

Marine birds drowning in fishing nets in the Gulf of Gdańsk (southern Baltic): numbers, species composition, age and sex structure

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Abstract

During 8 seasons (1972–1976 and 1986–1990) 1 254 marine birds of 24 species, drowned in fishing nets in the Gulf of Gdańsk, were collected and studied. As a rule, the most numerous bird species in the Gulf constituted the most common by-catch. The exceptions are the Golden-eye *Bucephala clangula*, Tufted Duck *Aythya fuligula* and Coot *Fulica atra*, the numbers drowned being incomparably low compared with those observed in the Gulf. The reverse is the case in the Eider *Somateria mollissima*. The percentage share of the Long-tailed Ducks *Clangula hyemalis* and Eiders in by-catches increased in general and that of the Velvet *Melanitta fusca* and Common Scoters *Melanitta nigra* decreased during successive years of the study. The number of birds drowned in nets in different months roughly reflects the seasonal changes in their numbers in the Gulf. Adult birds, particularly males, predominated among the Long-tailed Ducks (68% and

47% respectively) and Velvet Scoters (65% and 46% respectively). The opposite was the case among the Common Scoters and Eiders, where immature birds constituted as much as 71% and 67% respectively. With the passage of the season, these proportions changed in a species specific way. Adult birds became entangled in fishing nets less frequently than expected, considering their percentage share in the wintering population. It is estimated that about 17 500 birds (10–20% of the number observed in the area) die annually in nets. These include Long-tailed Ducks (about 8 400), Velvet Scoters (about 4 000), Scaups *Aythya marila* (about 1 300), Common Scoters and Eiders (each about 1 000).

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Introduction

Marine birds, fish and fishermen concentrate in the same food-abundant regions of the sea for trophic reasons. This convergence in time and space have to lead to conflicts. Large numbers of birds, mainly diving birds (auks, penguins, shearwaters, gannets, divers, grebes, sawbills, diving ducks) drown each year in fishing nets (bottom set and floating gill nets, cod and lobster traps, etc.) in all seas of the world. Scavengers (gulls, petrels) feeding on fish, birds and mammals entangled on the surface, also often die in nets. Incidental catches in fishing nets, together with oil pollution, are considered to be the main anthropogenic factors in marine bird mortality (Ashmole 1971, Bourne 1976, 1977, Cobb 1976, King et al. 1979, Nettleship et al. 1984, Stempniewicz 1991, Harrison & Robins 1992).

The problem occurs during the breeding season (especially in the vicinity of large colonies of sea-

birds) as well as in the moulting and wintering areas. This has been reported from both Pacific (Ainley et al. 1981, Carter & Sealy 1984) and Atlantic regions (Tull et al. 1972, Piatt et al. 1984, Olden et al. 1985, Piatt & Nettleship 1987). Also in Polish coastal waters it has been noted that birds may drown in fishing nets (Szczeplski 1948, Kowalski & Mankowski 1982, Kieś & Tomek 1990). The Gulf of Gdańsk is such a risky region for waterbirds, since the fishing is intensive and large numbers of waterbirds concentrate here during winter, autumn and spring (Górski & Strawinski 1986, Meissner 1989, 1992).

This paper presents data on number, species composition, age and sex structure of diving birds drowned in fishing nets set in the Gulf of Gdańsk during eight wintering seasons, 1972–1976 and 1986–1990. The spatial and temporal (within a sea-

son) variability of catches is also described. The results are discussed and compared with data obtained during field observations. On that basis the mortality of diving birds in fishing nets in the Gulf of Gdańsk is estimated.

Material and methods

Birds entangled and drowned in nets were collected with the co-operation of fishermen from two fishing ports (Orłowo – 6 motor boats, and Sopot – 9 motor boats registered). The ports were visited and birds collected 1–3 times a week over 8 seasons (November–May) in 1972–1976 and 1986–1990. During two seasons (1973/74 and 1987/88) drowned birds were regularly stored by fishermen (in their opinion, 65–75% of the total number drowned) and then collected. In the remaining seasons birds were stored irregularly so the proportion of the drowned birds that was collected is not known. Data from these seasons were not taken into account when estimating total number of bird catches in the Gulf. Birds were thoroughly examined and dissected in the laboratory, determining species, age (2 categories: immature and adult) and sex of each individual.

The study area (i.e. fishing grounds) covers shallow (2–10 m) coastal waters from Orłowo to Jantar

(including Vistula Mouth), and deeper waters (up to 80 m) in the central part of the Gulf (Fig. 1). In this area both benthic species (Bivalves, Gastropods, Polychaetes, Crustaceans) and fishes are very abundant. The most important fish species netted here are Cod *Gadus morhua*, flatfish (*Platessa platessa*, *Platichthys flesus*), Herring *Clupea harengus*, Trout *Salmo trutta*, and Perch *Perca fluviatilis*. Also Eel *Anguilla anguilla* and Eelpout *Zoarces viviparus* constitute an important catch but they are trapped, and not netted.

Cod is caught in bottom-set gill nets (40×2.5 m, mesh-size 55 mm) at depths from about 10 m (September, October) to 80 m (usually 20–30 m) in the winter months. There are no permanent cod fishing grounds in the Gulf. Flatfish nets (40×1.5 m, mesh-size 60–70 mm) are set anywhere on bottoms in shallow water (2.5–8 m deep). Nets used for trout are of two types. Bottom-set nets (35×2.5 m, mesh-size 65 mm) are put in shallow (2–3 m deep) river mouths, and floating nets (1.5×2–3 m, mesh-size 80 mm) are set only out of the ship routes (mainly in Puck Bay, i.e. out of the study area). Herring nets (2 sizes: 25×6 m, and 50×2.5 m, mesh-size 24–26 mm) are set floating 1–2 m below the water surface at depth not exceeding 10 m. The main herring fishing grounds are situated in the region of Vistula Mouth, spreading eastward to Jantar and westward to Gdańsk (Fig. 1).

The nets are checked usually after one, and sometimes after more days, depending on weather conditions. The crew of one boat uses about 80 cod nets (40 rolled and 40 set during one control), 30–40 nets for flatfish and 20–25 herring nets. The number of salmon nets per boat is very variable depending on specialization of the particular crew. Some of them use as much as 100 nets and others do not use them at all.

Nets are set all year around but the main fishing season (November–April) coincides with the wintering season of diving birds in the Gulf of Gdańsk. Flatfish constitutes the most important catch in October and November, and the second most important in December, April and May. Cod predominates in net catches during the winter months (December–March) and in April. Herring is caught in greatest quantities in May and also much in October/November and March/April. In general, the catch of fish of the majority of species decreased during the study period except for flatfish and Perch. However, detailed data are not available.

Total catches of birds during one season were based on material collected in two fishing ports

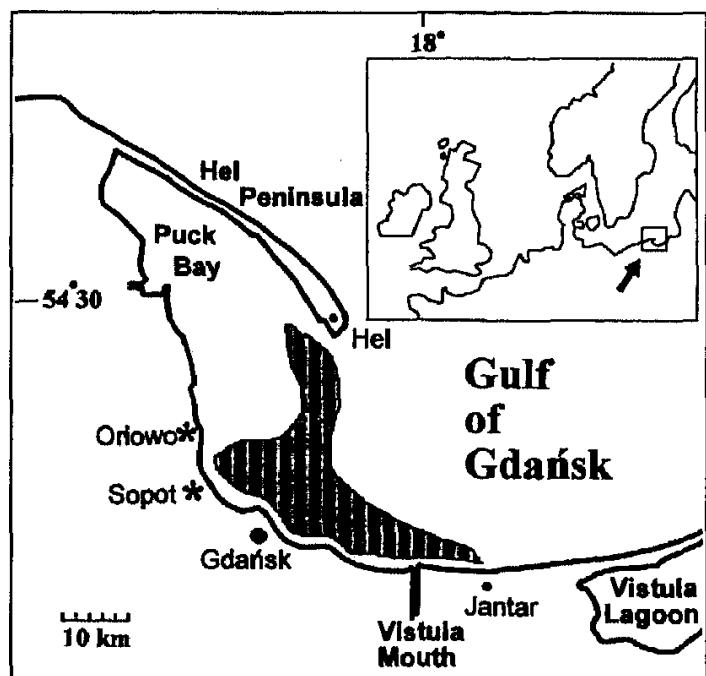


Fig. 1. Area of the Gulf of Gdańsk, Southern Baltic (asterisks indicate the fishing ports, Orłowo and Sopot, where net catches were collected; shading indicates fishing grounds).

Karta över Gdanskbukten i södra Östersjön. Asterisker visar fiskehamnarna där fåglar som drunknat i fisknät insamlats. Skuggning markerar fiskeområden.

Table 1. Number (%), age and sex structure of waterbirds drowned in nets in the Gulf of Gdańsk (ad - adult; im - immature; m - males; f - females)

Antal, ålders- och könsfördelning av sjöfåglar drunknade i fisknät i Gdanskbukten (ad - adult, im. - ung, m - hane, f - hona)

Species	Total	%	ad m	ad f	im m	im f
<i>Clangula hyemalis</i>	606	48.3	286	124	75	106
<i>Melanitta fusca</i>	289	23.0	132	56	48	48
<i>Aythya marila</i>	96	7.7	17	36	31	9
<i>Melanitta nigra</i>	78	6.2	9	9	28	28
<i>Somateria mollissima</i>	69	5.5	13	9	25	21
<i>Podiceps cristatus</i>	28	2.2	9	11	2	2
<i>Aythya fuligula</i>	19	1.5	11	3		1
<i>Fulica atra</i>	12	1.0		1		1
<i>Uria aalge</i>	10	0.8	2		6	
<i>Cephus grylle</i>	9	0.7	3	3	2	
<i>Mergus serrator</i>	8	0.6	2		2	1
<i>Podiceps griseogenus</i>	5	0.4		2		
<i>Gavia stellata</i>	5	0.4		1	1	
<i>Alca torda</i>	5	0.4			1	4
<i>Gavia artica</i>	3	0.2	1			
<i>Bucephala clangula</i>	3	0.2	1			2
<i>Podiceps auritus</i>	2	0.2		1		
<i>Somateria spectabilis</i>	1	0.1				1
<i>Mergus albellus</i>	1	0.1	1			
<i>Mergus merganser</i>	1	0.1	1			
<i>Gavia immer</i>	1	0.1	1			
<i>Gavia adamsi</i>	1	0.1				1
<i>Phalacrocorax carbo</i>	1	0.1	1			
<i>Alle alle</i>	1	0.1				1
Total number	1254	100.0	489	257	222	225
%	100		39.0	20.5	17.7	17.9

Note: Age and/or sex of some birds has not been noted. Ålder och/eller kön har inte registrerats för vissa fåglar

during two seasons (1973/74 and 1987/88) and extrapolated from calculated catch per registered motor boat per season to total fishing effort in the Gulf. Rowing boats (46 registered in the Gulf, usually assisting but also fishing) were not included in the calculations. Information concerning the number of boats registered was obtained from the Maritime Office in Gdynia.

Results and discussion

Species composition

Altogether, 1 254 birds of 24 species were examined. Represented by 8 species, diving ducks were most frequently entangled in nets, being followed by auks and divers (4 species each), grebes and sawbills (3 species each). The Long-tailed Duck *Clangula hyemalis*

was the most numerous species (606 birds – 48.3%), followed by the Velvet Scoter *Melanitta fusca* (289 birds – 23.0%). Birds of other species did not exceed 10%, the majority constituting less than 1% of the material. Also, some rare species (*Somateria spectabilis*, *Gavia immer*, *G. adamsi*, *Alle alle*), observed sporadically on the Polish Baltic coast, were found during the study (Table 1).

The species composition of birds drowned in nets in different fishing grounds did not differ much, despite significant differences in their distribution in the Gulf. The Long-tailed Duck was the first and the Velvet Scoter the second most frequent prey entangled in nets set in the Vistula Mouth (48.3% and 23.0%, respectively, this study), in Puck Bay (41.0% and 21.9%, respectively, Kieś & Tomek 1990) and in the central part of the Polish Baltic coast, in the Dziwnów area (53.0% and 26.8% respectively, Kow-

alski & Manikowski 1982). There seem to exist differences concerning bird species drowning in nets in smaller numbers (<10% of the total share), since auks (*Uria aalge*, *Alca torda*) constitute a common by-catch (25%) in Puck Bay (Kieś & Tomek 1990), where they concentrate during the winter period (Meissner 1989).

The number of birds drowned in nets roughly reflects their proportions in the Gulf. However, exceptions are Goldeneye *Bucephala clangula*, Tufted Duck *Aythya fuligula* and Coot *Fulica atra*, since they winter in large numbers (Górski & Strawinski 1986, Strawinski 1990, Meissner & Klawikowska 1993, Michno et al. 1993), but are rarely found in the nets (Table 1). Kowalski & Manikowski (1982) and Kieś & Tomek (1990) also did not report these species in by-catches from other localities, probably because these species may forage away from the main fishing grounds. Covered areas (ports, piers, breakwaters, etc.) and very shallow waters often occupied by these species are usually free of the fishing nets.

The opposite is the case with the Eider *Somateria mollissima*, which winters in the Gulf in small numbers (Górski & Strawinski 1986, Strawinski 1990, Meissner & Sikora 1993) and yet is frequently found drowned in nets. The reasons for this are not clear, although a likely explanation is that the distribution of the Eider is limited to coastal waters overlapping with fishing grounds. For example, in the opinion of fishermen, Eiders concentrate in areas with an abundance of Herring and become entangled mainly in herring gill nets. This is supported by an analysis of

stomach contents (Stempniewicz, unpubl.). Also the Velvet and Common Scoters drown in nets more frequently than would be expected considering their relatively low numbers in the Gulf (Meissner 1993, Stempniewicz 1986).

During successive seasons different numbers of birds were collected (Table 2). The percentage share of the five most numerous ducks in by-catches changed in successive seasons. The Long-tailed Duck was the commonest prey during the whole study period, with the exception of 1987/88, when more Scaups were caught. However, the Scaups generally occurred only sporadically, and such erratic changes in numbers are characteristic for this species, at least in the Gulf of Gdańsk (Michno et al. 1993). During the years of study, the proportion of Long-tailed Ducks generally increased. By contrast, the second most numerous species, the Velvet Scoter, showed a continuous decrease in share over successive years. Also the proportion of Common Scoter tended to decline, while the number of Eiders obviously increased, during the consecutive seasons (Table 2). It is difficult to explain these trends. Unfortunately, it is not possible to relate these figures to changes in the number of seabirds wintering in the Gulf of Gdańsk during the study period because of the lack of such data in the 1970s. However, existing data for the 1980s do not show any consistent trends (Meissner, unpubl.).

For five of the most common species drowned, it was possible to show how abundance varied during the wintering season. Long-tailed Ducks showed their first peak in December and a second peak in

Table 2. Collected waterbirds of the five most numerous species drowned in fishing nets in the Gulf of Gdańsk.
Insamlade i fisknät drunknade individer av de fem vanligaste övervintrande sjöfågelarterna i Gdanskbukten.

Species		72/3	73/4	74/5	75/6	86/7	87/8	88/9	89/90	Total
Long-tailed Duck <i>Clangula hyemalis</i>	N	37	217	36	19	80	80	77	60	606
	%	42.5	42.5	45.0	70.4	68.4	35.1	68.1	65.9	48.3
Velvet Scoter <i>Melanitta fusca</i>	N	28	203	16	4	8	21	5	4	289
	%	32.2	39.7	20.0	14.8	6.8	9.2	4.4	4.4	23.0
Scaup <i>Aythya marila</i>	N	1	0	0	0	0	93	2	0	96
	%	1.1	0.0	0.0	0.0	0.0	40.8	1.8	0.0	7.7
Common Scoter <i>Melanitta nigra</i>	N	4	52	14	0	5	0	2	1	78
	%	4.6	10.2	17.5	0.0	4.3	0.0	1.8	1.1	6.2
Eider <i>Somateria mollissima</i>	N	1	8	3	2	10	8	13	24	69
	%	1.1	1.6	3.7	7.4	8.5	3.5	11.5	26.4	5.5
All 24 species in total	N	87	511	80	27	117	228	113	91	1254
% of total number	%	6.9	40.7	6.4	2.1	9.3	18.2	9.0	7.3	100.0

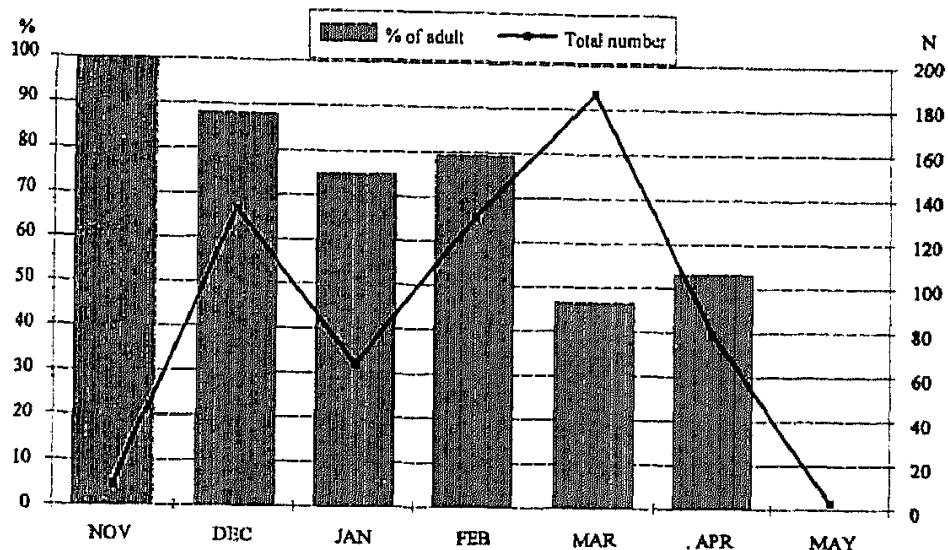


Fig. 2. Number of Long-tailed Ducks (N) and proportion (%) of adult birds in the material collected during particular months of the whole period of study. Percentage not shown for May because of small sample size.

Månatlig fördelning av antal alfväglar som drunknat i fisknät (höldragen linje; N) och andel adulta individer (staplar; %) i Gdanskbukten. Procentstapel för maj utelämnad på grund av litet stickprov.

February and March (Fig. 2, Table 3). This confirms the views of a 2-peak temporal distribution of the Long-tailed Ducks in the Baltic wintering grounds (Mathiasson 1970, Górska & Strawinski 1986, Strawinski 1990, Meissner & Maracewicz 1993). The Velvet Scoter, on the other hand, showed only one peak in February (Fig. 3, Table 4). This pattern resembles that observed in the Gulf of Gdańsk (Górska & Strawinski 1986, Strawinski 1990, Meissner 1993).

Scaups were collected almost exclusively in March (98%), while Common Scoters were numerous in by-catches in November (20%) and in February and March (25% and 27%, respectively). A very similar two-peak temporal distribution of the wintering Common Scoters was observed in the Gulf (Manikowski 1968, Meissner 1993). Eiders displayed two peaks, the first one in December (42%) and the second one in March (28%). The first Eiders were

found in nets in November and the last in April. Field observations in the Gulf offer a similar picture, but the peaks are slightly shifted in time (January and February/March) (Meissner & Sikora 1993). This may be related with local and inter-seasonal differences of Eider wintering phenology in the Gulf.

Age and sex proportions

In the catch of the Long-tailed Duck, adults predominated (68%) and among them the males (Table 3). During the successive months of the wintering season the share of adults gradually dropped from 100% in November to about 50% in March and April (only 3 individuals were picked up in May). These proportions were mainly due to the share of males, being almost 90% at the beginning and only about one third towards the end of the season. The change in the share of females was not as distinct as the season passed. Young Long-tailed Ducks drowned with

Table 3. Number (%) of Long-tailed Ducks drowned in different months during the whole period of study.

Månatlig fördelning av fisknätsdrunknade alfväglar av olika kön och ålder i Gdanskbukten.

Month	Total number	(%)	Adult (%)		Immature (%)	
			males	females	males	females
Nov	9	(1.5)	88.9	11.1	0.0	0.0
Dec	133	(21.9)	63.9	24.1	5.3	6.0
Jan	64	(10.6)	46.9	28.1	6.3	3.1
Feb	131	(21.6)	42.2	25.2	6.1	14.5
Mar	187	(30.9)	32.6	13.9	17.1	34.2
Apr	79	(13.0)	35.4	17.7	30.4	16.5
May	3	(0.5)	100.0	0.0	0.0	0.0
Sum (%)	606	(100)	286 (47.2)	124 (20.5)	75 (12.4)	106 (17.5)

Note: Age and/or sex of some birds has not been noted. *Ålder och/eller kön har inte registerats för vissa fåglar.*

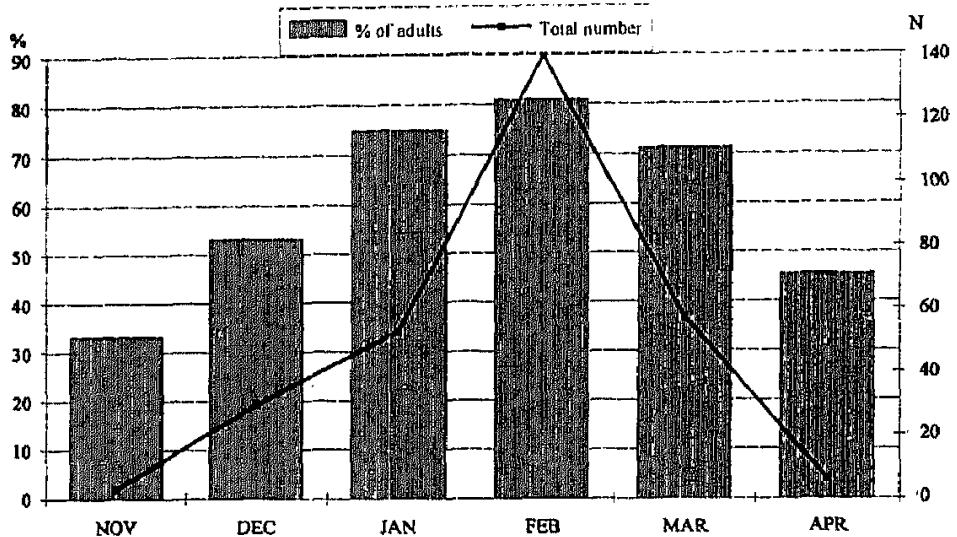


Fig. 3. Number of Velvet Scoters (N) and proportion (%) of adult birds in the material collected during particular months of the whole period of study.

Månatlig fördelning av antal svärtor som drunknat i fisknät (höldragen linje; N) och andel adulta individer (staplar; %) i Gdanskbukten.

increasing frequency in the consecutive months (Fig. 2, Table 3).

The age-sex structure of the Velvet Scoter was similar. Almost two thirds of the total were adults, 46% being males (Table 4). The changes in age-sex groups in consecutive months were less distinct in the Velvet Scoters than in the Long-tailed Duck. Adult Velvet Scoters tended to show lower proportions at the beginning and end of the season, with the maximum (81%) in January (Fig. 3, Table 4).

In Scaups the proportions of adults and immatures, females and males were fairly even, with a slight predominance of adults. As already mentioned, the Scaups appeared only once in large numbers (in March 1988), hence the analysis of age and sex structure refers only to that period. Females were the most common sex among the adults, while males were more common among immatures (Table 1).

Among the Common Scoters and Eiders young birds predominated (71% and 67%), with an equal

proportion of the sexes within both age groups (Table 1). In both species the share of immature birds tended to increase in the consecutive months of the season (Table 5).

A comparison of the age-sex structure of birds drowned in fishing nets with that observed during field counts in the Gulf is only partially possible. In the field it is usually possible to distinguish only two "age-sex" groups, i.e. adult males and the rest (adult females plus juveniles), hence the incomplete data (Nilsson 1970). The material collected in the present study, on the other hand, provides detailed information on the subject, at least for the most numerous species, thus constituting a valuable supplement to field studies. However, we lack enough information about possible differences between age groups and sexes concerning their vulnerability to fishing nets and the ensuing winter losses. Hence only adult males can be analysed.

Field counts of all Long-tailed Ducks in the Gulf

Table 4. Number (%) of Velvet Scoters drowned in different months during the whole period of study.

Månatlig fördelning av fisknätsdrunknade svärtor av olika kön och ålder i Gdanskbukten.

Month	Total		Adult (%)		Immature (%)	
	number	(%)	males	females	males	females
Nov	3	(1.0)	33.3	0.0	33.3	0.0
Dec	30	(10.4)	50.5	3.3	16.7	20.0
Jan	53	(18.3)	56.5	24.5	11.3	7.5
Feb	140	(48.4)	50.7	20.7	12.1	15.7
Mar	57	(19.7)	26.3	19.3	29.8	24.6
Apr	6	(2.1)	0.0	33.3	33.3	33.3
Sum (%)	289	(100)	132 (45.7)	56 (19.4)	48 (16.6)	48 (16.6)

Note: Age and/or sex of some birds has not been noted. *Ålder och/eller kön har inte registerats för vissa fåglar.*

Table 5. Number of Common Scoters and Eiders and proportion of immatures drowned in different months during the whole period of study.

Antal i fisknät drunknade sjöorrar och ejdrar, samt andel ungfåglar under olika månader.

Month	Common Scoter		Eider	
	Total	% immatures	Total	% immatures
Nov-Dec	23	47.8	33	63.6
Jan-Feb	28	71.4	14	64.3
Mar-Apr	27	92.6	22	77.3

in the winter months (December–February) show that adult males constitute from 60% (in sheltered bays) to 85% (in open areas, e.g. the region of Hel and the Vistula Estuary, from where the birds caught in nets originated (Fig. 1, Meissner & Maracewicz 1993). This should be compared to the distinctly lower estimate based on drowned birds, fluctuating from 54% in February to 64% in December (Table 3). This difference suggests that adult males avoid fishing nets.

The same conclusion is obtained for the Velvet Scoter when comparing the share of adult males present in the Gulf (about 70%; Meissner 1993) with their share among those drowned in nets (about 50%; Table 4), and also for the remaining species analysed. It is possible that a greater proportion of juveniles than of adult males are used for consumption. This would overestimate the share of adult males in the material collected and strengthen the suggestion that adult males learn to avoid nets.

Mortality of marine birds in fishing nets

Data obtained in the 1973/74 and 1987/88 seasons, when material was collected most regularly, calling at the fishing berth 2–3 times per week throughout the whole season, were taken as the basis for calculations. In the opinion of the fishermen, during these two seasons, 65–75% of all the birds caught in the nets were collected. After an appropriate correction (assuming that 70% of netted birds were collected), the number of drowned birds per boat was estimated at 76. The number of birds caught in the nets by all the boats registered in the Gulf (230) could then be calculated (Table 6). The result was that about 17 500 diving birds die in the nets in the Polish part of the Gulf of Gdańsk during one season. Of this total, about 13 800 birds are lost in nets in the western part of the Gulf (to the west of the Vistula Estuary) for

Table 6. Estimated number of diving birds drowned in nets in the Gulf of Gdańsk during one season.

Uppskattat antal fåglar som drunknat i fisknät i Gdańskbukten under en säsong.

	1973/74	1987/88	Total
No. collected in 2 ports *	511	288	799
<i>Antal insamlade i 2 hamnar *</i>			
No. drowned (2 ports)	730	411	1141
<i>Antal drunknade (2 hamnar)</i>			
No. of registered motor boats (2 ports)	9	6	15
<i>Antal registrerade motorbåtar (2 hamnar)</i>			
Mean no. drowned per boat	81	68	76
<i>Medeltal drunknade per båt</i>			
Total no. of motor boats registered			
<i>Totala antalet registrerade motorbåtar</i>			
whole Polish part of the Gulf <i>hela polska delen av bukten</i>			230
west of Vistula mouth ** <i>väster om Vistulas mynning **</i>			82
Total no. of birds drowned			
<i>Totala antalet drunknade fåglar</i>			
whole <i>hela</i>			17 480
western part <i>västra delen</i>			13 832

* Estimated at 70 % of those drowned.

Uppskattat till 70 % av antalet drunknade.

** The birds wintering in this area are censused regularly.

Fåglarna som övervintrar i detta område räknas regelbundet.

which numbers of wintering birds are available. These 13 800 birds constitute about 15% of the maximum number of birds noted here during the counts.

Table 7 gives estimates of the numbers lost in nets during a single season. Their percentage share in the material available was taken as the basis. The results obtained have been compared with the estimated numbers of the particular species in the western part of the Gulf. This comparison suggests that birds caught in nets in the western part of the Gulf constitute about 10–20% of the peak numbers recorded in field counts in the area.

An exception is the Eider where the estimated number of individuals lost in the nets annually exceeds the maximum number of birds noted during

Table 7. Estimated number of drowned birds among the five most common diving ducks in the Gulf of Gdańsk during one winter season.

Uppskattat antal fåglar av de fem vanligaste dykänderna som drunknat i nät under en vinter i Gdanskbukten.

Species <i>Art</i>	% share whole* % andel <i>hela</i> *	No. drowned western** <i>Antal drunknade västra</i> **	Est. winter peak no.*** <i>Uppsk. högsta vinterantal</i> ***	% drowned of peak no. % drunknade av <i>högsta antal</i>
<i>Clangula hyemalis</i>	48.3	8443 6681	30–40000 MM	16.7–22.3
<i>Melanitta fusca</i>	23.0	4020 3181	14800 M	21.5
<i>Aythya marila</i>	7.7	1346 1065	10000 Mi	10.6
<i>Melanitta nigra</i>	6.2	1084 858	4200 M	20.4
<i>Somateria mollissima</i>	5.5	961 761	500 MS	152.2
Other species <i>Andra arter</i>	9.3	1626 1286		

* Whole Polish part of the Gulf of Gdańsk. *Hela polska delen av Gdanskbukten*

** Western part of the Gulf (west of Vistula mouth). *Västra delen av bukten (väster om Vistulas mynning)*

*** References Referenser: MM – Meissner & Maracewicz (1993), M – Meissner (1993), Mi – Michno et al. (1993), MS – Meissner & Sikora (1993)

the counts. Either the estimated number of this species in the Gulf is too low, or the share of birds in transit substantially increases the overall number of Eiders staying in the region. This is backed by the fact that the largest winter concentration of this species in the Western Palearctic (about one million birds) is relatively near by (on the Danish coast; Laursen 1989). Because of the same reason, it is possible that the estimates of mortality rate of the other common species also are too high.

Despite all the reservations below, the estimated number of birds lost in fishing nets in the Gulf of Gdańsk, based on material collected over 8 years, does not seem overestimated. Kieś & Tomek (1990) give a much higher figure – 250 birds caught in nets per season and boat, and the total number of birds lost in fishing nets in one port alone (Kuźnica, 15 boats) as 3 750. Kowalski & Manikowski (1982) counted 581 birds drowned in one season in fishing nets from Dziwnów. Given a maximum number of three boats fishing with ground nets we have no less than 194 birds per boat. The basis for calculation in the present paper is much lower, 76 birds/boat/season. In fact, the average number of birds caught in nets by the active crew of one boat, was higher. In the 1973/74 and 1987/88 seasons, 1 141 birds were caught in nets set by 8 regularly working boats from Orłowo and Sopot, i.e. 143 birds/boat/season (Table 6). The maximum by-catch brought to the port after one net control by fishermen from Sopot on 20–22 February 1974 amounted to 97 birds, of these 50 Long-tailed Ducks, 32 Velvet Scoters, 10 Common

Scoters, three Crested Grebes, one Red-necked Grebe *Podiceps griseigena* and one Red-breasted Merganser *Mergus serrator*. Durinck et al. (1993) reports that 340 Velvet and Common Scoters were caught in one night in 120 fishing nets set on Danish coastal waters near Hanstholm, North Sea.

Estimating mortality of marine birds in fishing nets in the Gulf of Gdańsk during the whole post-breeding period is associated with several problems. First, the number of birds drowned in nets is only an estimate of the actual number. This is because not all drowned birds are reported. Some are utilized as food for foxes and minks or even humans. Furthermore, fishing effort (number of nets/days per season), related with fishing profitability as well as weather conditions (storm and ice-bound periods), considerably influence the by-catch size.

Types of nets used and areas of their setting also strongly affect the numbers of killed birds. Most dangerous for diving birds are nets of mesh-size exceeding 35 mm, set in shallow water (up to 20 m) in some food-attractive regions (e.g. river mouths, banks, etc.). In the nets set at depth exceeding 30 m (max. 65 m) only single Long-tailed Ducks and Common Guillemots were found. Bottom diving birds are most threatened by nets set loose (not strained; e.g. flatfish nets) or loosen by storms. A majority of birds collected (although detailed data are lacking) drowned in nets used for flatfish, cod and salmon. Herring nets are relatively safe because of fine mesh-size, unless set loose in very shallow water. The number of drowned birds usually increased

after a storm since birds concentrated closer to shore, the nets came loose and water transparency dropped (making the nets difficult to perceive).

A fundamental difficulty in the quantitative assessment of the mortality of marine birds in fishing nets is also the lack of data on the total number of birds in the Gulf during the whole post-breeding season. Long-term counts by the Waterbird Research Group "Kuling" (Gdańsk University's Department of Vertebrate Ecology and Zoology) suggest that the total number of individuals, appearing for short periods in the waters of the Gulf, substantially exceeds maximum numbers noted during counts. Not knowing the proportion of the transit to stationary fraction it is impossible to estimate the global number of birds of particular species in the Gulf of Gdańsk during the season.

It is for these reasons that any attempt at estimating the mortality of birds in fishing nets in the Gulf can only be of an approximate character. This naturally refers to maximum numbers of particular species of birds observed in the Gulf. The more mobile the species, i.e. the more individuals there are which belong to the transit fraction, the lower is the true mortality of birds lost in fishing nets.

Irrespective of the accuracy of the results, there is no doubt that fishing activities (especially set-nets) in the Gulf of Gdańsk result in substantial losses among the diving birds wintering here in large numbers. In recent years this has been a much stronger anthropogenic mortality factor than oil pollution.

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Sammanfattning

Drunknade sjöfåglar i fisknät i Gdanskbukten: antal, artsammansättning, köns- och åldersfördelning

Denna undersökning analyserar antal, artsammansättning, köns- och åldersfördelning av sjöfåglar drunknade i fisknät i Gdanskbukten under vintermånaderna 1972–1976 och 1986–1990. Totalt undersöktes 1254 fåglar av 24 arter. Av dessa arter var 1 dykänder, 4 lommar, 4 alkor, samt 3 doppingar. De två i särklass vanligast fångade arterna var alfågel (48,3%) och svärta (23,0%), därefter följde bergan (7,7%), sjöorre (6,2%), ejder (5,5%), skäggdoppi (2,2%) och vigg (1,5%). Övriga arters andel understeg 1 % av totala fångsten. Generellt tycks artsammansättningen av drunknade fåglar återspeglar sammansättningen övervintrande sjöfåglar. Undantage är knipa, vigg och sothöna, som samtliga fångades mindre antal än förväntat, samt ejder som fångade i större antal än förväntat. Orsakerna till dessa avvikelser kan troligen förklaras av artskillnader i överlapp mellan huvudsakliga födosöksområden och intensivt utnyttjade fiskeområden. Flera arter uppvisar stora mellanårsskillnader i antal, varav några arter uppvisade långtidstrenger. Sålunda ökade andelen fångade alfåglar (från 42% 1972–1974 till 65% 1989/90), medan andelen svärter minskat drastiskt (från 35% 1972–1974 till 4% 1989/90). Ålders och könsfördelning av drunknade fåglar varierade kraftigt mellan arter och mellan månader inom arter. Adulter var vanligast hos alfågel (68%) och svärta (65%), medan juveniler dominerade bland ejdra (71%) och sjöorrar (67%). Hanar var dominerande kön hos både alfågel och svärta, men andelen adulta hanar som drunknade i fisknät var dock lägre än observerat i den övervintrande populationen alfåglar och svärter. En trolig orsak till denna skillnad är att gamla individer är skickligare på att undvika fisknät. Totalt uppskattas att 17 500 sjöfåglar drunknar årligen i fisknät i Gdanskbukten, vilket motsvarar ca 10–20% av den övervintrande populationen inom området. Sålunda uppskattas 8 400 alfåglar, 4 000 svärter, 1 300 bergänder, 1 000 ejdrar och 100 sjöorrar gå drunkningsdöden till mötes i fisknät. Även om dessa uppskattningar är något osäkra råder det inget som helst tvivel om att fiskenäringen orsakar stora förluster av sjöfåglar i Gdanskbukten. För tillfället är dessa förluster mycket större än de som orsakas av olja.