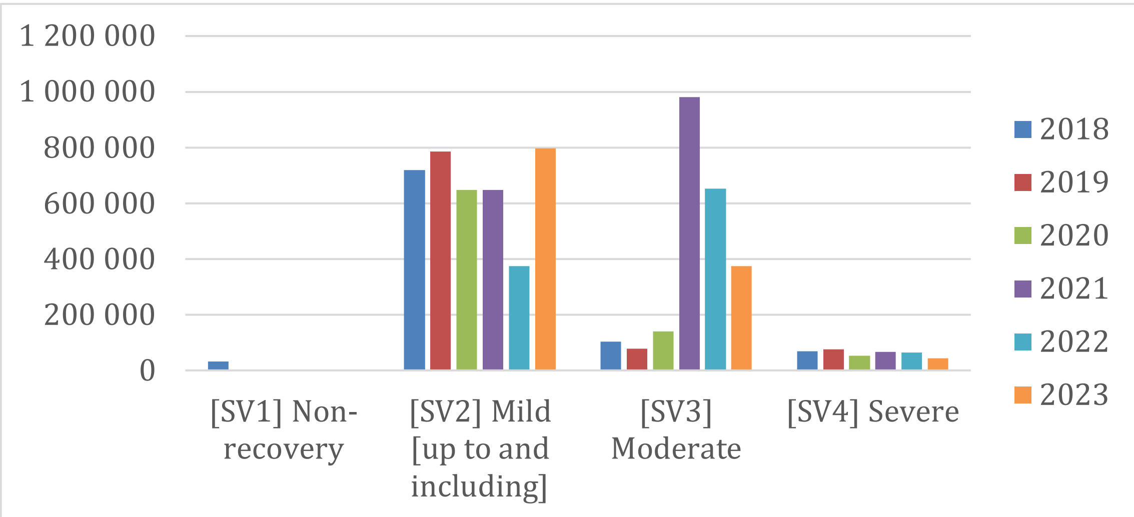


Figure 7: Number of Atlantic salmon used in each severity category by year

The mild and moderate severity categories represent the majority of salmon uses. The large increase in the moderate category (SV3) i 2021 does not seem to indicate a new trend, since numbers decreased in the two following years.

The severity of zebra fish use also fails to follow clear trends, with individual projects generating spikes from year to year (Figure 8).

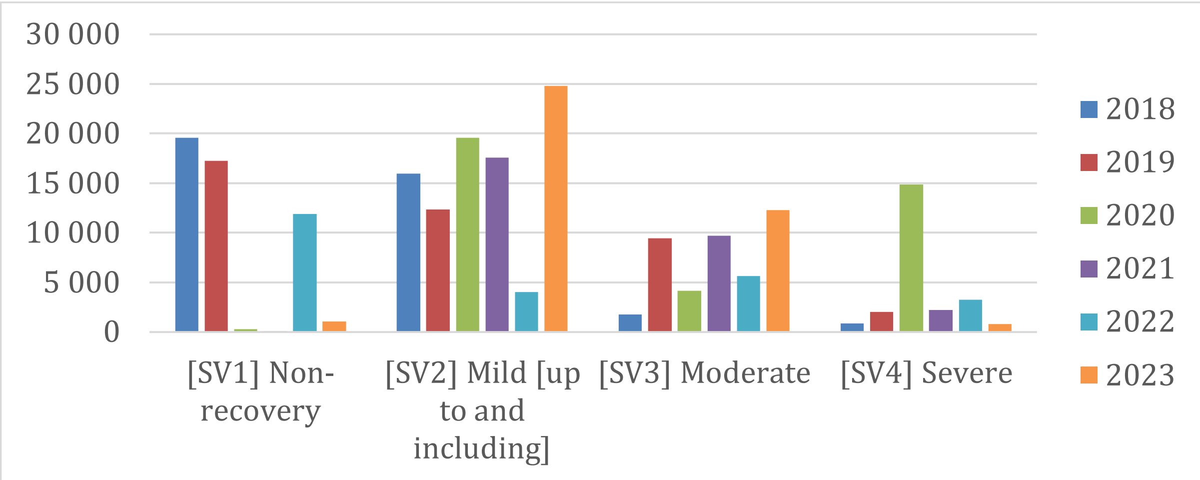


Figure 8: Number of zebra fish used by severity category by year

For fish that are neither salmon nor zebra fish, there seems to be a pattern towards a reduction in moderate severity (Figure 9), but here again large projects make it difficult to identify any trends.

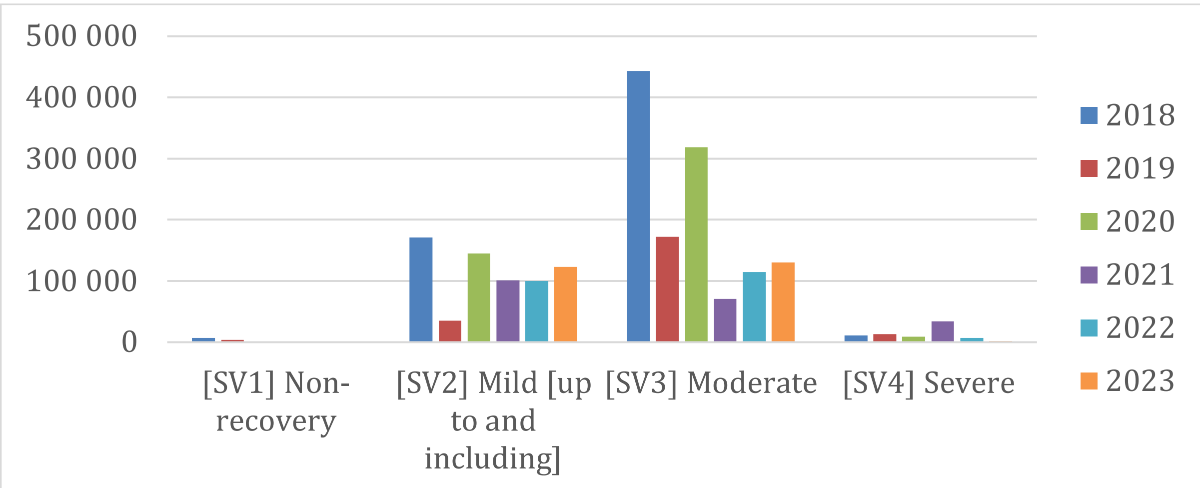


Figure 9: Number of animals used by severity category by year for fish, excluding salmon and zebra fish

c. Mice

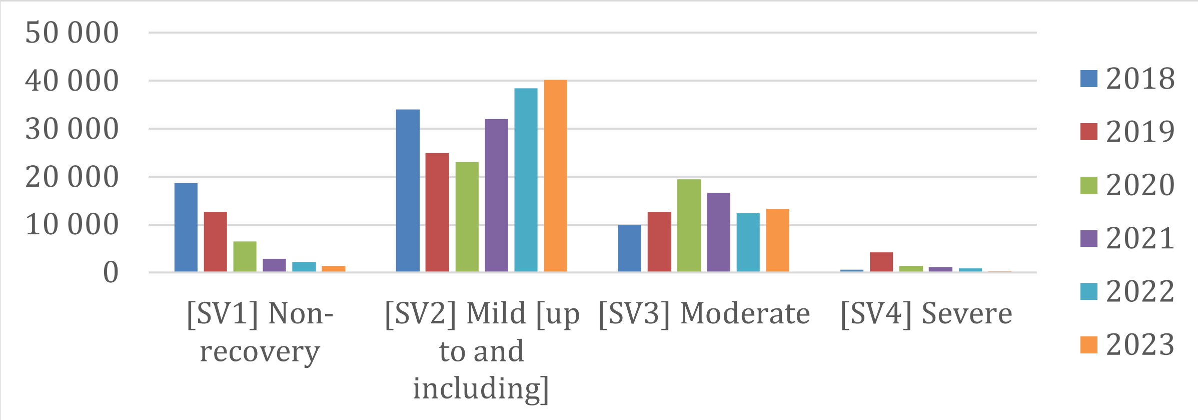


Figure 10: Number of mice used by severity category by year

Projects involving mice tend to use fewer animals. The number of animals used for non-recovery studies (SV1) shows a steady decrease over the period. The Norwegian Food Safety Authority states that this decrease has resulted from corrections they have made, due to errors in reporting (personal communication).

The number of mice used for severe procedures (SV4) was generally small, with an indication that the number is decreasing. The numbers of mice in the two other categories have fluctuated in the period, and it will be interesting to see if an apparent trend towards mild procedures (SV2) continues in future years.

The apparent decrease in the number of mice in SV4 in Norway may be comparable to the pattern observed in the UK[9], but contrasts with the pattern observed in Switzerland.[10]

Figure 11 provides a comparison of the proportions of animal uses by severity between two commonly used species - mice and zebra fish - for the period covered by the data. The most striking difference is the much larger average proportion of zebra fish uses occurring in the most severe category (SV4), but with a larger range as well (see Table 3).

[9] "Annual Statistics of Scientific Procedures on Living Animals, Great Britain 2023" available at https://www.gov.uk/government/collections/statistics-of-scientific-procedures-on-living-animals
[10] "Rapport sur la statistique de l'experimentation animale en 2023" available at https://www.blv.admin.ch/blv/fr/home/tiere/tierversuche/bericht-tierversuchsstatistik.html

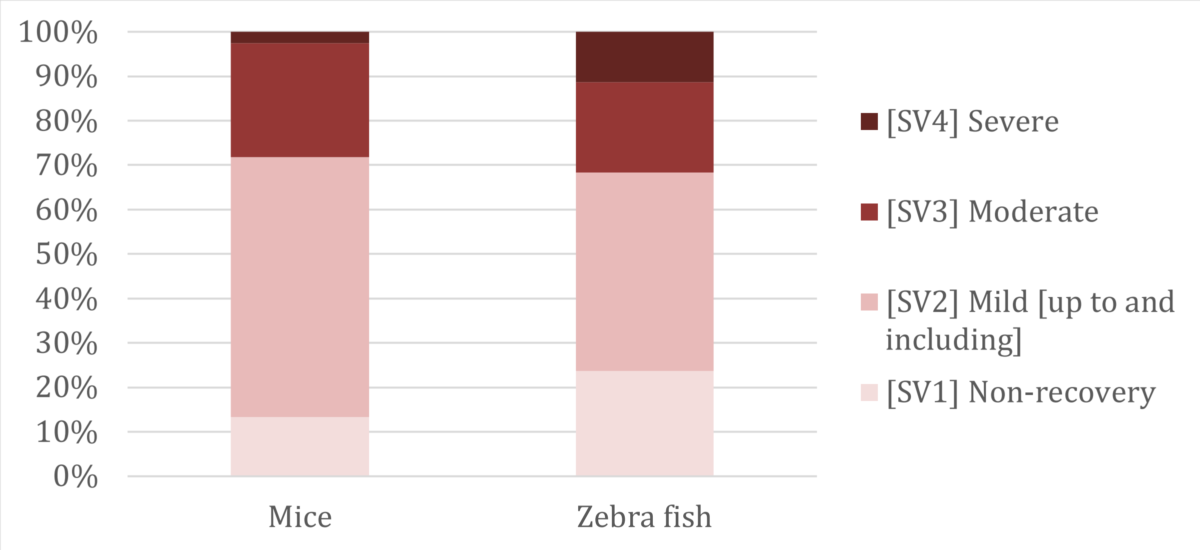


Figure 11: Comparison of severity between mice and zebra fish over the 2018-2023 period

The percentages from Figure 11 and their ranges by year are reported in Table 3.

Table 3: Percentage of uses by severity in mice and zebra fish: average and ranges for 2018-2023:

	Mice			Zebra fish		
	Average	Range		Average	Range	
[SV1]	13.4%	2.5%	29.5%	23.7%	0.3%	51.2%
[SV2]	58.4%	45.8%	72.8%	44.6%	16.1%	63.7%
[SV3]	25.6%	15.7%	38.8%	20.4%	4.7%	32.8%
[SV4]	2.6%	0.7%	7.7%	11.4%	2.0%	38.3%
Total	**100.0%**			**100.0%**		

6. Purposes

Tables 4 and 5 display the number of animals used in Norway for purposes defined by the EU.

a. All species

Applied research and basic research are the dominant reasons for animal use over the period studied. Two patterns appeared to exist:

1. The emergence of "preservation of species" as a key purpose.
2. A decrease in the number of uses in basic research.

The Norwegian Food Safety Authority reports that this is due to corrections which they have made to reports from the animal facilities (personal communication).

The gradual but consistent increase in animal use for the maintenance of genetically modified (GM) colonies is of interest, even though it involves a small number of animals.

Table 4: Total number of animals used by purpose by year

Purpose of use	2018	2019	2020	2021	2022	2023
Translational/ Applied research	759 924	654 907	838 407	1 384 130	857 101	976 122
Basic research	859 179	491 303	403 394	86 249	114 007	111 628
Preservation of species	9 497	4 034	27 913	470 668	380 259	430 620
Protection of the natural environment	17 858	91 320	106 211	19 373	16 013	22 045
Regulatory use	34 728	30 762	36 455	31 871	30 145	21 812
Maintenance of GM colonies	4 186	8 136	8 399	14 380	15 193	17 185
Education	1 026	788	1 262	1 954	2 019	1 673
Forensic enquiries	251	345				
Total	**1 686 649**	**1 281 595**	**1 422 041**	**2 008 625**	**1 414 737**	**1 581 085**

As pointed out by the Norwegian Food Safety Authority in their annual report for 2023 (figures 6-8[11]), the *relative* proportions of animal use in these 6 categories have been similar for the last three years (2021-2023), dominated by Translational/Applied Research (61-69%) and Preservation of Species (23-27%).

b. Fish

As noted earlier, the overall trends for all species (when counted together) are mostly connected to the trends in fish, and in particular in Atlantic salmon. Table 5 shows how the shifts in basic research and preservation of species concern fish. The Table also reflects the fact that the maintenance of GM colonies occurs mostly in mice and is not becoming more frequent in fish.

[11] https://mattilsynet-xp7prod.enonic.cloud/_/attachment/inline/def3bff7-05c8-45b6-8ba1-34b961a41aa4:500ee9faf7e1f52a696792207d7564c2230fd5e1/Bruk%20av%20dyr%20i%20forsøk%20i%202023.pdf

Table 5: Total number of fish (other than zebra fish) used by purpose by year

Row Labels	2018	2019	2020	2021	2022	2023
Translational/ Applied research	743 899	635 651	821 730	1 360 704	832 900	934 844
Basic research	756 827	406 220	323 243	25 202	65 619	66 112
Preservation of species	6 545	3 451	27 586	469 475	378 160	429 393
Protection of the natural environment	13 659	90 642	104 210	17 379	7 158	19 656
Regulatory use	33 880	29 613	35 332	31 035	28 818	20 361
Maintenance of GM colonies			1 400			
Education	163	64	64	142	180	85
Grand Total	**1 554 973**	**1 165 641**	**1 313 565**	**1 903 937**	**1 312 835**	**1 470 451**

Batch testing and other regulatory and quality control purposes are among the uses where severity is highest for fish. There is indication of an overall downward trend for the number of fish used for these purposes (Figures 12 and 13). However, the trend in the highest severity category is not as clear and is easily altered by the timing of a few large projects.

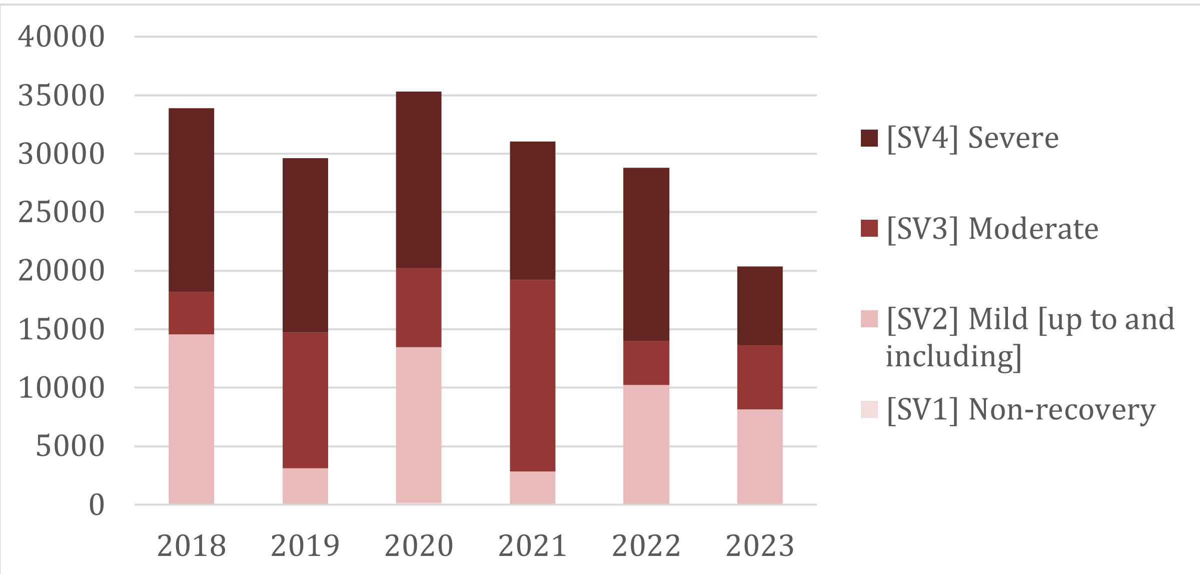


Figure 12: Severity categories in regulatory use and quality control for fish by year

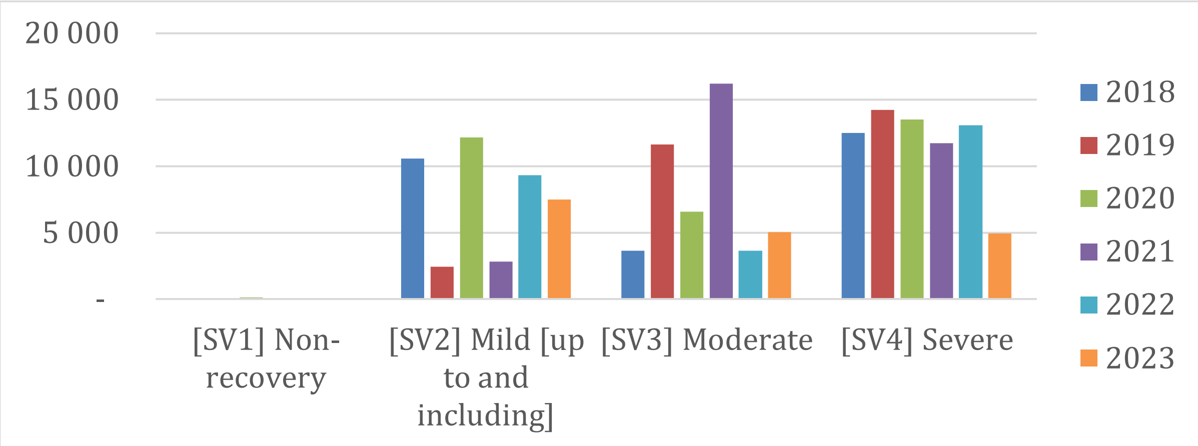


Figure 13: The number of Atlantic salmon used for regulatory purposes and quality control, by severity degree and year

7. Genetic status

Animals used in procedures are classified by the EU in three categories of genetic status:

- [GS1] Not genetically altered
- [GS2] Genetically altered without a harmful phenotype
- [GS3] Genetically altered with a harmful phenotype

a. All species

The vast majority (95.9%) of animals used for the period 2018-2023 were not genetically altered in any way (GS1; Table 6). There is no clear trend indicating an increase or decrease of the relative size of the three categories.

Table 6: Percentages of animals in each genetic category (all species)

Genetic status	2018	2019	2020	2021	2022	2023
[GS1] Not genetically altered	97.1%	94.8%	95.1%	97.0%	95.9%	94.7%
[GS2] Genetically altered without a harmful phenotype	2.7%	4.4%	4.3%	2.6%	3.8%	4.0%
[GS3] Genetically altered with a harmful phenotype	0.2%	0.8%	0.6%	0.4%	0.3%	1.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Mice and zebra fish represent the majority of genetically altered animals, with or without a harmful phenotype (Table 7). However, a few other species were also genetically altered, notably the Atlantic salmon and the rat. Table 7 includes all genetically altered species in the data for the six years. See also Figures 14 & 15.

Table 7: Number of animals used for all species with genetically altered status (totals from all years)

Species	[GS1] Not genetically altered	[GS2] Genetically altered without a harmful phenotype	[GS3] Genetically altered with a harmful phenotype
Mouse	130 241	166 577	32 370
Zebra fish	72 408	120 831	18 366
Atlantic salmon	6 662 100	42 940	2 324
Rat	19 465	1 808	1 147
Japanese rice fish	876	590	
Lumpfish	224 380	181	
Pig	4 637	12	
Ballan wrasse	114 119	10	
All other species	1 779 350		
Total	9 007 576	332 949	54 207

b. Mice

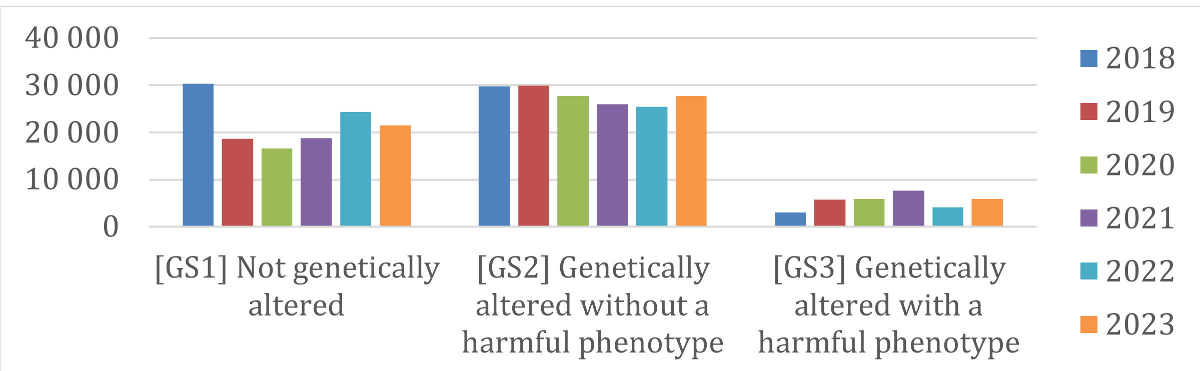


Figure 14: Number of mice used by genetic status

c. Zebra fish

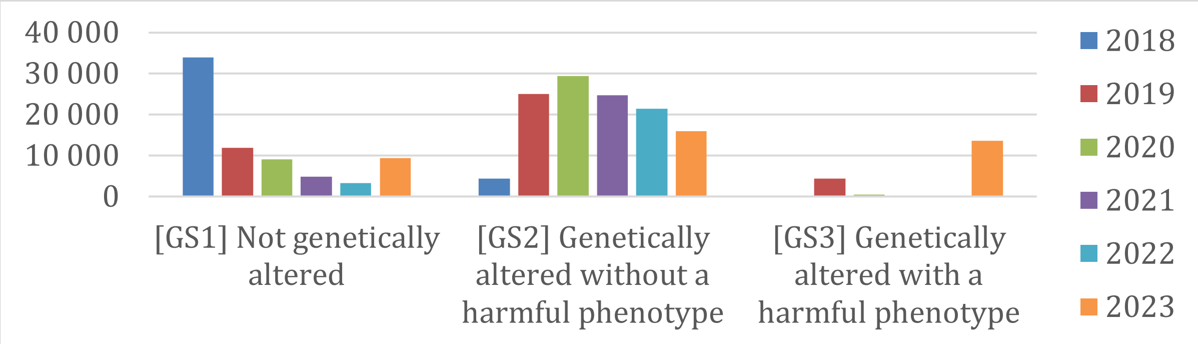


Figure 15: Number of zebra fish used by genetic status

8. Reuse of animals

Reuse can be within the same project or in separate projects. Animals that are reused remain a very small fraction of the total number of animals in Norway. A total of 37 432 animals were reused over the six years of this report (Tables 8 and 9).

Reuse is specifically regulated, both by Article 16 of Directive 2010/63/EU[12] and §17 of the Norwegian Regulation[13].

There is no clear trend indicating an increase or decrease. There were no reuses for animals in the most severe category (SV4), in compliance with the legislation.

Table 8: Number of animals reused by species and year

Species	2018	2019	2020	2021	2022	2023	Total
Zebra fish	4 500	64	1 214	212	700	8 550	15 240
Atlantic salmon	6 402	461	15	11	2 216	3 000	12 105
Mouse	4 278	24	116	3	12	85	4 518
Brown trout	2 398						2 398
Goat				404	600		1 004
Cattle	52	82		100	150	124	508
Svalbard reindeer	65	106				202	373
Guppy			265				265

[12] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0063&from=EN (Article 16)
[13] https://lovdata.no/dokument/SF/forskrift/2015-06-18-761#KAPITTEL_3 (§17)

Sheepshead minnow			210				210
Eurasian tundra reindeer			4			200	204
Sheep	15	6	24	16	104		165
Mink				40	80		120
Dog	6	44	1	1	33		85
Rock ptarmigan		53				5	58
Elk				30	9		39
Rat	2	1		6	20		29
Horses, donkeys & Crossbreeds	1	9	5	5		4	24
Black-legged kittiwake	22						22
Pig	7			10			17
Arctic tern	16						16
European plaice				10			10
Atlantic halibut				10			10
Spotted wolffish					8		8
Hooded seal		3					3
Beluga whale		1					1
Grand Total	**17 764**	**854**	**1 854**	**858**	**3 932**	**12 170**	**37 432**

Table 9 provides a breakdown of reuses by severity.

Table 9: Number of animals reused by severity and year

Severity	2018	2019	2020	2021	2022	2023	All years
[SV1]	5 722	356	40		1	12	6 131
[SV2]	11 975	418	1 674	793	3 590	11 874	30 324
[SV3]	67	80	140	65	341	284	977
Total	**17 764**	**854**	**1 854**	**858**	**3 932**	**12 170**	**37 432**

The data does not track the severity of the initial use of the animals, so the severity indicated in Table 9 indicates the severity of the reuse.

Over the six years of the dataset, 81% of the animal uses that were labelled as “reuses” were in the severity category “Up to and including Mild”. Very few animals (under 3%) were reused for moderately severe procedures, and none was reused for severe procedures.

9. Counts and characteristics of projects

The data about procedures on animals in Norway is characterized by the heterogeneity of project sizes: a few large projects account for a large proportion of the procedures. These can distort yearly averages for individual species, groups of species and research areas, giving the false impression of a trend, or hiding regularities, simply by their idiosyncratic timing.

The description of projects is therefore more complex than that of the individual uses presented in the previous sections of this report. Moreover, not only do projects often span multiple years, but they may also involve several species. In addition, one project often consists of procedures within different severity categories, meaning that a single project cannot be characterized by one severity category.

In this dataset for the years 2018 to 2023, there were 3 104 individual projects. The subsections below illustrate the variation in these projects in terms of size (number of procedures), duration, species and purpose.

a. Number of procedures in projects

Figure 16 shows a histogram of project sizes for the 6 years of data as a whole (a total of more than 9 million procedures), collected in bins for each power of ten (1-9 procedures, 10-99, 100-999, and so on).

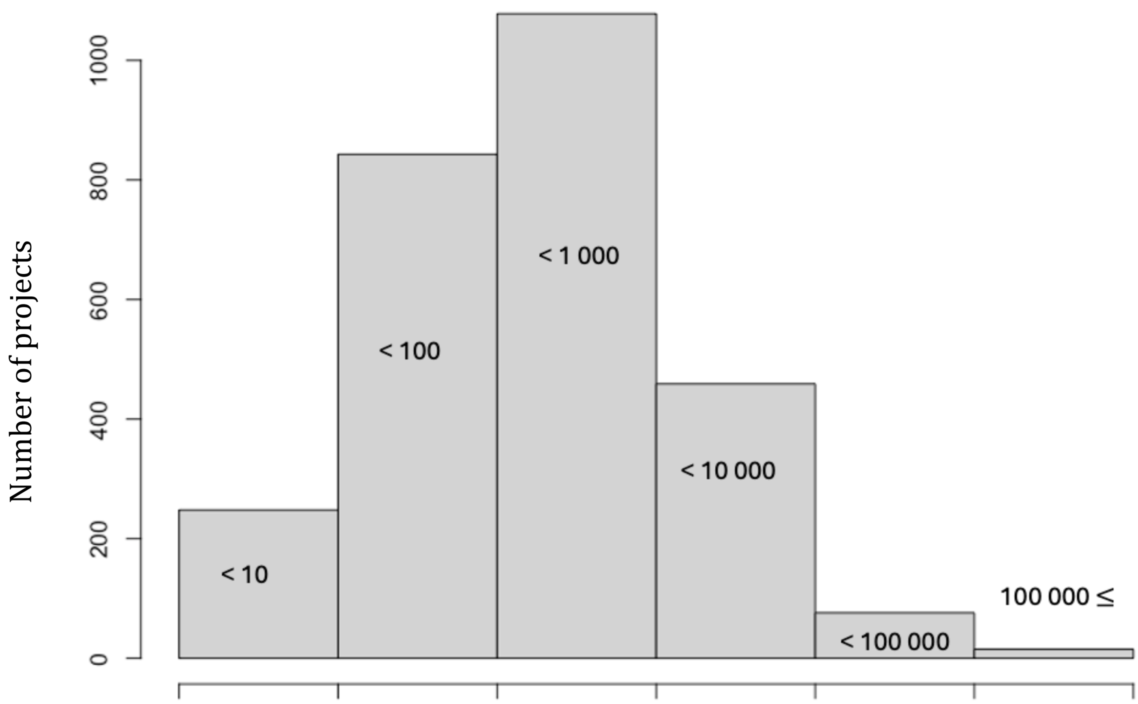


Figure 16. Number of projects by size (number of procedures) for 2018-2023

The most frequent project size (defined by the number of procedures in the project) is between 100 and 999 procedures, with over a third of the projects in that category. Yet, even though there are only a few hundred projects containing tens or hundreds of thousands of procedures, these constitute the majority of the over 9 million procedures. This can be visualised in Table 10, which shows the number of projects in each of the above categories, along with the number of procedures they each represent.

Table 10: Number of projects and procedures by size of project

Procedures in project	Projects	Percentage of projects	Sum of procedures	Percentage of procedures
Less than 10	236	7.6%	1 103	0.01%
10 to 99	969	31%	42 891	0.5%
100 to 999	1 254	40%	480 324	5.1%
1 000 to 9 999	533	17%	1 522 722	16.2%
10 000 to 999 999	93	3.0%	2 602 834	27.7%
over 100 000	19	0.6%	4 744 858	50.5%
Total	**3 104**	**100%**	**9 394 732**	**100.0%**

Half of the procedures in the 6 years of data were found in the top 0.6% of projects (100 000 procedures or more). In contrast, there were 2 459 projects with less than a thousand procedures each, and these represented 79% of all projects (but only 5.6% of all procedures).

b. Severity of procedures within projects

As noted above, one project often includes procedures in several severity categories. One initial simple indicator is to only consider the maximum severity found in each project. Table 11 provides a breakdown of the number of projects sorted by maximum severities by year. Here it is important to remember that projects often span several years.

To avoid double counting, we have counted the year of the project as its last year with procedures. This can be interpreted as the end year for projects, except for 2023 where the data does not allow us to distinguish projects that will continue in 2024 from those that ended in 2023. Characterising projects by end year is nevertheless useful for previous years, and gives a sense of the variation from year to year in maximum severity.

Table 11: Number of projects by year and maximum severity for 2018-2023

Year ended	SV1	SV2	SV3	SV4	All severities
2018	89	233	131	52	505
2019	46	195	140	90	471
2020	23	171	123	68	385
2021	22	166	175	111	474
2022	19	156	166	76	417
2023	61	299	331	161	852
All years	**260**	**1220**	**1066**	**558**	**3104**
Percentage	8%	39%	34%	18%	100%

For a description of categories SV1-4, see section 5 of this report.

The most frequent maximum severity of projects was SV2 (Up to and including Mild), followed closely by SV3 (Moderate). There were 558 projects with a maximum severity of SV4 (Severe, 18% of projects).

Over the years (excluding 2023, for the reason given above) SV1 and SV2 maximum severity categories show a consistent decline. The SV3 and SV4 maximum severity categories do not show clear patterns over the course of these five years.

For 2023, which combines projects ending that year with multi-year projects that will continue in 2024, the *proportion* of projects in each maximum severity category is similar to the total for other years, with SV2 the most frequent maximum severity.

Table 12 reports the average number of procedures per project broken down by maximum severity and by year, to identify any pattern of correlation between project size and maximum severity. While it is true that, on average, projects with maximum severity SV4 tend to involve more procedures (an average of 4 538 per project over the whole period), there is substantial variation from year to year, and the most common maximum severity group (SV2) also shows a large average size - larger than the SV4 group in some years (2018, 2019 & 2020). The year-to-year variation is indicative of the impact of the very large projects, which are the focus of section 10 in this report.

Table 12: Average number of procedures per project by year and maximum severity for 2018-2023

Year ended	SV1	SV2	SV3	SV4	All severities
2018	346	3 059	3 562	1 272	2 527
2019	709	4 194	1 726	2 086	2 717
2020	106	3 852	3 123	1 643	3 005
2021	69	3 309	2 607	7 473	3 875
2022	71	4 637	2 245	9 372	4 340
2023	44	3 316	1 257	3 881	2 389
All years	**275**	**3 651**	**2 193**	**4 538**	**3 027**

Maximum severity in a project is a useful initial indicator, but it has the important limitation of ignoring the severity of procedures in the project that have less severity. For example, a project with only SV4 uses will be in the same group as a project with one SV4 procedure and all other procedures in SV3 or lower. There are several ways to overcome this limitation, but all are more complicated to display than the simple maximum severity index.

The severity of a project has 4 dimensions: one for each severity degree. To reduce the number of dimensions, one option is to ignore SV1 (non-recovery) procedures, which brings severity down to 3 dimensions and allows plotting, for example in a ternary diagram. In the years 2018-2023, SV1 procedures are rare, and projects with only SV1 represent a mere 8% of the total.

Figure 17 shows a ternary diagram of all projects with a maximum severity of SV2 or more.

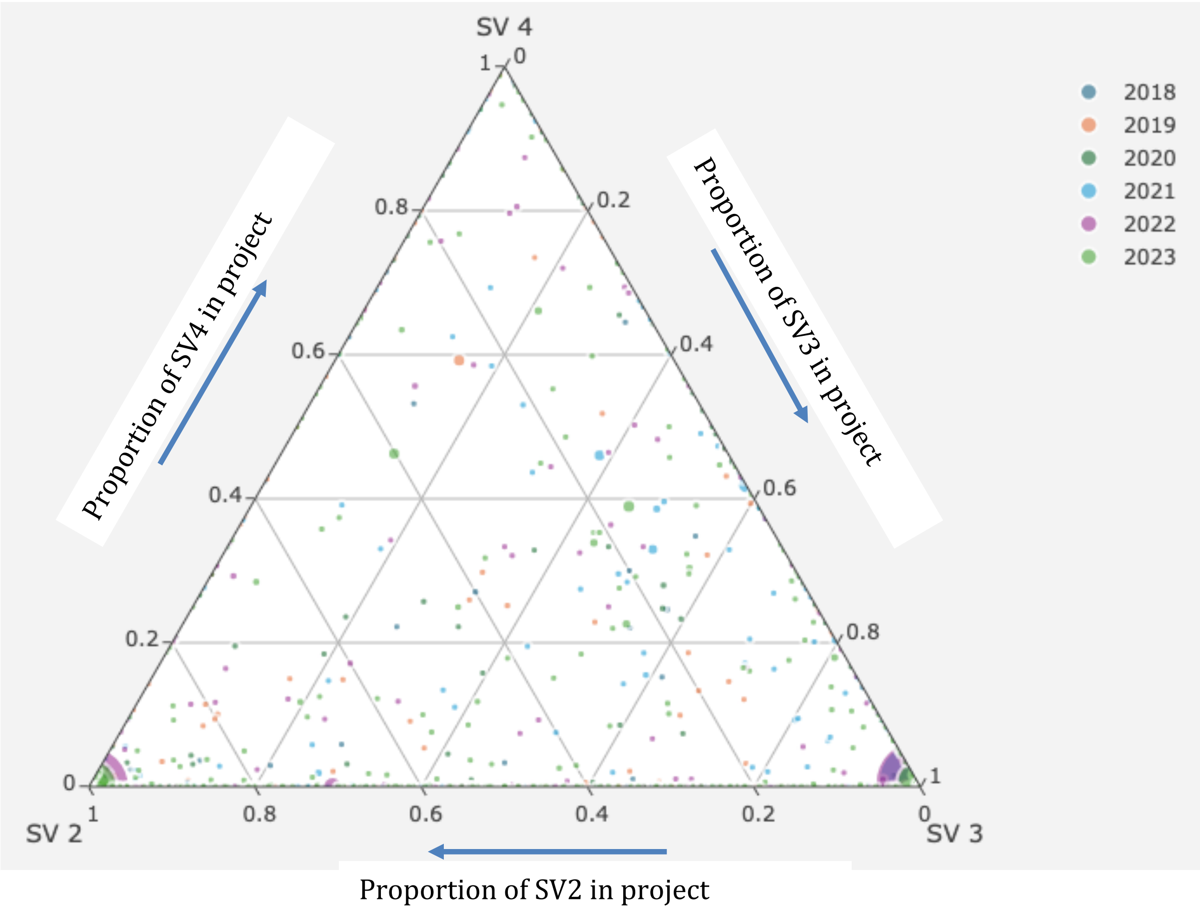


Figure 17: Ternary diagram of the severity of projects

Each bubble in the figure represents an individual project, and its colour indicates the end year of the project. The size (area) of the bubbles is proportional to the total number of procedures in that project (including the SV1 category). Projects where all the procedures had one single severity degree are located in the corresponding corners of the diagram (SV2, SV3 or SV4). For instance, all projects with only SV3 procedures are to be found at the bottom right corner.

Moving away from a corner indicates that procedures from other severity categories were also present. For example, starting at the SV3 corner, moving horizontally towards the SV2 corner finds projects with an increasing number of both SV2 and SV3 procedures. Any project that is located *inside* the triangle (i.e. not on a corner or a side) has procedures in *all three* severity categories.

Figure 17 demonstrates that many projects have a single severity category of SV2 or SV3, and that many others have a combination of all categories. However, the "bunching" and overlapping of projects in the SV2 and SV3 corners prevents a clear visual representation of the distribution of severity in projects. Ternary diagrams are also not particularly intuitive for most readers.

Other visualisations of project severities are possible, but they also show trade-offs between power of representation and ease of understanding. We propose a mixed index of severity (combining the maximum severity found in a project with the proportion of procedures in that severity category) in section 10 of the report, which focuses on the larger projects in the dataset.

c. Duration of projects

The duration of projects is shown in Table 13 and ranged from 1 to 5 years (as of 2023). Again, the data does not allow to differentiate projects that will end in 2023 from projects that are ongoing in 2023 and will continue in 2024. Another issue applies to the first year of data (2018), for which the data does not allow computation of the duration of *projects* ending that year, as previous years are not observed. Therefore, Table 13 excludes data from 2018 and 2023.

In this very limited material, most projects (80%) lasted only one year, but projects lasting 2 or 3 years were also common (19%). There were few projects lasting longer than 3 years.

Table 13: Duration of projects in years

Number of years	Project count		Project count (excluding 2018 and 2023)	
1	2511	81%	1389	80%
2	343	11%	213	12%
3	189	6%	124	7%
4	60	2%	21	1%
5	1	0%	0	0%
Total	**3104**	**100%**	**1747**	**100%**

Combining the findings from Tables 12 and 13, it is possible to characterize the average composition of projects for an average year:
There are 400 to 500 projects active in any given year and about 100 of them will also be active in the year before or after. There is no clear trend in either the number or duration of the projects.

A dataset with more years might in the future reveal more subtle trends in project counts and duration.

d. Species in projects

The complexity of describing projects rather than procedures becomes again apparent when looking at the species and purposes.

The breakdown of number of species per project is shown in Table 14.

Table 14: Number of species in project

Number of species	Project count	Percentages
1	3019	97.3%
2	45	1.4%
3	14	0.5%
4	9	0.3%
5 to 10	9	0.3%
11 to 20	8	0.3%
Total	**3104**	**100%**

Table 15 shows the number of projects with Atlantic salmon containing procedures in each of the four severity degrees over the years of the dataset. Note that since a project can contain procedures from several severity degrees, the sum of projects for each year will be greater than the projects active that year. Similarly, since projects may last for several years, the sum of projects over six years will be greater than the total number of projects in the data.

Table 15 is nevertheless useful to identify potential trends in the number of projects in each severity category. The number of projects that include procedures in SV1 shows a clear decrease over the six years.

In contrast, there seems to be an increase in the number of projects that include procedures in the two highest severity degrees (SV3 and SV4). However, this increase is irregular, and more years of data are needed to see if any clear patterns emerge.

Table 15: Number of projects with Atlantic salmon by severity and year

	SV1	SV2	SV3	SV4
2018	28	163	113	64
2019	27	171	109	83
2020	26	150	132	73
2021	16	172	165	94
2022	5	157	135	70
2023	6	181	142	92

Table 16 provides the same project counts for zebra fish. A similar trend as in Atlantic salmon is observable for projects with SV1 procedures. The number of projects with SV2 procedures also seems to be declining. There is no indication of an increase in the number of projects with SV3 or SV4.

Table 16: Number of projects with zebra fish by severity and year

	SV1	SV2	SV3	SV4
2018	9	20	6	1
2019	8	25	11	5
2020	3	25	11	4
2021	1	20	8	4
2022	3	11	9	3
2023	4	13	8	1

Table 17 shows the number of projects with mice in which procedures of each severity degree are found over the years. Here again, an apparent decrease in the number of projects with procedures in SV1 is clearly visible, but, as mentioned in section 5, the Norwegian Food Safety Authority has had to correct errors in reporting of this category.

In addition, there seems to be an increase in the number of projects with procedures in SV2 and SV3. The figures for SV4 are less consistent.

Table 17: Number of projects with mice by severity and year

	SV1	SV2	SV3	SV4
2018	245	362	186	47
2019	223	351	186	84
2020	133	369	237	52
2021	103	443	282	62
2022	73	423	265	39
2023	60	474	274	47

While almost all projects (97.3%) involve a single species, 85 projects include procedures with two or more species. A few projects include more than 10 species.

Table 18 provides a list of the most common combinations of species found within the same project. There were six projects with the combination of Arctic char, Atlantic salmon and Brown trout. Atlantic salmon are found in many of the multi-species projects.

Of the 85 multi-species projects, 55 have unique combinations of species.

Table 18: Most frequent combinations of species within a project

Number of projects	Species list
6	Arctic char, Atlantic salmon, Brown trout
5	Atlantic salmon, Ballan wrasse, Lumpfish
3	Cat, Dog, Horses, donkeys & cross-breeds
3	Eurasian blue tit, European pied flycatcher, Great tit
3	Atlantic puffin, Black guillemot, Black-legged kittiwake, Common eider, Common murre, European herring gull, European shag, Glaucous gull, Great black-backed gull, Great skua, Ivory gull, Lesser black-backed gull, Little auk, Razorbill, Thick-billed murre
2	Atlantic salmon, Lumpfish, Rainbow trout
2	Ballan wrasse, Cod, Corkwing wrasse, Goldsinny wrasse, Pollack
2	Great skua, Long-tailed jaeger, Parasitic jaeger
2	Fin whale, Humpback whale, Long-finned pilot whale, Orca, Sperm whale
2	Cattle, Dog, Domestic fowl, Eurasian tundra reindeer

e. Purposes in projects

For the purposes of projects ('general purpose' in the EU classification), the pattern is comparable to that of the distribution of species, with most projects (85.4%) being single-purposed and a minority being associated with two or more purposes.

Table 19 provides the breakdown of projects by number of purposes found associated with them.

Table 19: Number of purposes associated with a project

Number of purposes	Project count	Percentages
1	2938	85.4%
2	286	9.2%
3	130	4.2%
4	22	0.7%
5	9	0.3%
6	4	0.1%
7	1	0.0%
Total	**3104**	**100.0%**

Table 20 shows the most common combination of purposes found within single projects. Basic research is the most common purpose found in combination with other purposes. It is most often combined with Translational/Applied research (255 projects out of the 452 multi-purpose projects shown in Table 19). This may be a reflection of the difficulty to set a clear demarcation between basic and applied research.

Table 20: Most frequent combinations of purposes with a project

Number of projects	Combination of purposes in project
255	Basic research and Translational/ Applied research
52	Basic research and Maintenance of colonies of established genetically altered animals, not used in other procedures
30	Basic research and Preservation of species
22	Basic research and Protection of the natural environment in the interests of the health or welfare of human beings or animals
20	Regulatory use, Translational/ Applied research
14	Protection of the natural environment in the interests of the health or welfare of human beings or animals and Translational/ Applied research
11	Basic research, Maintenance of colonies of established genetically altered animals, not used in other procedures and Translational/ Applied research
10	Preservation of species and Protection of the natural environment in the interests of the health or welfare of human beings or animals
8	Maintenance of colonies of established genetically altered animals, not used in other procedures and Translational/ Applied research

10. Influence of large projects

To better understand how large projects affect the number and severity of procedures, we developed a visualisation technique using a mixed severity index. We focus here on the 186 projects with more than 5 000 procedures, which represent a total of 7 875 312 procedures (84% of all the procedures performed in 2018-2023).

Table 21 provides the number of projects broken down by maximum severity and year for these large projects and can be compared with Table 11 which provided the same figures but for all projects.

By comparing the percentages of projects in each maximum severity category, one can observe that larger projects tend to occur more frequently in maximum severity category SV2 (48% compared to 39% for all projects) or SV4 (29% compared to 18%), with many fewer projects in SV1 (1.1% compared to 8%) or SV3 (22% compared to 34%).

Table 21: Number of projects with more than 5 000 procedures, by year and maximum severity

Year ended	SV1	SV2	SV3	SV4	All severities
2018	1	19	6	3	29
2019	1	16	5	6	28
2020	0	13	5	5	23
2021	0	12	5	16	33
2022	0	9	9	7	25
2023	0	20	11	17	48
All years	**2**	**89**	**41**	**54**	**186**
	1.1%	48%	22%	29%	100%

The year-to-year variation, however, is similar with no clear trend except for a slight but irregular increase in the number of large projects with a maximum severity SV4. Note that the year 2023 should be interpreted carefully as previously, since it includes projects that would in fact continue in 2024.

Table 22 provides the number of procedures corresponding to the large project breakdown in Table 21. There is a clear increase in the number of procedures in projects with a maximum severity of SV4 in 2021 and 2022, but it is due to the idiosyncratic timing of a few very large projects, rather than a trend.

Table 22: Number of procedures in projects with more than 5 000 procedures

Year ended	SV1	SV2	SV3	SV4	All severities
2018	17 449	632 038	414 185	21 364	1 085 036
2019	25 600	732 183	178 644	92 656	1 029 083
2020	0	585 226	309 326	40 542	935 094
2021	0	478 245	372 633	747 614	1 598 492
2022	0	649 549	297 010	642 899	1 589 458
2023	0	860 411	293 815	483 923	1 638 149
All years	**43 049**	**3 937 652**	**1 865 613**	**2 028 998**	**7 875 312**

a. A mixed index to describe severity in projects

In this visualisation, we have first used the maximum severity category in each project to make 4 groups. Within each of these groups, we have then sorted the projects by calculating the proportion of procedures that are in the maximum category of the project, the rest being in lower severity categories.

Figure 18 provides a visualisation of this mixed severity index. Each bubble is a project, and its size (area) is proportional to the total number of procedures in the project.

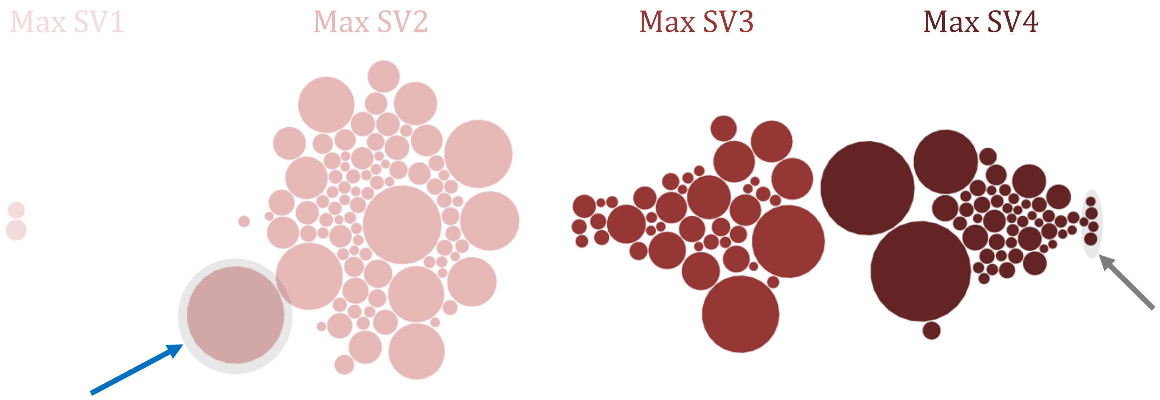


Figure 18: Bubble chart of the large projects grouped by maximum severity.

Withing each group, projects are placed in increasing severity from left to right, with the severity being defined here as *the proportion of procedures of the maximum severity defining the group*. For instance, the large project found at the bottom left of the group of maximum severity 2 (indicated by grey shading and a blue arrow), is among the ones with the smallest proportion of SV2 procedures in the group of projects with maximum severity of SV2. Similarly, the 4 relatively small projects on the far right of the figure (also in grey shading and with a grey arrow) include only SV4 procedures and are therefore placed to the right of all the other projects in their SV4 group.

Importantly, the placement of the bubbles/projects within groups is approximate, to aid visualisation.

The key observable pattern is the importance of the group of Max SV2 projects, both in the number of projects and the number of procedures (area covered). This pattern was already visible in Tables 21 & 22. An additional insight from Figure 18, however, is the shape of the two groups of highest maximum severity SV3 & SV4. In the group for Max SV3 projects, the larger projects in the group have large proportions of SV3 procedures and few lower severities in each project. In contrast, the projects in the Max SV4 group are fewer and smaller as severity increases (as measured by the increasing share of SV4 in each project).

This visualisation, based on our mixed severity index (maximum severity *and* proportion of maximum severity), allows to see at once both the severity of project, their size and any other project characteristic identified by colour. It also has a benefit of showing individual project data in a way that preserves confidentiality.

b. Species in large projects

Figure 19 shows the dominance of Atlantic Salmon in the large projects. It also shows that large multi-species projects tend to include salmon. Furthermore, the figure indicates that large projects with species other than salmon seem to be often found in the group of projects with a maximum severity of SV3.

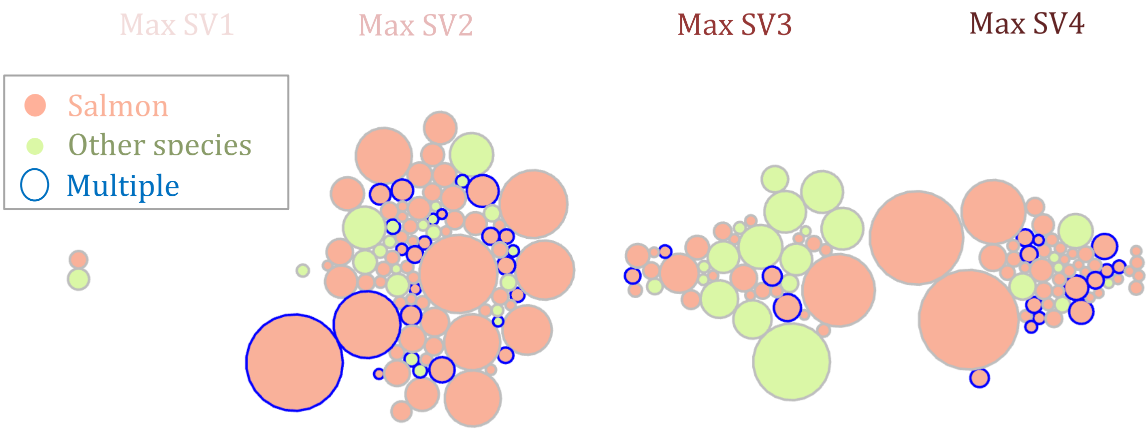


Figure 19: Bubble chart of the large projects with colour corresponding to species (Atlantic salmon vs. all other species)

The pattern observable from this Figure can also be seen in part in the count of large projects, as shown in Table 23.

Table 23: Number of projects by species and maximum severity

	SV1	SV2	SV3	SV4	All severities	Percentage
Salmon	1	68	25	48	142	76%
Other than salmon	1	21	16	6	44	24%
All species	**2**	**89**	**41**	**54**	**186**	**100%**

The rainbow trout was the most common species found in combination with Atlantic salmon.

In these large projects, the most common species other than salmon were cod, mackerel, herring, zebra fish, lumpfish, ballan wrasse, mouse and rainbow trout. A few projects on sea birds are also part of these large projects.

c. Purposes in large projects

Figure 20 reproduces the previous bubble charts (Figure 19) with colour representing the general purpose of the projects.

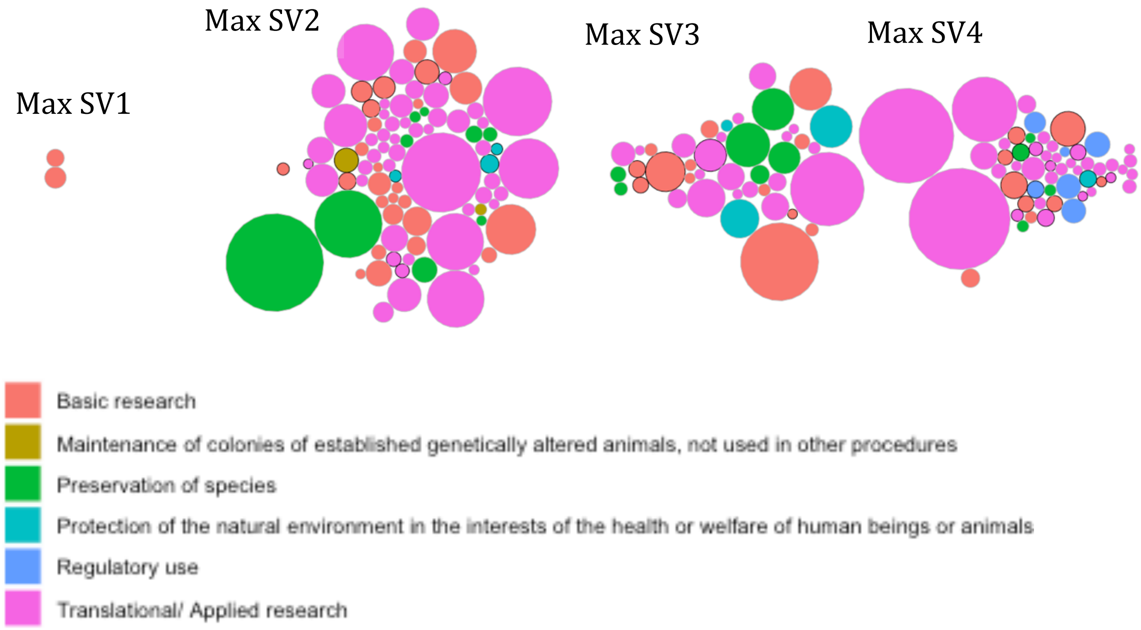


Figure 20: Bubble chart of large projects with colour corresponding to general purpose. Multi-purpose projects are enclosed by thin black circles.

Research, both basic and applied (also qualified as translational in the EU classification of purposes) is, as expected, the dominant purpose of experiments across all groups of maximum severity. The applied research projects tend to be larger and are more frequent among the higher severities, but some large basic research projects can also be found with maximum severities of SV3. An additional indication of the difficulty of defining a clear delineation between basic and applied research is found in the fact that most of the multi-purpose projects combine both.

'Preservation of species' is the purpose of a few very large projects, found in the maximum severity groups SV2 and SV3. Quite a few smaller projects with this purpose can be found across the severity groups. A group that stands out in Figure 20 is the group of projects for regulatory use which are of medium size (among large projects, so still in the tens to hundreds of thousands of procedures) but all grouped within SV4 maximum severity. In fact, within that group, they tend to be in the middle of the group (horizontally) which indicates that they include a relatively large proportion of SV4 procedures.

The Norwegian Food Safety Authority report (personal communication) that changes in classification by purpose over the years are primarily due to corrections of errors in reporting, and that a project should only have had one purpose.

One of the consequences of the lack of clear distinction between basic and applied research is that the analysis of 'purposes' as recorded in the dataset is not very informative about the actual purpose of many large and severe experiments. We tried to fill this important gap with a text mining analysis, described in the last section of this report (Section 11), but with only limited success.

d. Timing of large projects

To provide an indication of the trend in size and severity of large projects over the six years of data, Figure 21 reproduces the bubble chart from Figure 19 with colours indicating the year the project ended. Note again that for 2023, some projects will not have ended, despite being represented in green in the Figure.

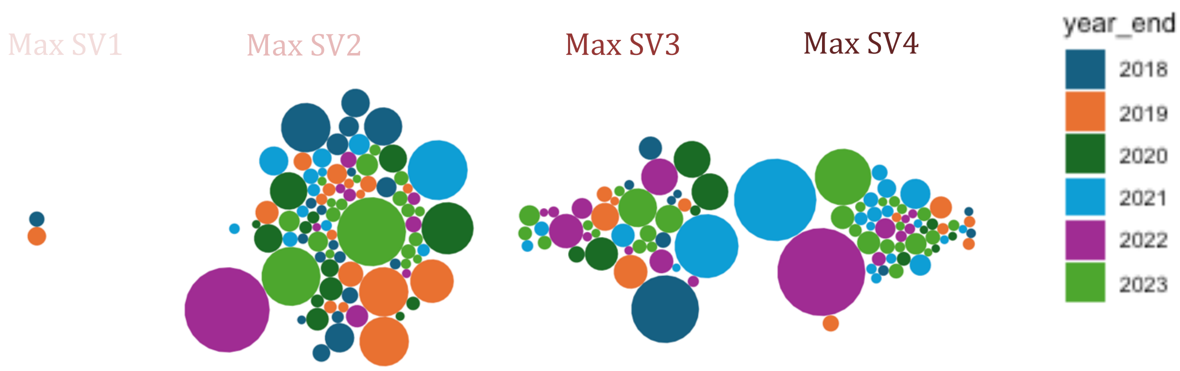


Figure 21: Bubble chart of large projects with colour corresponding to year of end of project.

No clear trend is visible in Figure 21 for the largest projects. Figure 22 separates them by year:

Figure 22: Bubble chart of large projects showing individual year of end of project.

One pattern that may be of concern is the number of projects in the SV4 maximum severity group, even accounting for the fact that 2023 combines both projects ending that year and projects that continued in 2024. This number deserves to be further evaluated with more data.

11. Text mining analysis of non-technical summaries for large projects

We attempted to improve our understanding of the purposes and causes of severity in the large projects that influence the overall statistics of animal use in Norway by matching the dataset on animal uses with their Non-Technical Summaries (NTS).

We collected the Non-Technical Summaries for all projects using 20 000 or more animals. Given data availability, we included the years 2018 to 2023 in this analysis. For projects prior to 2022, this required manual import, so we focused on the larger projects.

The 2023 data were made available to us after some of our analyses were already performed, and they are therefore not included in the second analysis presented here. The Non-Technical Summaries for projects after 2023 are all available in a single file from the ALURES NTS database[14], and our analysis can therefore in principle be easily extended for later years. Note, however, that some Non-Technical Summaries are missing for projects in previous years, including some very large projects, and thus an exhaustive text-mining analysis of large projects is impossible.

After importing all summaries, we translated them into either Norwegian or English (i.e. the language not used in the original NTS), using DeepL[15].

We then proceeded to analyse the text in two ways:

a. In a first analysis, we chose a few keywords which we hypothesised were central to many of the large experiments performed on animals in Norway (e.g. the word "lice" and various forms of the word "vaccination"). We then simply searched the summaries for these keywords to classify the projects.
b. In a second analysis, we used a "brute force" text mining approach to build tables of the frequency of words for each NTS. To prevent words without much semantic value from driving the analysis, we performed a "tokenisation" by removing stop words and by combining words with similar meanings (such as conjugations of the same verb). We then grouped (clustered) summaries according to the frequency of their use of words. This frequency-based analysis was performed in English with a robustness check implemented with the Norwegian version of the summaries.

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[14] https://webgate.ec.europa.eu/envdataportal/web/resources/alures/submission/nts/list

[15] https://www.deepl.com/en/translator

A further text analysis was performed using the Large Language Model ChatGPT 3.5[16]. In this analysis, we asked ChatGPT to provide ten keywords for each NTS and then tried again to group projects with similar keyword descriptions. Unfortunately, this analysis proved to be of limited reliability, as the keywords provided changed when the same NTS was sent to ChatGPT several times, resulting in clustering changing significantly every time the analysis was run. This text mining experiment may be indicative of the poor reliability of Large Language Models in their current versions, even for relatively simple tasks (such as providing keywords for a summary). One of the authors (AS) has previously encountered similar problems when attempting to use ChatGPT to analyse UK Non-Technical Summaries from online pdf files[17] (unpublished data).

a. Project classification based on pre-defined keywords

The keywords we selected for searching in the Non-Technical Summaries are given in Table 24, along with the number of projects in which they were found (out of 86 projects for this analysis).

Table 24: Keywords and number of projects summaries in which they were found

Keywords	**Number of NTS**
Lice, louse or delousing	29
Vaccine or vaccination	19
Commercial	32
Tag or tagging	27
Adipose fin	5
Anesthesia or anaesthesia	15
Commercial **and** lice	16

As expected, the problem of lice in fish farming is connected to many of the large projects using animals. The importance of fish farming is also seen in the relatively large number of projects containing the word commercial, although some of these NTS may be using the word in other contexts, such as testing of products before commercialisation. We also searched for summaries containing two words to find overlaps.

[16] https://chatgpt.com/g/g-F00faAwkE-open-a-i-gpt-3-5
[17] https://www.gov.uk/government/collections/non-technical-summaries-of-projects-granted-under-aspa

Applying the result of the word search to the bubble graphs with our mixed severity index allowed us to identify more patterns in the size and distribution of the projects in which words were found.

Figures 23-29 identify the project summaries where each of the keywords are found (in blue). The red bubbles show projects with NTS that do ***not*** contain the searched keywords, and the grey bubbles show the projects for which an NTS was not available for analysis.

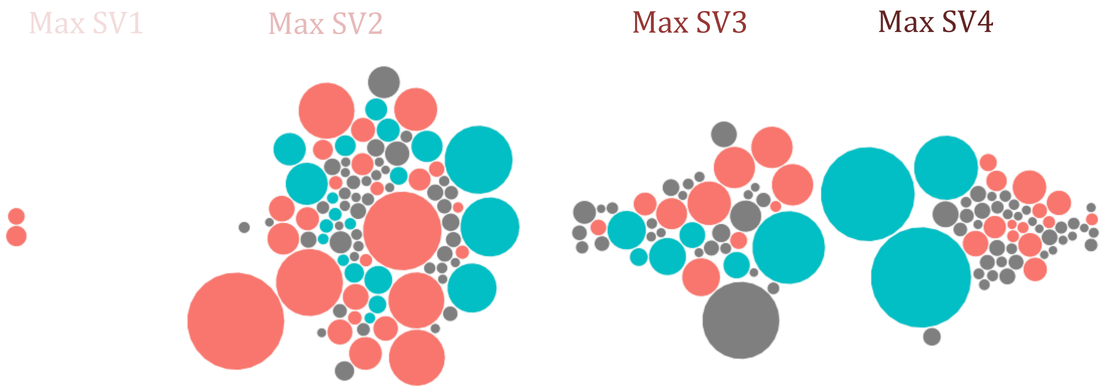


Figure 23. Bubble chart for the keywords "lice", "louse" or "delousing" (in blue)

Figure 23 shows that several of the largest and more severe projects relate to lice, along with many projects of lower severity. However, even when reaching a severity of category SV4, experiments related to lice do not involve a large proportion of procedures in that category, since many projects at the right end of the figure (those with mostly SV4 procedures, in red) do not include the words lice, louse or delousing in their summaries.

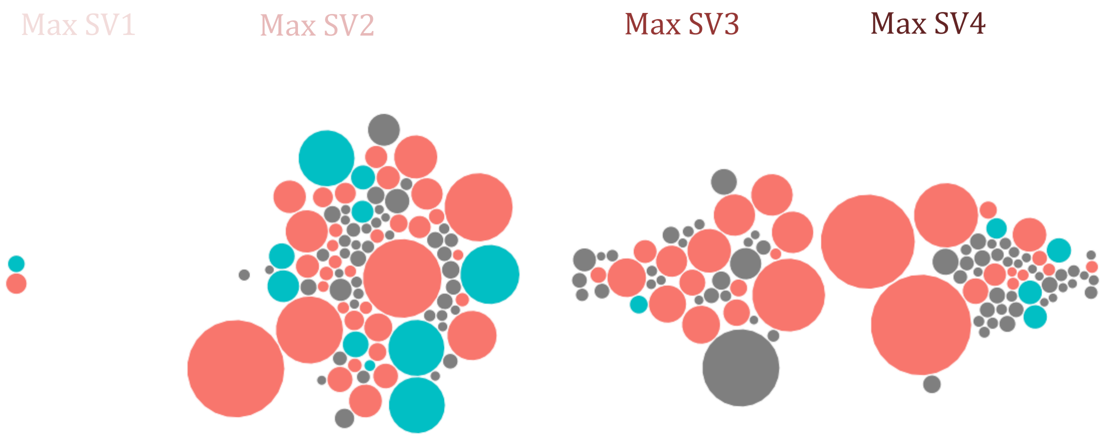


Figure 24. Bubble chart for the NTS keywords "vaccine" or "vaccination"

Figure 24 shows that vaccination-related projects (blue bubbles), while less frequent than lice-related projects, can be found in the most severe category (i.e. maximum severity of SV4 with a large proportion of SV4 procedures).

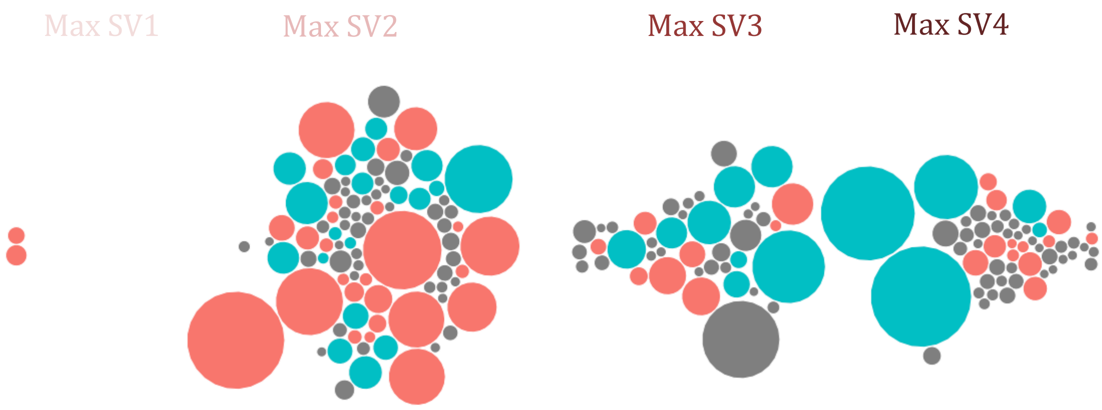


Figure 25. Bubble chart for the NTS keyword "commercial"

Figure 25 indicates that projects related to commercial fish farming (blue bubbles) are likely to be spread across all sizes and severities and are linked to some of the largest projects.

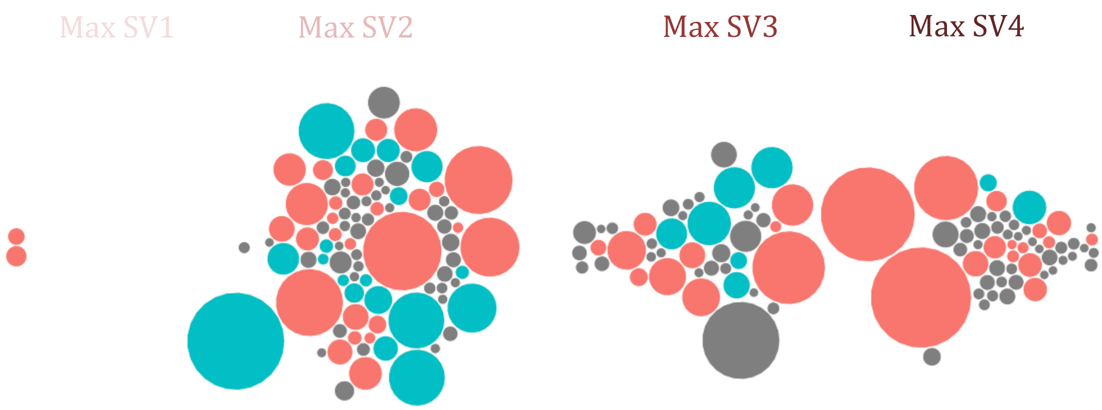


Figure 26. Bubble chart for the NTS keywords "tag" or "tagging"

Figures 26 and 27 are interesting from the point of view of Refinement, as they indicate a shift to the left in severity category.

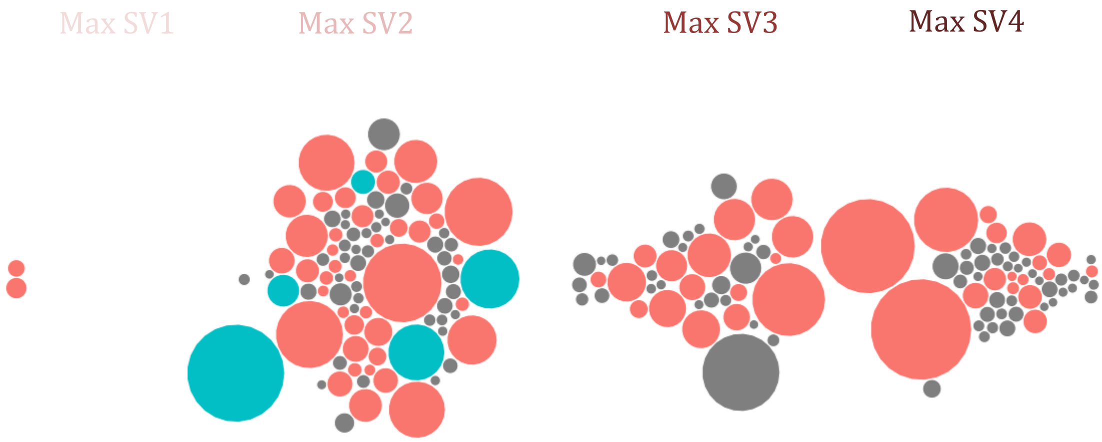


Figure 27. Bubble chart for the NTS keyword "adipose fin"

Figure 28 is also interesting for refinement efforts. Further analysis would be useful to identify why a few of the more severe projects that included the keyword "anaesthesia" still ended up in those categories (the blue bubbles in Max SV3 & Max SV4). The text in these NTS may indicate, for example, why anaesthesia was not possible, or why it failed to reduce severity.

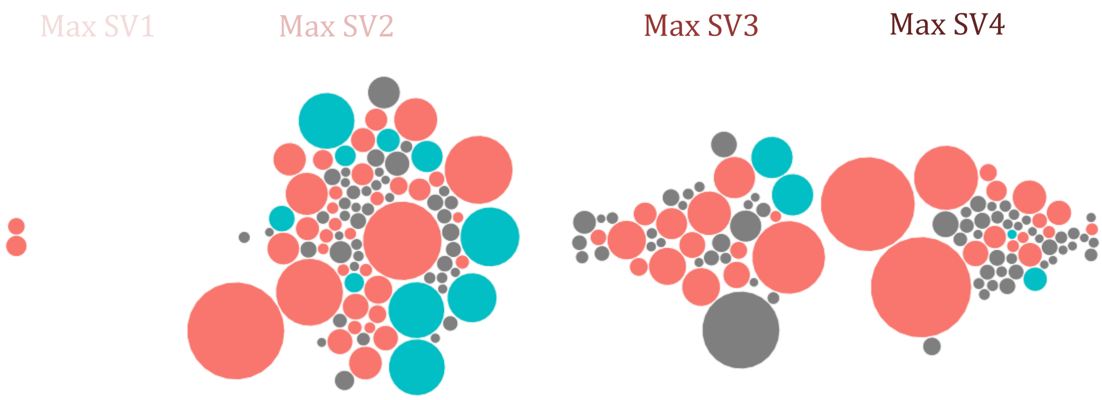


Figure 28. Bubble chart with projects containing "anesthesia" or "anaesthesia" in their non-technical summaries in blue.

Figure 29 identifies project with summaries containing both "commercial" and "lice". It shows that the match between projects with each word separately is only partial, suggesting that additional content regarding the use of the two keywords would help assess the size and severity of projects related to lice in the specific context of commercial fish farming. All the same, Figure 29 and a comparison with Figures 23 & 25 indicate that the lack of matching is spread across all project severities and sizes.

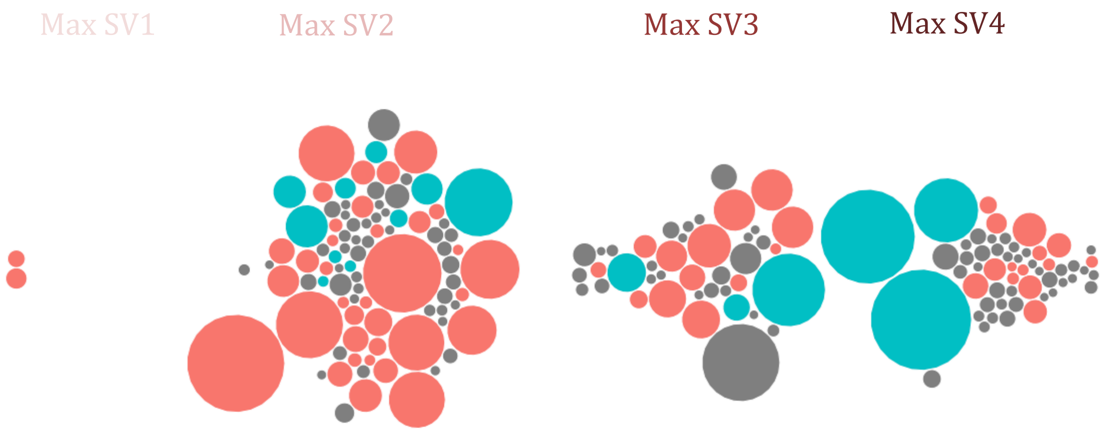


Figure 29. Bubble chart of projects containing "commercial" and "lice" in their non-technical summaries (in blue).

The keyword matching approach used in this section is useful to understand the severity and size of projects, based upon prior knowledge of the context of animal use in Norway. It confirms that lice and commercial fish farming are important drivers of procedures. However, it is of limited use in trying to reveal new patterns.

We therefore supplemented this approach with a word-frequency analysis that does not rely on prior knowledge, to try and identify homogenous groups among large projects.

b. Clustering using word frequency analysis

To group projects based on their summaries but without prior selection of keywords, we conducted a word-frequency analysis. This analysis started by building a list of meaningful words used in each NTS. This was achieved by splitting the text into words and removing stopwords (for example "and", "is", "the"). The lists were then combined in one large frequency table, where each column represented a word out of all the words used in all summaries, with a line for each project. The entries in the table indicate how many times each word is used by each NTS. The next step consisted of comparing the word frequencies of each project and trying to group them so that projects with similar word usage are in the same groups, and that groups differ from each other as much as possible. The specific method used for this method of grouping is called k-means clustering[18].

In all clustering, there is an inherent trade-off between the number of groups and how close elements within a group are to each other. Many groups or clusters means less variation within groups, but also leads to less useful sorting.

Clustering is known to be sensitive to assumptions and parameters. We performed several checks to try and identify a means of robust clustering. To choose the number of clusters we ran the clustering algorithm with one to 40 clusters, to find when the variation within clusters tapers off as more groups are added. We found that with 5

[18] https://en.wikipedia.org/wiki/K-means_clustering

groups we were able to generate relatively homogenous groups without creating too many of them. This meant that adding more groups after the 5 first did not generate significantly more homogenous groups and did not greatly increase the difference between groups.

Figure 28 provides a visualisation of the five groups obtained from this clustering analysis.

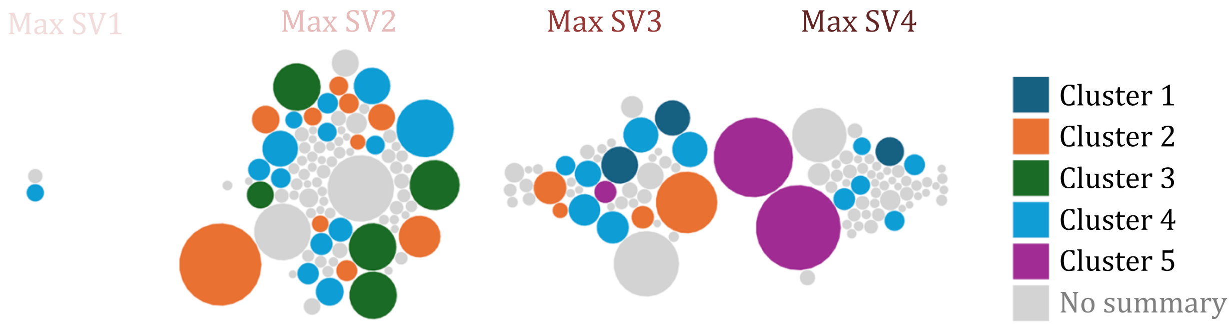


Figure 28. Bubble chart of large projects showing groups based on word frequency in Non-Technical Summaries

Table 25 shows the number of project summaries found in each of these groups:

Table 25: Number of projects per group in word-frequency clustering

Group/cluster	Number of project
1	3
2	14
3	5
4	25
5	3
Total	50

It is important to note that only the text data in the summaries is used for the clustering. A complementary clustering could also include species, purpose and other categorical data, although some of this information is expected to be contained in the summaries.

Figures 29 to 33 show, as word clouds, the most frequent words in each of the five clusters.

Figure 29. Word cloud for the first group of projects

Figure 30. Word cloud for the second group of projects

Figure 31. Word cloud for the third group of projects

Figure 32. Word cloud for the fourth group of projects

Figure 33. Word cloud for the fifth group of projects

To check the robustness of this grouping, we varied the selection of words used in the groups. For example, we removed all the words that appeared less than 10 times altogether in the summaries, and we only used the 100 most frequent words, or the most meaningful 100 words based upon our knowledge of the subject matter. For the most part, the composition of the groups was conserved when using these methods, particularly in the smaller groups (1, 3 and 5 above) but the larger groups tended to be split or combined into one larger one.

We also performed the same analysis on the Norwegian versions of the summaries (some of these were original Norwegian text, and others were translated into Norwegian using DeepL). We found that the two large groups (2 and 4) were then combined, and group 3 was split into two. This may be indicative of a pattern in the words picked by the translation algorithm, or in the quality of the list of stopwords in Norwegian, since text-mining tools are probably more widely used and tested in English.

Further work is necessary to try and compare the findings from our text-mining analyses. This first text-mining effort on the Non-Technical Summaries of Norway's animal use has revealed some possibilities for insights into the purpose of procedures and the causes of their severity. However, it also suggests that more elaborate text-mining approaches tailored for the specific field of animal experimentation are required.

12. Concluding remarks

The aim of this work was to inform both the Norwegian authorities and researchers, and to help identify where the most effective measures might be applied to reduce both the total number of animals and the severity of the scientific procedures which must still be performed.

The Norwegian Food Safety Authority reports that the changes in purpose over time are largely caused by corrections which they have made to projects that have involved relatively many animals. The apparent reduction of number of animals in the “Non-recovery” category is a result of corrections of obvious misunderstandings. Animals dying from disease or being euthanised after procedures shall not be reported in the “non-recovery” category. The responsibility for correct reporting lies with the scientists and their institutions, not the authorities (Norwegian Food Safety Authority, personal communication).

The value of this document is therefore dependent upon correct reporting. In particular, differences in the use of categories may have affected both the allocation of severity (Mild, Moderate or Severe) and purpose (e.g. Basic or Translational/Applied research). In particular, there is a need to continue the international discussions on differentiation between the severity categories, to which Norecopa has contributed[19]. It has been shown in other countries that procedures have been assigned to differing categories depending upon the authority issuing the guidelines[20].

The absolute number of animals used for scientific purposes in any country is, of course, a reflection of the general level of scientific activity as well as the number of animals in individual projects. Norway's statistics are also highly influenced by the needs generated by fish farming, and by the number of animals used in field research.

This report aims to supplement the annual reports of the Norwegian regulatory authorities, and their submissions to the EU Commission, by giving additional visual presentations of the data available. It is our hope that this report, and the Excel file generated from all the 6 years that were studied, can be used to help identify areas where further implementation of all the Three Rs can be achieved.

13. Acknowledgements

The work was financed by a grant from the Norwegian Animal Protection Alliance's Research Fund (*Dyrevernalliansens forskningsfond*)[4], to whom we are very grateful.

We gratefully acknowledge comments from representatives of the Norwegian Food Safety Authority.

[19] https://norecopa.no/more-resources/severity-classification
[20] https://norecopa.no/severity

14. Appendix

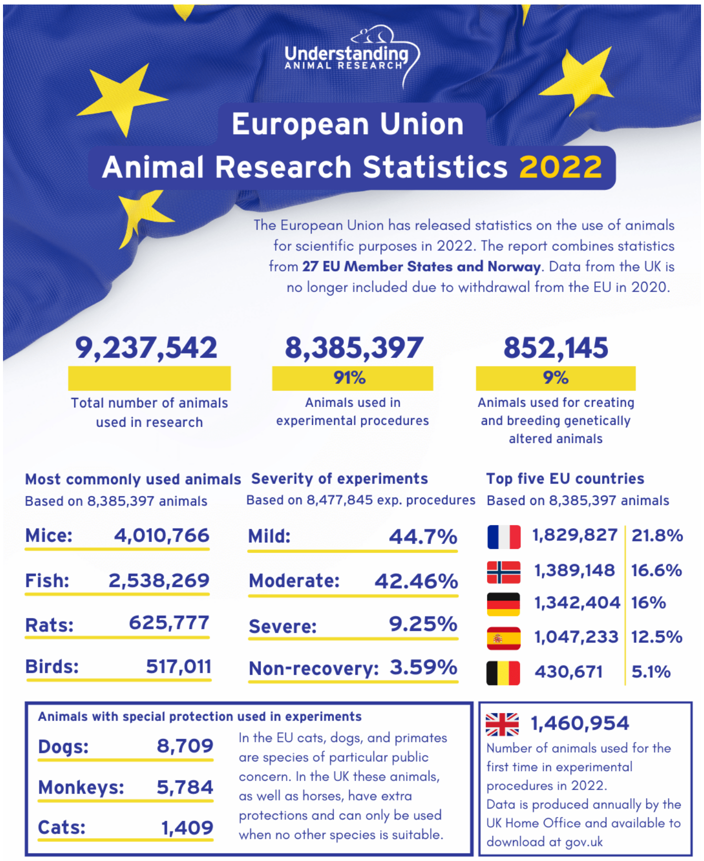
A1: EU's definitions of the severity categories

Category symbol and name	Definition
[SV1] Non-recovery	Procedures which are performed entirely under general anaesthesia from which the animal shall not recover consciousness shall be classified as 'non-recovery'.
[SV2] Mild [up to and including]	Procedures on animals as a result of which the animals are likely to experience short-term mild pain, suffering or distress, as well as procedures with no significant impairment of the well-being or general condition of the animals shall be classified as 'mild'.
[SV3] Moderate	Procedures on animals as a result of which the animals are likely to experience short-term moderate pain, suffering or distress, or long-lasting mild pain, suffering or distress as well as procedures that are likely to cause moderate impairment of the well-being or general condition of the animals shall be classified as 'moderate'.
[SV4] Severe	Procedures on animals as a result of which the animals are likely to experience severe pain, suffering or distress, or long-lasting moderate pain, suffering or distress as well as procedures that are likely to cause severe impairment of the wellbeing or general condition of the animals shall be classified as 'severe'.

See also the working documents on a *Severity Assessment Framework* endorsed by the National Competent Authorities of the EU Member States for the implementation of Directive 2010/63/EU[21].

[21] https://ec.europa.eu/environment/chemicals/lab_animals/interpretation_en.htm

A2: Infographic from *Understanding Animal Research* showing the latest figures for animal use in the EU (2022) and Norway[22]



The respective figures for Norway (from Table 1 and [23]) are:

Mice:	53,187	Mild:	38%
Fish:	1,497,886	Moderate:	56%
Rats:	2,740	Severe:	5%
Birds:	10,197	Non-recovery:	1%

Dogs: 215
Monkeys: 0
Cats: 0

Note that the UK would have been in second place among the top 5 EU countries, above Norway, had they not withdrawn from the EU in 2020.

22 https://www.understandinganimalresearch.org.uk/resources/infographics/european-union-animal-research-statistics-2022

23 https://mattilsynet-xp7prod.enonic.cloud/_/attachment/inline/bc429366-0e50-43c3-9446-115464212e09:5f98c08cc5daeceaa924fbf183a6f87875da209d/BRUK%20AV%20DYR%20I%20FORSØK%20I%202022.pdf

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