Population size and density distribution of the Caspian seal (*Phoca caspica*) on the winter ice field in Kazakh waters 2005

A report on the findings of a fixed wing aerial population survey conducted February-March 2005, by Caspian International Seal Survey (CISS) for the Caspian Environment Programme, with recommendations for the development of a Caspian seal conservation action and management plan

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EXECUTIVE SUMMARY

1. An aerial survey of Caspian seals was carried out over the winter ice-field in Kazakhstan in February 23–27, 2005. The purpose of the survey was to obtain an accurate estimate of pup production, number of adult seals and their distribution.

2. A L410 fixed-wing aircraft, flying at 250 km/h and 90 m altitude, was used to fly transects along longitudinal strips at intervals of six longitudinal minutes within Kazakhstan territory. Each strip was 800 m wide (a 400 m strip on each side of the aircraft) and thus 11% of the total ice-field in Kazakhstan was covered by the survey. Seals, eagles and wolves were counted within the strip by two observers on each side of the aircraft and 782 photographs were taken of larger groups of seals. The total number of each category of animals was divided by 11% to obtain an estimate for the total number on the ice-field.

3. The final estimates were: 19,452 seal pups (coefficient of variation, CV, 12.4), 17,720 seal mothers (CV 10.9), 14,722 other seals (CV 12.7), 2,209 eagles (CV 7.7) and 18 wolves. Eagles were often seen feeding on seal pup carcases.

4. The survey had to exclude Russian territory and the southern Caspian because of funding limitations. Nevertheless, the survey will have included at least 90% of the breeding seal population. The total female population (including juveniles) was estimated at 55,498. This gives a total population of Caspian seals at present of about 111,000 seals.

5. In order to obtain a chart of the distribution of the seals, each strip was divided into 5 km segments. The resulting charts indicated a considerable area of adult seals and pups at low densities (0.1–3 adults and pups per km^2) over a wide area of the ice-field with a much smaller number of hot spots (with up to 22 adult seals or 12 pups per km^2). The eagle hot spots did not correspond well with the seal pup hot spots, however.

6. A hind cast for the Caspian seal population from 2005 to 1900 was carried out using this year's survey data and past hunting records. The pup production (or size of the fertile female population) has fallen from approximately 263,000 in 1900 to approximately 20,000 in 2005 (92% decline).

7. The mean annual decrease since 1960 in the total population was estimated at 3%, while the number of fertile females has fallen by about 4% per annum during the same period. Assessment of the current state of decline or recovery will require several more years of detailed survey and analyses.

8. A number of factors are known to cause the decline, including excessive juvenile mortality and persistent organic pollutant (POP) contamination of seal tissues leading to reduced fertility. However, an elasticity analysis (a mathematical population modelling technique) indicates that the principal driver of the decline is excessive juvenile mortality, with low fertility playing a relatively minor role.

9. The contributory causes of mortality, particularly of juveniles, are reviewed. These include commercial and 'scientific' hunting, seal-fisheries interactions, canine distemper virus (CDV) and other pathogens, as well as 'natural' neonatal mortality and loss to natural predators.

10. The IUCN Red listing of the Caspian seal as 'vulnerable' is briefly reviewed here and a preliminary suggestion is made that the seal presently seems to meet the criteria for the 'endangered' category, since it has experienced a decline in the region of 83% over the past three generations (about 50 years). The status of the Caspian seal is due to be reviewed in 2006.

11. It is concluded that all deliberate and avoidable killing of seals should be stopped, by multilateral agreement, to allow the seal population to begin to recover.

12. It is suggested that a Seal conservation action and management plan (SCAMP) be drawn up under a legal agreement between the five littoral States. The Agreement should be developed as a protocol, or part of a protocol, to the 2003 Framework Convention. A draft Agreement and SCAMP is appended to this report (Appendix 3).

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1. INTRODUCTION

The Caspian seal (*Phoca caspica*) is the only marine mammal inhabiting the Caspian Sea, and is endemic. It is one of two distinct species in the subgenus *Pusa* (ringed seals) found in inland water basins (the other being the Baikal seal, *P. sibirica*). Caspian seals are a sentinel species for the whole Caspian ecosystem and currently face multiple threats from past overexploitation, habitat degradation, invasive species, disease, pollution, and climate change. The aim of this study, which took place in February 2005, was to carry out the first systematic aerial survey of the Caspian seal population over the northern ice-field during the breeding season. An accurate estimate of the current population size and number of reproductively active females is an essential basis for developing a conservation action and management plan for this species, and to evaluate the likely consequences of known threats.

The Caspian Sea is the largest inland water basin on the planet, situated on the edge of southeastern Europe, bordering on Asia, and surrounded by five independent States. It measures 1030 km long and between 196 and 435 km wide, covering an area of 393,000 km^2. It has no current natural connections with the world's oceans, and stands approximately 27 m below datum sea level (Kosarev and Yablonskaya, 1994). The Caspian has long been known to suffer problems caused by alteration of water courses and damming as well as anthropogenic waste (Dumont, 1995). Pollutants enter the Caspian via disused oil wells, rivers and coastal seepage, and because there is no outflow, they become concentrated in the Caspian. Recently the biota has received a further challenge by the invasion of the ctenophore *Mnemiopsis leidyi* via the Volga-Don Canal (Ivanov et al., 2000). This comb jelly is a voracious consumer of zooplankton, and is already affecting fish stocks, particularly those of the Caspian sprat (*Clupeonella* spp.) on which seals feed (Yousefian & Kideys, 2003).

Much of the information on the Caspian seal that was gathered by scientists of the former Soviet Union was summarised by Krylov (1990). It is thought there may have been about a million Caspian seals at one time. The seal has been hunted commercially since the 19th century and became an important target for the USSR sealing industry. Hunting of tens of thousands of seals took place annually, principally at the seals' breeding assemblies on the northern ice fields, and until 1967, was focussed on breeding females as well as pups. After 1967 the majority of seals taken were pups. High natural mortality of pups (up to 15%) was reported, and predation by wolves was also considered to be an important cause of pup deaths, while predation by sea eagles was considered to be low. In 1986–89, 64 –70% of mature females from the mouth of the Ural River were found to be barren and similar levels of infertility were found in more recent studies (e.g. Eybatov, 1997; Watanabe et al., 1999).

More recent studies have focussed on the causes of large-scale seal mortalities occurring throughout the Caspian, most notably in 1997, 2000 and 2001. A new strain of canine distemper virus (CDV) was identified from the brain of a dead Caspian seal in 1997 (Forsyth et al., 1998) and was found to be the primary cause of a mass mortality in 2000 (Kennedy et al., 2000; Kuiken et al., 2002; in prep.). A sero-epidemiological study of seals from the NW Caspian between 1993 and 1998 suggested that CDV may have been endemic before 1997 (Ohashi et al., 2001). A time series of stranding data from the west Caspian from 1978 suggests a continuous

level of mortality with enhanced levels occurring every few years (Eybatov et al., 2002), which is suggestive of recurrent epidemics in this period.

High levels of organochlorine contaminants, particularly of DDTs in adult males, were also recorded in these recent studies (Watanabe et al., 1999; Hall et al., 1999; Kajiwara et al., 2002; Tanabe and Kajiwara, 2002) and it is suspected that these may play a role in the low level of female fertility. Other causes of death in 2000 and 2001 included various bacterial infections and apparent starvation (Kuiken et al., 2002; Collins et al., 2004) as well as fishing by-catch and deliberate killing during commercial fishing operations (Eybatov et al., 2002).

All the above information points to a broad array of threats facing the Caspian seal. However, despite ongoing concern about the conservation status of the seal, the impact of these various threats cannot be evaluated in the absence of knowledge of the seal population size and trends. A much-quoted figure for the total population of about 360,000–400,000, including 46,800 breeding females, was suggested by Krylov (1990) for the 1989 breeding season, but without supporting data.

The species was categorised in the IUCN Red List as 'vulnerable' in 1996, with ongoing human-induced habitat loss and degradation highlighted as a major issue (IUCN, 2003) while the population trend was unknown. However, the 'vulnerable' listing was based on the 1994 criteria B1 (severely fragmented and known to exist at no more than 10 locations) and B2e (a continuing decline in the number of mature individuals) assuming an extent of occurrence of less than 20,000 km^2, or an area of occupancy of less than 2,000 km^2. A continuing decline in the number of mature individuals was suggested by Krylov (1990), but the criterion of fragmented distribution would not appear to be met. The criteria for 'vulnerable' listing have changed in the 2001 revision, and the Caspian seal will be due for re-evaluation in 2006. The results of the present survey should be able to assist in the new evaluation of the species' conservation status.

In this report we first present methodology and results of the aerial survey that allowed us to generate estimates of the total and reproductive female population sizes, the extent of natural pup mortality and a density distribution map of seals on the ice-sheet indicating key pupping areas. Secondly we present methods and results for a population model that incorporates data from hunting records over the 20th century to produce a likely demographic history for Caspian seals over this period. Our findings are discussed in the context of known threats to Caspian seals, how they can be used to begin constructing a Seal Conservation Action and Management Plan (SCAMP) and what further research is required to permit construction of a full SCAMP.

The aerial survey in this study was designed to sample the northern ice-field in such a way as to obtain an estimate, with a measure of precision, of the size of the breeding population and pup production for the entire Caspian seal population. Ideally a simultaneous survey of seals would be carried out in the ice-free remainder of the Caspian, where a small number of pups may be born and non-breeding seals may congregate (Krylov, 1990; P. Erokhin, pers. comm.; Duck, 1996). However, this was not done in 2005 due to funding limitations.

2. THE AERIAL SURVEY

2.1 Survey design

We used a strip survey technique originally developed for surveys of Baltic ringed seals (*Phoca hispida baltica*) (Härkönen & Heide Jørgensen 1990, Härkönen & Lunneryd, 1992; Härkönen et al. 1999), and modified the methodology to Caspian conditions. The aircraft, an L410 (Fig. 1), was flown at a ground speed of 250 km/hour. The survey altitude of 90 m was kept constant using a radio altimeter on the aircraft.

Figure 1. The L410 aircraft used for the survey, February 2005

Two preparatory aerial observation flights were carried out on a helicopter on February 19–20 2005, prior to the start of the main survey, in order to plan the observation transect layout and to survey seal densities on the ice (Fig. 2).

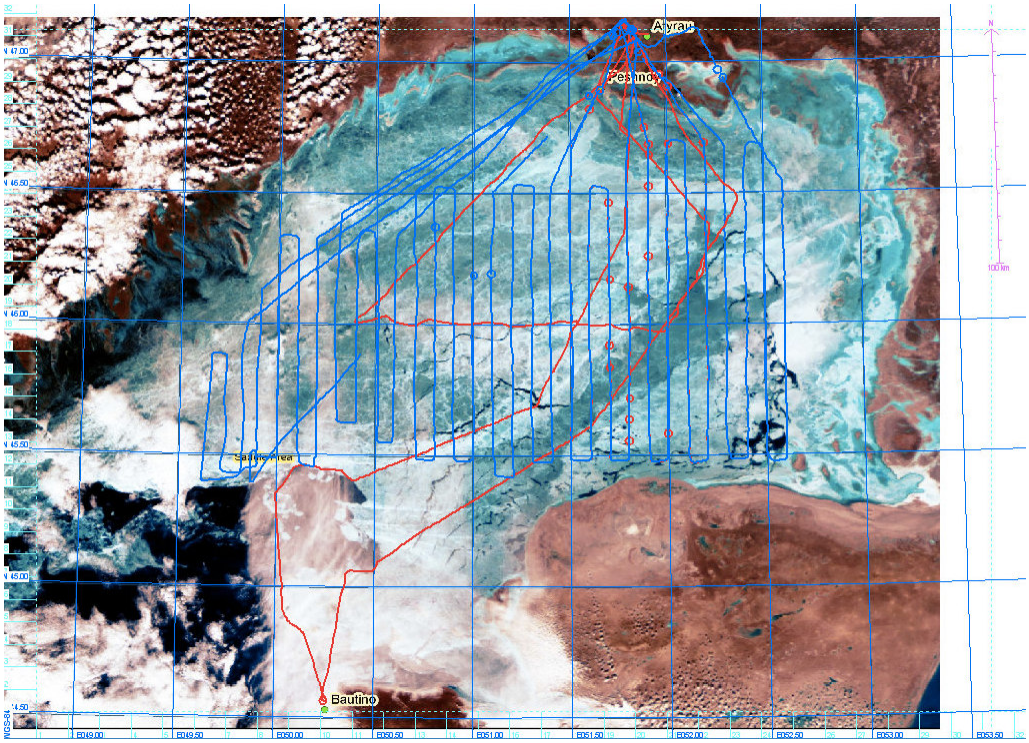

Figure 2. The helicopter observation flights (red) and main survey transects (blue) overlaid on North Caspian satellite ice image from 21 February 2005.

The fixed-wing aerial survey was carried out during a total of 27 hours flying time on February 23–27. Flown transects followed evenly spaced longitudes, where the inter-distance was six longitudinal minutes. Alternate transects were flown from north to south and from south to north such that the entire range of the ice area of the Kazakh territory was covered (Fig. 2).

The observation strip width was 400m on each side of the aircraft, totalling 800m. The windows of the aircraft had double panes about five cm apart, which made it possible to mark sighting angles using marks on the outer and inner windows. Inclinometers were used to find the sighting angles at 10.2° (500m distance from the aircraft) and 46° (100m distance) for each side of the aircraft and for each observer. Thus, the 200 m wide strip under the aircraft was not surveyed. Flying the 800m wide strip at longitudes six longitudinal minutes apart, resulted in a total survey fraction of 11% of the ice area.

Four observers, two at each side of the aircraft, made visual counts of pups, mother-pup pairs, and seals older than pups during the entire survey, while one observer on each side took digital photos (782 in all) of groups of seals. During some flights a fifth person was present on the starboard side as a trainee observer. The geographical position of each observed seal or group of seals was noted by each observer having a hand-held GPS unit (Garmin 12 XL, Garmin 76, or Garmin 76 S). All eagles and wolves on the ice were also counted.

The survey helicopter, detailed ice maps and bathymetric charts of the area surveyed were provided by Agip KCO.

2.2 Data treatment

For each observation, the waypoint number was stored in a GPS-unit. Observers made notes on numbers of different categories of seals at every waypoint number, either by noting on paper forms, or orally to dictaphones. Back at the base, the waypoints were downloaded to a computer spreadsheet file, after which each observer inserted their notes.

The most detailed information for each waypoint was used as an estimate of numbers of seals of different categories, e.g. if one observer had noted five seals, and the other one mother-pup pair and three older seals, we always used the more detailed data. With the photos the same approach was used, and the photos were relied on if there was a discrepancy between observers. Finally the port and starboard observations were merged.

2.3 Results

2.3.1 Number of seals counted on the ice

The total number of seals counted within the 800m strips was 5,708. Of these, 2,140 were pups, 1,949 were mothers and 1,619 were other seals older than pups (Table 1).

Since the survey fraction was 11%, this enables a total estimate for the population of seals hauled-out on the ice to be calculated as 51,895 seals, including 19,452 pups, 17,720 mothers and 14,722 other seals older than pups, with Coefficients of Variation (CVs) ranging between 8.8 and 12.4 (Table 1).

The number of mothers counted was fewer than the number of pups by 191, which indicated that pups are left unattended on the ice for some periods, i.e. about 9% of the time ((191/2140)x100), or a few were possibly already weaned.

Table 1: Summary of numbers of seals, wolves, and eagles in 28 strips covering 11% of the total ice area in the Kazakh territory of the Caspian Sea, February 23–27, 2005. Seals are identified here as Pups, Mothers (adults accompanying pups, and Other seals (older than pups).

Strip	Longitude	Wolves	Eagles	Pups	Mothers	Other	Total
1	49.6	0	0	76	67	107	250
2	49.7	0	2	40	36	50	126
3	49.8	0	3	216	195	188	599
4	49.9	0	2	156	144	110	410
5	50.0	0	9	221	214	95	530
6	50.1	0	12	83	81	39	203
7	50.2	0	23	145	141	107	393
8	50.3	0	30	102	93	201	396
9	50.4	0	7	122	113	213	448
10	50.5	0	1	115	105	84	304
11	50.6	0	15	58	55	79	192
12	50.7	0	13	147	132	44	323
13	50.8	0	29	198	173	38	409
14	50.9	0	11	151	143	20	314
15	51.0	2	25	60	52	38	150
16	51.1	0	12	96	75	49	220
17	51.2	0	15	59	56	20	135
18	51.3	0	10	41	33	47	121
19	51.4	0	0	27	24	16	67
20	51.5	0	4	15	7	9	31
21	51.6	0	13	7	6	47	60
22	51.7	0	6	1	1	12	14
23	51.8	0	0	1	1	6	8
24	51.9	0	0	1	1	0	2
25	52.0	0	0	0	0	0	0
26	52.1	0	0	0	0	1	1
27	52.2	0	0	0	0	0	0
28	52.3	0	1	0	0	1	1
TOTAL		**2**	**243**	**2,140**	**1,949**	**1,619**	**5,708**
Fraction		0.11	0.11	0.11	0.11	0.11	0.11
Pop Est		18	2,209	19,452	17,720	14,722	51,895
CV		n/a	7.7	12.4	10.9	12.7	8.8

Eagles and wolves

The technique employed in the 2005 survey of flying in regularly spaced longitudinal strips has enabled for the first time the production of detailed distribution density maps not only of different categories of seals, but also of their natural predators.

Eagles were frequently observed feeding on seal pups, and main concentrations of eagles were seen in areas with high densities of breeding seals. The total number of eagles counted within the strips was 243, giving an estimate for the overall total number of eagles on the ice of 2,209 (CV= 7.7). Most of the eagles were found in groups of up to 15 birds at, or in the vicinity of, pools of blood. Only two wolves were observed within the strips, suggesting about 18 altogether on the total ice area. However, we also observed one pack of 12 wolves outside the strips, which does indicate that wolves enter the seal breeding areas in packs as well as individually.

Eagles were frequently seen eating pups during the surveys, but it is not known to what extent eagles actually kill pups or scavenge on stillborns and afterbirths. However, there are up to ten species of eagles in the Caspian Sea, including the white-tailed eagle (*Haliaeetus albicilla*), which is known to prey on pups of Baltic ringed seals and the larger grey seals (*Halichoerus grypus*). Consequently, white-tailed eagles shouldn't have any problems killing pups of Caspian seals.

Wolves and eagles have long been recognised as the two main predators of seal pups in the breeding area, However, in his review paper, Krylov (1990) considered that wolves were by far the more important, killing 17–40% pups in 1974–76, while eagle predation killed less than 1% of pups. Our results indicated the opposite, with low numbers of wolves on the ice, and therefore a probably insignificant impact of wolf predation on the total pup mortality on ice. By contrast, our estimate for the total number of eagles feeding on seals on the ice in February was 2209. Thus our survey indicated that in 2005 eagles were by far the more important of the two predators.

2.3 Discussion

2.3.1 Scope of survey

The CISS team has succeeded in carrying out the first systematic aerial survey of Caspian seals, and is presenting here the first scientifically sound data on the distribution and abundance for the species.

The 2005 survey was restricted to Kazakhstan territory due to funding limitations. Otherwise the longitudinal flight strips would have continued westwards over Russian territory. In total the surveys covered an area of 27,360km^2, leaving an area of suitable seal ice of 3675km^2 (11%) uncovered. Therefore it is evident that most of the pupping in fact took place in Kazakhstan territory covered by the survey. Nevertheless, it needs to be acknowledged that a small number of pups in Russia may have been discounted from the survey and the resulting population estimate may be slightly lower than in reality. At the Russian border the density of seals was 6 per km^2. If this maximum density were to have continued for the whole of the unsurveyed Russian ice (an extremely unrealistic assumption), it would increase the population

estimate by up to 20%. In reality the unsampled population fraction will be much less than this but at the moment it is not appropriate to speculate what this might be. However, we would not expect estimates from subsequent full surveys to deviate beyond the coefficient of variation (CV) for the population estimate reported here.

Ideally, a simultaneous survey of seals would also have been be carried out in the ice-free remainder of the Caspian, where a small number of pups may be born and large numbers of juveniles and non-breeding adults occur (Krylov, 1990; Duck, 1996; P. Erokhin, pers.comm.; H. Asadi, pers. comm.). However, these individuals are unlikely to be a source of significant numbers of breeding seals, which is the critical component for assessing the status of the Caspian seal. Our total population estimate (see below) includes all juvenile and non-breeding adult seals in all parts of the Caspian.

2.3.1 Comment on survey technique

The approach of using evenly spaced transects has some major advantages compared with randomly spaced transects, which has been proposed by e.g. Stirling et al. (1982) for ringed seals in the Canadian Arctic. The most obvious advantage is that it enables detailed analyses of the density distribution, which can be related to physical parameters such as ice quality and water depth. The main reason for using randomly placed transects are that in cases where the sampling fraction is low (e.g. less than 2%), the statistical treatment of survey data is straightforward. However, one basic assumption here is that seals are randomly distributed. This assumption is seldom met, and for many ice seal populations investigated, there are apparent clines in seal density, where 90% of the seals can be found in less than 10% of the investigated area (Härkönen et al., 1999).

As shown for ringed seals in the Baltic, clines in seal density and clumped distribution of seals require sampling fractions exceeding 10% of the ice area to generate population estimates with an acceptable confidence interval (Härkönen & Heide-Jørgensen 1990; Härkönen & Lunneryd 1992). Estimates of variation for population estimates, such as CVs, increase sharply from sampling fractions less than 7-8%, whereas sampling fractions of more than 15% increase survey precision only marginally (Härkönen & Lunneryd 1992). Therefore the optimal sampling fraction to balance time, effort and expense against precision of the population estimate lies in the range of 10-15% of the ice area.

3. DISTRIBUTION AND DENSITY

3.1 Methods

For the mapping of seal density distribution we divided each 800m transect into five km segments, resulting in segment areas of 4 km^2. These segments were used as the density mapping units, densities being expressed as numbers of animals/ km^2. The segments also formed the basic units for calculating the coefficient of variation (CV) of population size: the segments were sampled randomly from the entire data set into four sub-samples. The CV of the mean of the four samples was used as an indicator of survey precision. Seals were assigned to two categories, 'Pups' (pups born this year on the ice) and 'Adults' (all seals older than pups).

3.2 Results

The general distribution pattern of breeding Caspian seals shows that seals avoid land-fast ice and shallow sea areas while hauling out on the ice. The main distribution area of the seals was found in the pack ice where haul-out holes were established by seals and close ice with cracks of open water providing access to the sea. Open ice near the ice-edge in the SW was also used by large groups of seals, but it was not possible to determine whether selection by the seals of this type of habitat was by choice or as a consequence of decomposition of the ice fields. The seals preferred natural cracks and ice ridges to open, flat ice fields and the small-scale seal distribution is very strongly influenced by extent and location of these formations.

In general, the seals were distributed over water areas deeper than 2.5 meters. Although this should have enabled the seals to occupy also the south-eastern parts of the ice area, the ice formed there later than in the main distribution areas and was therefore not used by breeding seals. The distribution maps (Fig. 3) indicate that much of the seal haul-out area on the ice-field was occupied by seals at low (an average of 0.1–1.5 adult seals or pups per km^2) or medium low (1.5–3.0 adults or pups per km^2) densities. There were considerable areas of moderate adult and pup seal densities (3–6 adult or pups per km^2) sometimes surrounding a relatively few areas of seal 'hot spots' (up to an average of 22 adults or 12 pups per km^2). The maximum size of a group registered during the survey was 77 individuals. The areas of pup hot spots in the SW of the area coincided with the areas of adult hot spots, although the pup hot spots in the NE coincided with areas of only moderate adult densities. This indicates that in the SW there are probably proportionally more non-breeding adult seals than in the areas in the NE.

Eagles were distributed at fairly low densities (0.1–1 eagles per km^2) across the seal breeding grounds. Four eagle 'hot spots' can be distinguished, although these seemed not to correlate with the dense breeding areas of the Caspian seal. This is most probably because eagle groups are able to cover long distances in short time periods. Because a small number of seal carcases will feed a group of eagles for some time, and the eagles in flight can readily spot a seal carcase already being consumed, they can forage opportunistically, and do not necessarily need to congregate in the areas of highest seal pup density.

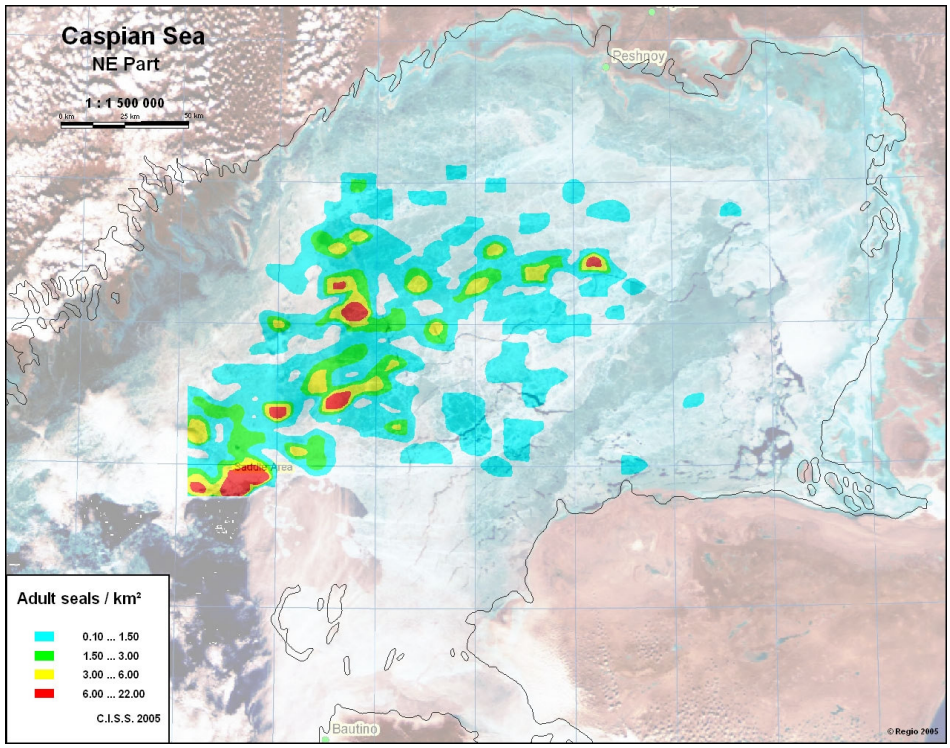

Figure 3(a). Distribution of Adult seals in survey area, Feb 23–27, 2005

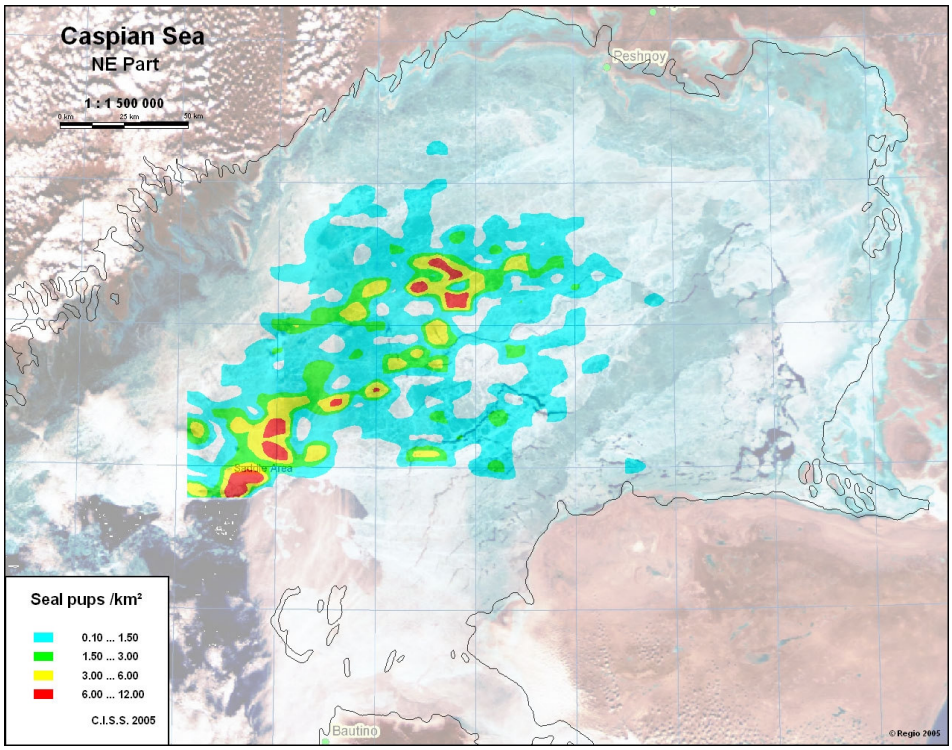

Figure 3(b). Distribution of pups in survey area, Feb 23–27, 2005

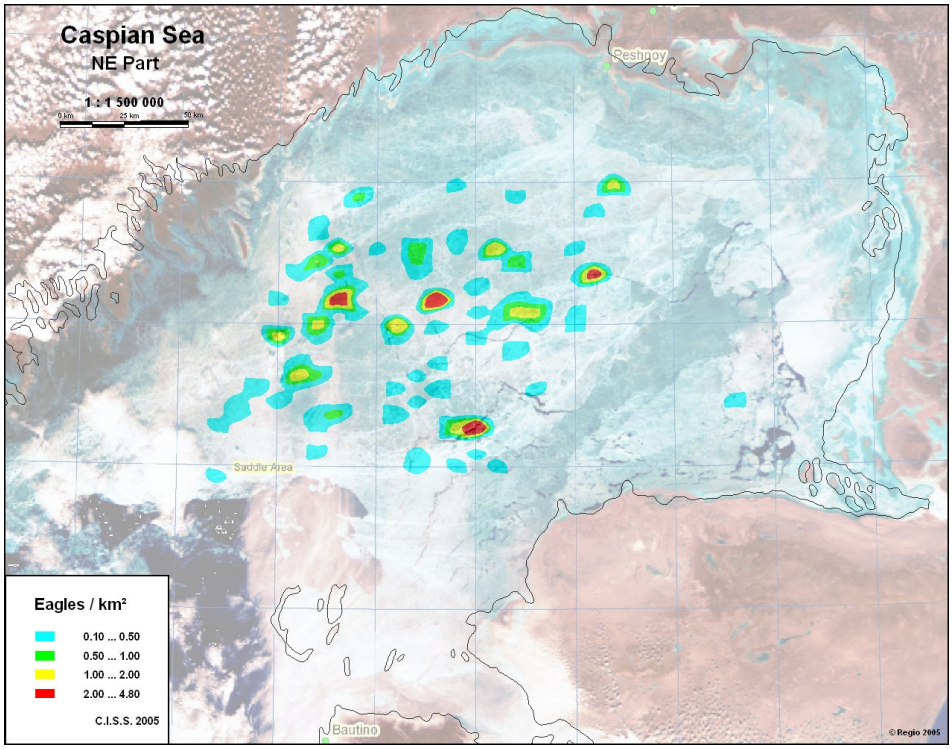

Figure 3(c). Distribution of eagles on the ice, February 23–27, 2005.

On February 21st 2005 some counts of seal adults and pups were made from an ice-breaker making a trip on behalf of Agip KCO from Bautino to a rig in the Kashagan oil field. These counts, together with the track of the ship superimposed upon the pup density map from the aerial survey, are presented in Appendix 1.

4. ESTIMATING POPULATION TRENDS

4.1 Methods

4.1.1 Estimating present population size

We focused on estimating the breeding female population size, which is given by the total numbers of pups counted during the survey divided by 0.11, since the survey fraction was 11%. An estimate of the total female population size in 2005 (N_t) is given by :

$N_t = J/F*A$ eqn 1

where J is the number of counted pups, F the fertility rate, and A the adult share of the total female population. We used a fertility rate of 0.5 for the period 1965 to 2005 (see Discussion), and carried out an analysis (in Appendix 2) to estimate the size of the adult component of the population.

4.1.2 Hind-casting population size

An estimate of the present population size can be used as a starting point for modelling past changes in population size in situations such as in the Caspian where the population has been heavily hunted (Harding & Härkönen 1999). Since the Caspian seal has been an important resource in the past, detailed records of the hunting have been collected since the beginning of the 20th century (Fig. 5; Krylov 1990; Sokolskii 2004). We used these hunting statistics, which for many periods included data on the annual proportions of pups killed, to model the minimum population sizes that could withstand the recorded hunt. The population size in the following year (N_{t+1}) in a hunted population (Smith 1983) is given by:

$$N_{t+1}= N_t–K_t+ R_t (N_t –SK_t) \qquad \text{eqn 2}$$

where N_t is the population size in year t, K_t the hunting mortality in year t, and the R_t is the net reproductive rate of the population. The S denotes the fraction of females that reproduced before they were killed, but we approximate $S\approx1$, which will result in under-estimates of back-casted population sizes. To permit successive hind-casts, eqn 2 was modified further using an approach analogous to that employed by Smith (1983):

$$N_t= (N_{t+1}+K_t+ R_tK_t)/(1 – R_t) \qquad \text{eqn 3}$$

In this model we only account for the female population size, but since the sex ratio in Caspian seals is close to parity (Krylov 1990), total population sizes can be achieved by multiplying the female population size by approximately two. Equations 1 and 2 are unstructured, which means that they cannot take into account which age classes are hunted. However, all seal populations are impacted more severely if adult females are killed as well as pups than if the hunt is focused on pups only. The model was therefore developed further to account for the age structure of the hunt:

$$N_{t+1}\approx ((N_{t+1}+K_tC+ R_tK_tC)/(1 – R_t)) \qquad \text{eqn 4}$$

Where C is the relative reproductive value of the catch compared with the reproductive value of females in a stable age distribution. The deduction of C is addressed in Appendix 2, where it is shown that

$$N_{t+1}\approx ((N_{t+1}+K_t(-0.5239p+1.0584)+ R_tK_t(-0.5239p+1.0584))/(1 – R_t)) \qquad \text{eqn 5}$$

where p is the proportion of pups in the catches. In Appendix 2 we also estimated ranges of stable age distributions to approximate the size of the adult population segment in relation to the total population, the age-specific reproductive values for estimating the cost of hunting different age classes of seals, and the elasticities for evaluating the relative contributions of survival versus fertility on the rate of decrease. We also used the projection matrix to calculate the generation time, measured as the mean age of females giving birth to a cohort.

4.1.3 Method for estimating population trends

In an initial step, eqn 5 was used to hind-cast population sizes to 1960. We obtained a maximum likelihood estimate of the stochastic rate of increase ($\log \lambda_s$) for the period 1960 to 2005 according to Dennis *et al.* (1991):

$$\log \lambda_s^n = \left[\sum_{t=1960}^{t=2005} \log(n_t / n_{t-1}) \right] \Big/ \sum_{t=1960}^{t=2005} n_i \qquad \text{eqn 6}$$

4.2 Results

4.2.1 The total female population size in 2005

The size of the total female population (N) can be estimated from eqn 1 if the fertility rate of adult Caspian seals is known on the one hand, and the size of the adult female population is known on the other. According to available data (see Discussion) we set the fertility rate (F) at 0.5 and chose an arbitrary value (e.g. 0.5) for the share of the adults (A) in the population. Consequently, a first rough estimate of N in 2005 would in this case be 77,808 (= 19,452/0.5*0.5). This was then further refined as follows.

Based on input into eqn 5 (above) of this value for N and a value of 0.5 for female fertility F in 2005, the result of the hind-cast total female population size for 1960 was 220,673. Applying this estimate for 1960, and our estimate of 77,808 for 2005, we used eqn 6 to obtain a maximum likelihood estimate of the stochastic rate of increase ($\log \lambda_s$) for the period 1960 to 2005. This gave a result of $\log \lambda_s$ = -0.02235, which corresponds to a per capita rate of increase of 0.977. The next step was to paramaterise the Leslie matrix (eqn 7, Appendix 2) with input data leading to a rate of increase of 0.977). The right eigen vector of the matrix gives the stable age distribution providing the share of the adult population (A= 0.684) resulting in a second, and more accurate estimate for N in 2005 of 56,887 (=19,452/0.5*0.684). This second estimate of N in 2005 was used as input value for a second run by eqn 5, which resulted in a new estimate for the population size in 1960 etc. This (iteration) procedure was repeated until changes in A only affected the fourth decimal, resulting in estimates for A and N in 2005 of 0.701 and 55,498, respectively. The total population size would be approximately double the total number of females, or approximately 111,000.

4.2.2 Population trend from 1900 to 2005

Based on the estimate of a total minimum female population size (including juveniles) of 55,498, population sizes were then hind-casted for the entire period 1900 to 2005 using eqn 5 (Fig. 4). Back-projected numbers of females were thus found to be about half a million in the beginning of the 20th century, but the population plummeted in the 1930s to about a quarter of a million. This decrease was probably caused by hunting, since the average annual kill in the period 1933-1940 was 164,750 seals of both sexes (Fig. 5).

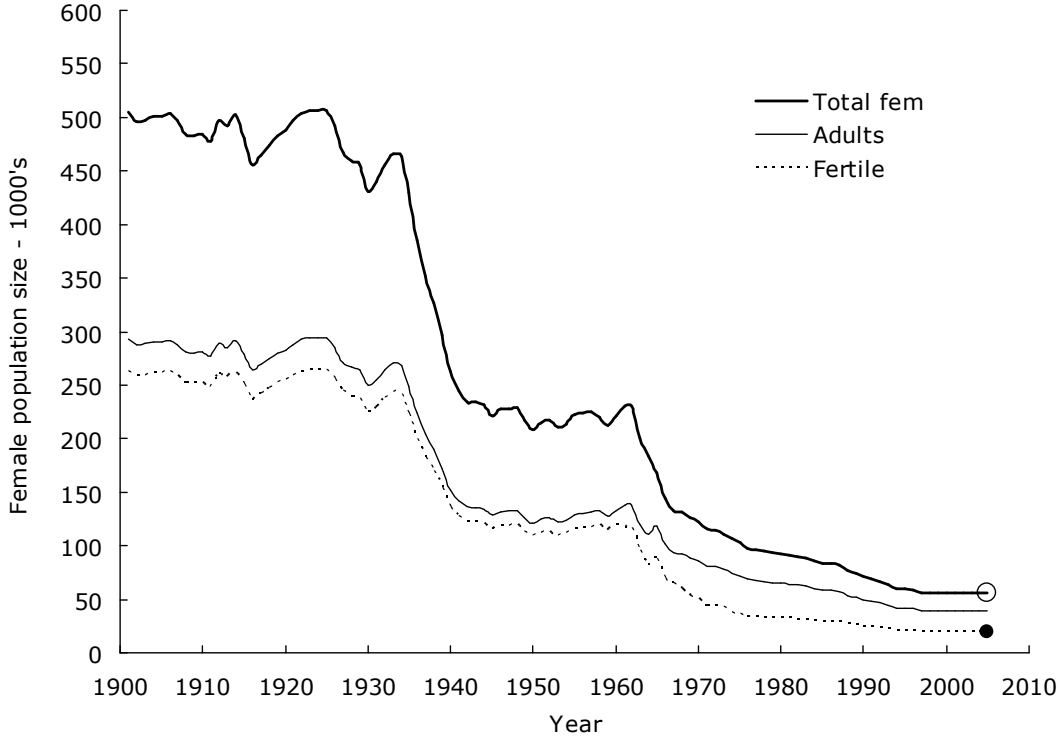

Figure 4. Hind-cast of the female population of Caspian seals, 1900–2005

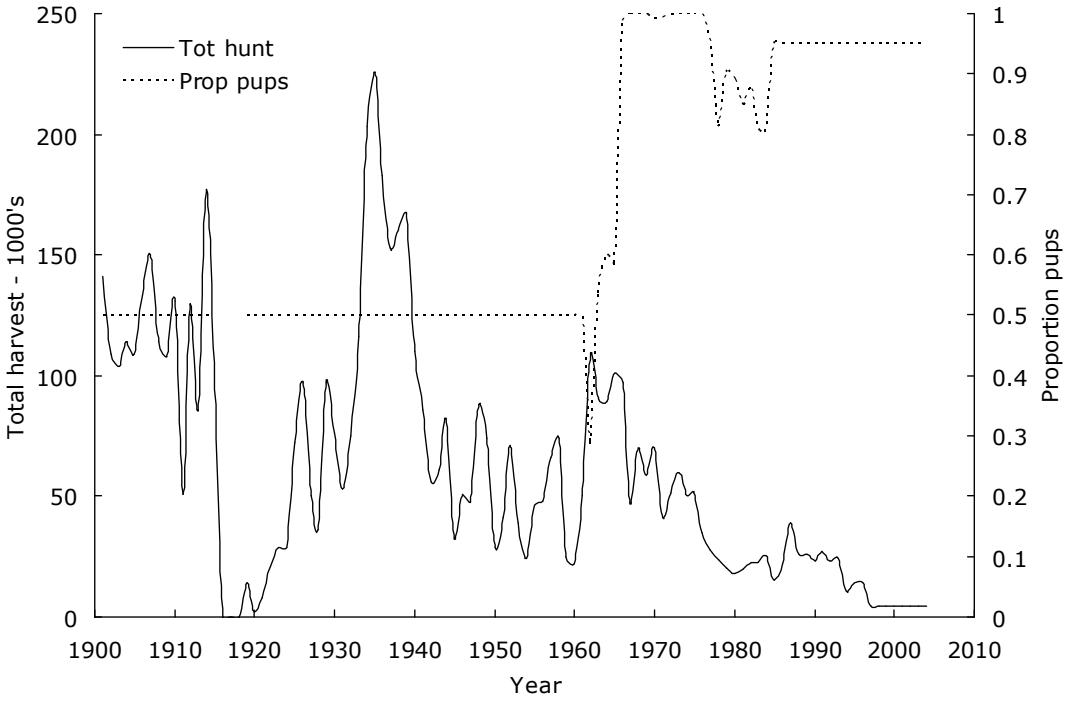

Figure 5. Records of the registered hunt of Caspian seals in the northern Caspian. 1900–2004 (from Krylov, 1990; Sokolskii, 2004)

The population then seems to have been relatively stable until the beginning of the 1960s, when a new dramatic decline started. This decline is suggested also to have been initiated by high hunting pressure, since 97,140 seals of both sexes were killed

annually in the period 1962-1966 (Fig. 5). The decline in population numbers continued up to 2005 (Fig. 4), although the commercial hunting officially ceased in 1996, when about 14,000 seals were killed (Sokolskii, 2004). Using eqn 6, the mean annual rate of decline over the period 1960 to 2005 was estimated at 3.0%. However, since our approach was to estimate minimum population sizes in the past, this rate of decline may actually have been greater.

4.2.3 Proportion of fertile females

The proportion of adult females is a function of the rate of increase in the population (Appendix 2, Fig. 9), and is based on the projected total female population size (Fig. 4, top graph). The adult female population size can therefore be estimated for the entire period 1900-2005 (Fig. 4). Using eqn 6, the mean annual rate of decrease in the adult female population was 2.7% over the period 1960 to 2005.

Assuming fertility rates of 0.9 before 1960, fertility rates are suggested to have dropped to about 0.5, which would result in an average annual decrease in the numbers of fertile females of 4.0% over the past 45 years.

4.3 Discussion

4.3.1 Fertility rate

The calculation of total female population size assumed a fertility rate of 0.5. However, this is uncertain and requires further investigation. Available data from a sample of 17 females taken from the Volga delta in 1993 suggest that only 35% were fertile, and this low fertility is assumed to be a consequence of POP accumulation (Watanabe *et al.* 1999). However, this particular sample was severely biased against older females (range 19.5 to 43.5 years). Fertility rates in the entire adult female population would be expected to be considerably higher, since POPs accumulate with age.

Studies of the age structure of stranded females in Azerbaijan have shown that approximately one third of adult females were more than 20 years of age (Hadjiev & Eybatov, 1995), which is consistent with our modelling results (Appendix 2). Consequently two thirds of adult females are expected to be younger than 20 years of age, at which age fertility rates are likely to be considerably greater. Thus, it is likely that fertility rate among adult females is in fact greater than 0.5, which would lead to an exaggeration for the total female population estimate for 2005.

4.3.2 Other biases in population estimates

In the hind-casts of earlier population sizes we systematically used parameter values that resulted in under-estimations of population sizes in the past. We assumed that the 20th century hunt killed equal numbers of males and females, when in reality the hunting on the ice was mainly targeted at females and pups and the hunting in late autumn was focused on adult animals of both sexes (Krylov 1990). This type of hunt structure is more harmful to the population than a hunt that targets animals in proportion to the age and sex structure of the population (Appendix 2, Fig. 11), and

therefore our assumptions (e.g. of a high reproductive rate in the historical population) will have resulted in an under-estimate of the historical population sizes. In reality they were probably considerably higher and therefore the rate of decline to 2005 (even assuming our 2005 estimate was conservative) of 3.0% is probably an under-estimate.

4.3.3 Reliability of hunting statistics

The Caspian sealing industry in the first half of the 20th century was primarily focused on production of seal oil, where a processing plant for fish and seals at Fort Schevchenko on the NE coast of the Caspian Sea engaged some 3000 workers up to the 1960s (Mr P. Kazakchkov - Harbour Master at Fort Schevchenko, pers. comm.) Sealers, operating from specially designed vessels, harvested seals at their assemblies on barren islets in the northern part of the Caspian in November-December, and then on the breeding ice between January and March. Skins with attached blubber from both pups and older animals were brought back to the processing plant where the annual catch was registered. This registration was probably reasonably accurate, since (a) the hides and pelts were transported elsewhere for further processing to leather and fur and (b) the annual harvest fluctuated considerably, only seldom reaching the set quota (Krylov 1990), which was rare in official reporting within the Soviet system.

4.3.4 Robustness of model

The model for hind-casting population sizes (eqn 5) is insensitive for input values of population size in 2005 for a period greater than about the past 45 years, since a doubling (100% change) of the present population size would result in an increase at 3.5% for the back-casted population estimate for 1960, and less than 0.01% for 1900. It is however sensitive for assumed values of the net reproductive rate; decreasing the net reproductive rate from 0.08 to 0.072 (10%) would increase back-casted population sizes by approximately 7.8%. This is the reason why we chose the approach of setting the net reproductive rate at maximum long-term values, resulting in minimum population sizes in the past that could with-stand the registered hunt. Consequently, population sizes before 1960 were probably greater than in Fig. 5, and the rates of decrease up to 2005 are likely to be under-estimates.

The model is less reliable, when the hunting pressure is low (Harding & Härkönen 1999), which is why the trend over the past 10 to 15 years is uncertain. We used the approach developed by Dennis *et al*. (1991) to estimate the mean rate of decrease from 1960 to 2005, since it is totally insensitive to the errors in this respect. Thus, the estimated rate of decrease from 1960 to 2005 is not affected by the limitations of the hind-casting model (eqn. 5).

4.3.5 Comparison with previous population estimates

Earlier reported population sizes of about one million Caspian seals in the beginning of the 20th century (e.g. Krylov 1990), are fairly consistent with our results, which suggest more than half a million females (Fig. 4). However, statements of more recent total population levels of about 400,000 after the 1960s (e.g. Krylov 1990), which are frequently cited in international compilations, deviate substantially from the pattern

shown in Fig. 4. Krylov (1990) gave an estimate of 360,000 to 400,000 for 1989 and 46,800 for the size of the reproductive female stock. Data from our study for the same period suggest a total population size in the order of 148,000 (the number of females multiplied by two) and 26,000 for the number of reproductive females. The total population size (both males and females) in 2005 would be around 111,000, with the number of reproductive females close to 20,000.

One main problem with earlier estimates is that neither the survey technique nor the extrapolation to total population size is transparent. Nevertheless, it seems that systematic surveys have not actually been previously carried out in the area, and that counts that have been made merely represented unknown fractions of high-density areas.

One question, which has been raised by stake-holders in the region, needs to be addressed here. This is that there are known to be fairly large numbers of seals in the southern Caspian at the same time as the ice-field survey described here. This is explained by understanding the means whereby the above total population estimate is derived. It is derived from observed counts of breeding seals on the ice, which represents more than 99% of breeding in the Caspian. The total population estimate derived by the population modelling therefore *includes* non-breeding animals, both juvenile and adult of either sex, wherever in the Caspian they may be. Only about 50,000 animals out of the total estimate of 111,000 were actually on the ice-field during the survey period. The remaining animals in the population, numbering around 60,000 animals, will have been distributed elsewhere in the Caspian. These will be mainly juveniles and non-breeding adults.

4.3.6 Present status

Present numbers of Caspian seals are the result of a long-term decline over the past 100 years. The main contributory factor was non-sustainable hunting, which caused a rapid decline in the mid 1960s. Although the commercial hunt officially ceased in 1996, takes for “scientific purposes” have occurred annually since then (Sokolskii, 2004). In addition, low fertility rates have contributed to this decline.

The relative contribution of changes in fertility and survival rates can be evaluated by using again the population projection matrix (Appendix 2). The elasticity analysis in fact shows that changes in survival affect the population growth rate (in this case the rate of decrease) about ten times more in all age classes compared with a similar proportional change in fertility (Fig. 6). Although this result may be counter-intuitive, it stems from the fact that if a female pup dies she can never reproduce, whereas if she survives to adulthood she can produce 10 pups or more.

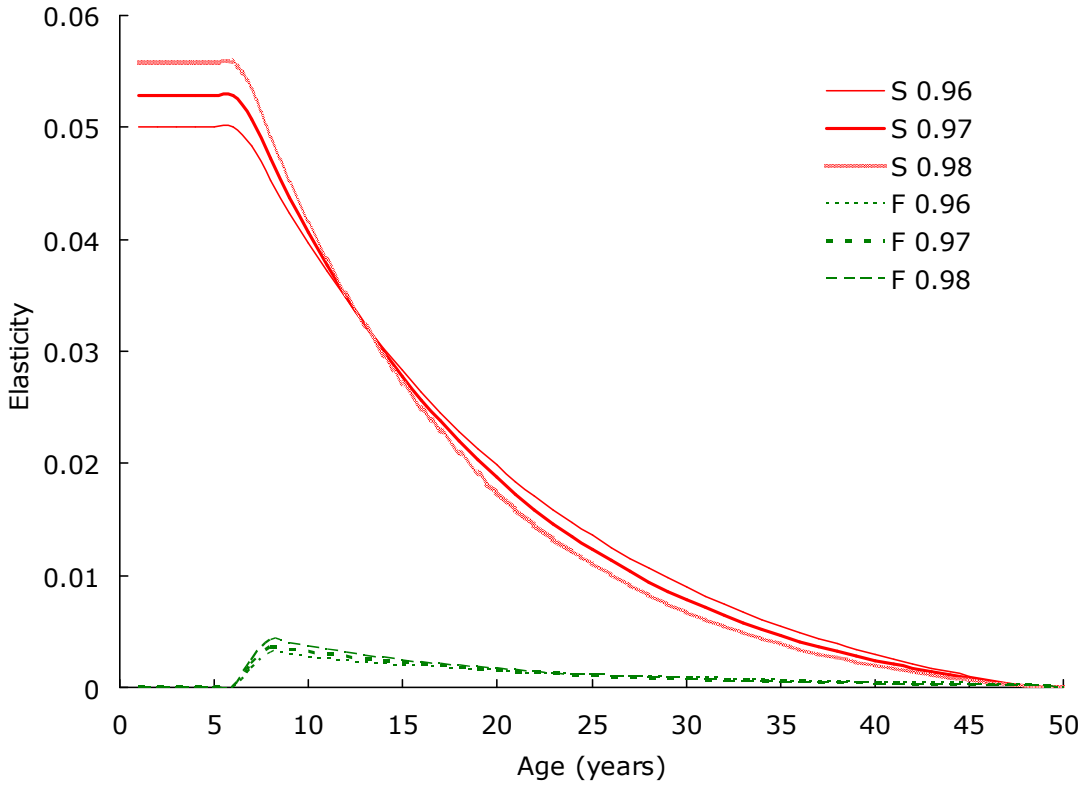

Figure 6. Elasticity analysis showing the effects of survival (red) and fertility (green) on the population growth rate (or decline).

An important implication from this analysis for a conservation action and management plan for the Caspian seal (SCAMP, Appendix 3) is that measures should be taken to reduce human induced mortality (take and fisheries by-catch), which will play by far most important role for the recovery of Caspian seals.

5. GENERAL DISCUSSION

5.1 *Sources of pup mortality*

If the natural pup mortality rate during the first days of life is up to 15% (Krylov 1990), this could account for the deaths of up to about 3000 pups at current pup production of around 20,000 births. The estimate of the total number of eagles feeding on seals on the ice in February was 2,209. If each eagle were to consume the equivalent of one seal pup over the pupping period, this population of eagles might consume around 2000 pups, or about 10% of pups born. An annual pup kill for 'scientific purposes' of 4,500 (Sokolskii, 2004) would increase the total mortality figure up to around 9,500, or about half the pups born In addition, several thousand young seals may die during epidemics of canine distemper virus (CDV), which are thought to recur every few years (Ohashi et al., 2001; Kuiken et al., 2002), while unknown, but significant numbers are thought to die during fishing operations throughout the Caspian (Eybatov, 1997; Eybatov et al., 2002).

All these causes of mortality (predators, human kill, fisheries by-catch, CDV) could add up to an average of more than 50% of the 20,000 pups currently born every year dying within a few months of birth. Since survival affects the rate of rate of decrease substantially more than fertility, the high juvenile mortality rate is doubtlessly the main reason for the continuing negative trend in the Caspian seal population.

The most important challenge for a seal conservation action plan is therefore to take measures to reduce human induced mortality (such as deliberate take and fisheries by-catch). Such measures would have the maximum effect in contributing to the recovery of the Caspian seal population.

5.2 Need for more detailed data for SCAMP

This is a preliminary report based on the first systematic survey and analyses of possible ranges of life history parameters at the observed rate of population decline. It is however evident that a seal conservation and management plan (SCAMP) must be based on a much firmer foundation. Similar plans for seals in the Wadden Sea and the Baltic relied on monitoring data collected over 20 to 30 years, where substantial scientific efforts had been put into monitoring of long-term trends in the populations, studies of movements (satellite telemetry etc.), area use over annual cycles, reproductive status, pathology, diet studies, monitoring of by-catches, parasitology, immunology, ecotoxicology, behaviour etc. These studies resulted in several hundred papers in peer-reviewed journals.

Unless dedicated research is carried out in a number of fields in the Caspian region, a SCAMP will suffer severe credibility problems from the scientific world as well as from local stake-holders. Actions must be based on knowledge, which unfortunately is still very fragmentary for Caspian seals. The 2005 survey was an important first step, but further information is needed:

a) Repeat surveys during the breeding season should also encompass Russia, Turkmenistan and Azerbaijan to get the full picture.
b) A pilot study should be carried out on surveying the entire population during the moult, which would give complementary information on the total population size.
c) Seals should be tagged with satellite transmitters, which would give data on the proportion of seals hauled out.
d) Satellite transmitters would also give data for seasonal changes in movements throughout the Caspian, foraging areas and diving patterns.
e) Ice work to study causes of mortality in pups, i.e. still births, proportions abandoned, diseases, predators.
f) Ice work to study, by non-lethal means, various health parameters.
g) Diet studies of seals throughout the Caspian and at different seasons needs to be studied, by non-lethal means.
h) Pathology, bacteriology, virology, ecotoxicology
i) Behavioural studies in the breeding area
j) Monitoring of by-catches and other mortality during fishing operations

The lack of detailed data and information on Caspian seals means a great challenge for some of the evaluations of the present status and risk assessments for future scenarios. Several years of consecutive surveys and analysis will be necessary to analyse the ongoing population trend to detect continuing decline or any recovery. We have here presented a preliminary analytical model (Appendix 2), but it needs to be elaborated further to take all uncertainties into account. This work includes several adjustments requiring advanced dynamic modelling, which will take quite some time, skills and effort.

5.3 Introduction of research methods involving non-lethal sampling

Lethal sampling (e.g. for e) and f) above) is no longer normally carried out by seal biologists in western Europe and the US. Former methods involving lethal sampling have been almost entirely superseded by non-lethal methodologies over the past few decades. For species with a healthy conservation status, the reasons for this shift in methodology are mainly ethical, whereas for species with an uncertain or poor conservation status, an additional reason is so as not to impact negatively on the conservation status of the species.

The outcome of the analyses presented here of the declining population trend being due in large part to excessive mortality, particularly of juveniles, presents a strong case for a moratorium on 'scientific culling' of Caspian seals. However, the urgent need for scientific information on the ecology of Caspian seal means that new research programmes are essential. Since many scientists in the Caspian region are as yet unfamiliar with the relatively new non-lethal methodologies, it is suggested that an international scientific advisory body be set up which will guide, advise and assist new research and monitoring programmes on the Caspian seal.

5.4 Further work on the biology of the Caspian seal necessary for the development of SCAMP

The 2005 survey and the resulting analysis of population trends has indicated (a) the present pup production is around 20,000 annually, (b) the total seal population size is about 111,000 (including infertile adults and juveniles), (c) there is an ongoing annual population decline of about 3% and (d) excessive mortality, particularly of juveniles, is the largest contributory factor to the ongoing population decline.

The existing perceived threats to the Caspian seal were summarised in the Final Report of the Ecotox study (Anon, 2002). However, the potential impact of such threats could not be evaluated at that time because no estimate of the population size, pup production or population trend was available, e.g. if five thousand juveniles died in 2000 from CDV, what impact on the population might this have had? The data from the 2005 survey provides a basis for evaluating the impact of such mortality.

One task for the future research programme is therefore not only to continue to

investigate the biology of these threats, but also to estimate the number of animals of each age class that may die as a result of them. The Ecotox project focused heavily on POP contamination levels in sediment, fish and seals. The elasticity analysis (Fig. 6) in the present study demonstrates that the relatively high infertility rate in Caspian seals (which is likely due to the high POP burden in older animals), probably has a relatively small effect on the population trend. It is therefore vital for SCAMP to develop methods for estimating the numbers of each age class dying annually due to: commercial hunting, 'scientific' culling, fisheries operations, illegal killing, CDV, bacterial infections, starvation, natural predation, and the number of pups dying due to disturbance (e.g. by shipping) of breeding grounds and premature melting of the ice in warm winters.

At present all we can say is that reproductive population is declining and clearly cannot tolerate present levels of anthropogenic mortality. In meantime, until SCAMP can be more fully developed based on good science, the more obvious human threats should be curtailed as a precautionary measure (deliberate killing of all kinds, including 'scientific kill', commercial or sport killing of pups, killing of seals caught in nets; use of DDT and other OCs in Caspian drainage system). An international agreement, under the 2003 Framework Convention, needs to be developed to implement this (Appendix 3). It is suggested that a pan-Caspian network of seal centres, coordinated by Kazakhstan, be defined, through which this work will be coordinated and executed. Further, it is suggested that the research and monitoring programme to be carried out through the seal centres should be guided, advised and assisted by an international team of seal specialists, who will help to train and equip young Caspian scientists in modern scientific approaches to such work and ensure that work is carried out to international scientific and ethical standards.

5.5 Re-evaluation of the IUCN category of 'vulnerable'

The criteria for the IUCN categories are: Extinct (EX), Extinct in the wild (EW), Critically endangered (CR), Endangered, (EN), Vulnerable (VU), Near threatened (NT), least concern (LC) and Data deficient (DD).

Most probably, the Caspian seal should properly have been listed as 'Data deficient (DD) in 1996. The DD definition is: "A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate." In 1996 the appropriate data on abundance and/or distribution for the Caspian seal were very clearly lacking.

The 2001 definition for 'Vulnerable' is: "when the best available evidence indicates that it meets any of the IUCN criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild."

The criteria for ‘Vulnerable’ that appear to be met by the Caspian seal are the following:

A2 An observed, estimated or suspected population size reduction of ≥ 30% over the last 10 years or 3 generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on A1(d) actual or potential levels of exploitation, and A1(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

The generation time in Caspian seals is approximately 16.5–20 years (Appendix 2). Three generations (i.e. about 50 years) back from 2005 would therefore suggest 1955 as a reference year. The hind-casting in Fig. 4 indicates, that the population has declined from at least 116,196 reproducing females in 1955 to 19,452 in 2005 (83% reduction. Thus the estimated decline since over the last three generations would seem to be greatly in excess of the criteria for the ‘vulnerable’ category, and be more appropriate to the ‘endangered’ category (≥ 50% reduction over past three generations with some causes still ongoing).

The species is also at risk from criteria A1(d) and (e). Since the Caspian is a completely closed ecosystem from which seals cannot disperse into adjacent or new habitat, the species is extremely vulnerable to major pan-Caspian ecological changes such as a catastrophic reduction in stocks of fish prey due to a combination of over-fishing and *Mnemiopsis* effects. The seals could also suffer severe losses from epidemics such as CDV or from continued ‘scientific’ hunting or a resumption of commercial hunting on the ice.

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APPENDIX 1. ICEBREAKER SURVEY

Methods

Counts of seals were made on February 21 2005 from an ice-breaker during a trip made by Agip KCO from Bautino to a rig in the Kashagan oil field. The location of all seals (adults and pups) visible from the ice-breaker was recorded with the ship's GPS system. The number of adults and pups in each group was counted, except for groups larger than 30 adults, when an approximate number was estimated.

Results

The track of this ice-breaker trip is shown in Fig. 7. The track is superimposed on the seal pup distribution map provided by the aerial survey on Feb 23–27, 2005, i.e. 2–6 days after the ice-breaker survey. Each dot on the line on the ship's track indicates where seals were recorded from the ship.

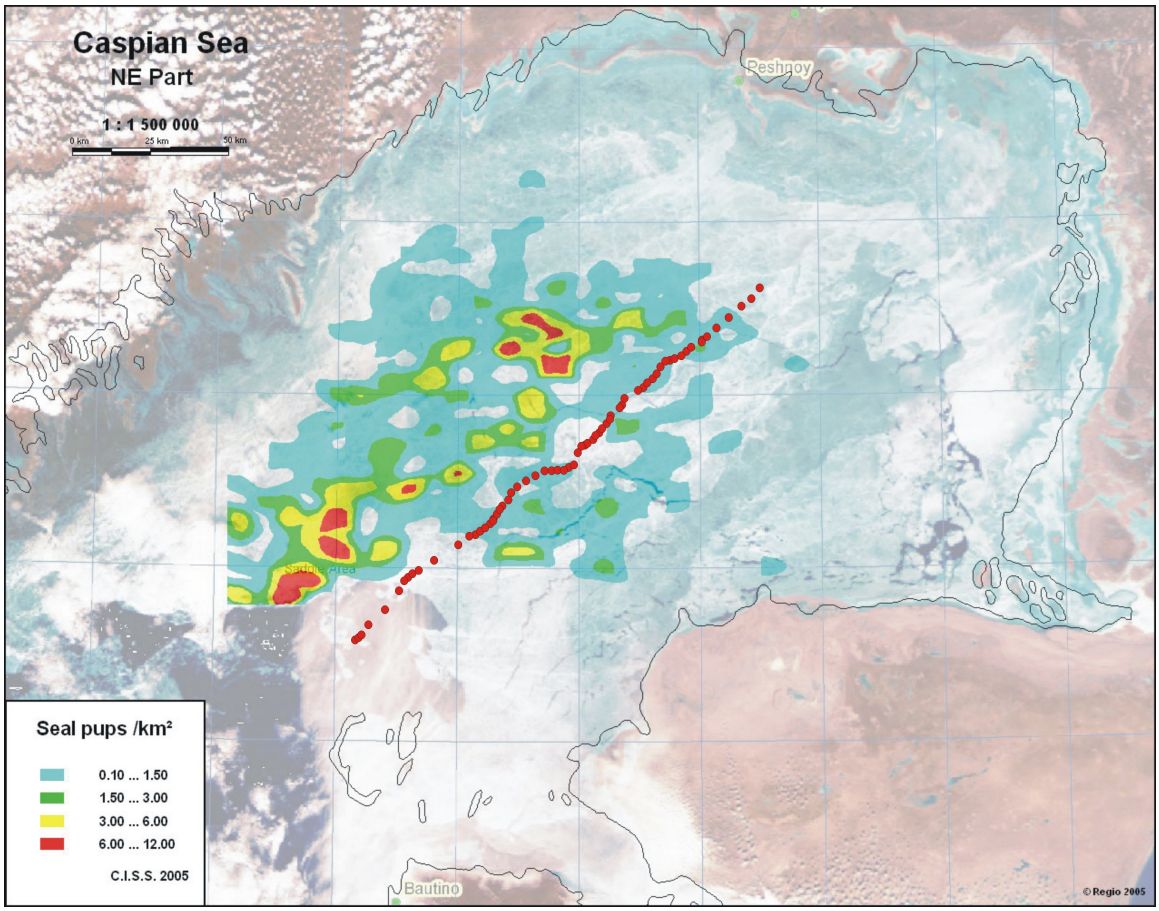

Figure 7. The ice-breaker track 21.02.04, superimposed on the distribution map of seal pups from the CISS aerial survey 23–27.02.05.

The total number of adults seen was 484 (including two nearby groups of adults of approximately 50 seals in each). The total number of pups seen was 90. The numbers of groups of each size are given in Table 2.

Table 2. The number of seal groups of different sizes recorded from the icebreaker

Group size	1	2–5	6–10	11–20	>20
Adults	13	23	8	11	3
Pups	6	17	4	0	0
% total pups in each group size	7%	58%	35%	0%	0%

Groups of adults larger than 10 were not recorded as including any pups. The greatest proportion of pups (58%), were in small groups of 2–5. Two pups from a group of four were seen being eaten by eagles. This ice-breaker track did not travel through any high density pupping areas as recorded by the aerial survey during the following week) Fig. 7).

Discussion

It is clear from Fig. 7 that the ice-breaker passed through areas of relatively low seal pup density. Consistent with this is the fact that the number of pups seen from the ship was relatively low. This particular passage was fortuitous, since it meant that disturbance to the seals from the ship would have been minimised by virtue of the relatively low numbers encountered.

In previous years 1999–2004 varying numbers of adults and pups have been recorded from ice-breakers travelling a similar route. These numbers have ranged from approximately 66 adults and 34 pups (Gistsov, 2002) to approximately 2367 adults and 2000 pups (Gistsov, 2004). The first icebreaker report (Duck and Gistsov, 1999) estimated seal densities of about 18 adult seals per km^2. Since this density would fall in the highest category of our 2005 survey, it is probable that the distribution of seals was different in 1999 and 2005.

This first study (Duck & Gistsov, 1999) described in qualitative detail how the approach and passage of the ice-breaker may cause pups and mothers in the vicinity to flee either across the ice or into the water. Therefore there is the potential for the pup's survival to be compromised by the pup entering the water or by the mother and pup becoming separated or displaced. A quantitative study in which it is noted how many pups are actually displaced or separated from their mothers would be necessary to assess the impact of the ship's passage on seal pupping groups.

Disturbance of seals from the ice-breaker was not recorded by the CISS team in 2005 because it was not possible on this occasion for appropriately trained and equipped personnel to be present on board. If this should be possible in future, years, however,

it would be possible to carry out a quantitative study of disturbance on board, and therefore to estimate the potential impact of ship disturbance in terms of the number of pups adversely affected and the number of ice-breaker trips made during the pupping season.

References

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Appendix 2. Demographic analyses

We performed analyses on the demography of declining seal populations based on best available data for Caspian seals. Although more detailed data on population parameters will alter some of the results, the main patterns presented here are expected to be correct, since most general features are robust for changes in individual parameters such as numbers of age classes, and age specific fertility rates. Using parameter values according to Table 3, we parameterized a Leslie matrix, *A* (Leslie 1948; Caswell 2001):

$$A = \begin{pmatrix} F_1 & F_2 & \dots & F_{49} & F_{50} \\ P_1 & 0 & \dots & 0 & 0 \\ 0 & P_2 & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \dots & P_{49} & 0 \end{pmatrix} \qquad \text{eqn 7}$$

A model for a 'post breeding' population was adopted (Caswell 2001). The elements in the first row of the matrix (F_i) are the fertility rates of age class i multiplied by the survival rate for age class i and the elements in the subdiagonal (P_i) are the age-specific survival rates. P_1 includes the mortality of pups of the year. Fertility rate (F_i) is defined as the number of female pups born in one time interval per female of age i. Survival rate (P_i) is defined as the probability that a female in age class x_i survived to enter age class x_{i+1}.

The young females do not reproduce and thus, F_1 to $F_6 = 0$. In the youngest maturing age class (6 years old) the fertility (F_7) is half that of the adult females. (Note: matrix column 7 corresponds to age 6). Fertility of adult females is given by the birth rate divided by two (counting female pups only) multiplied with female survival. There are many possible combinations of age-specific survival rates and fertility rates that can produce the observed population growth rate. However, based on available information we selected the combination of fertility values for Caspian scenarios according to Table 3. To assess the effects of potential errors in estimates of past and present population sizes and other parameter values, juvenile survival (P_1) was adjusted stepwise to produce the population growth rates (λ) at 0.96, 0.97, and 0.98.

Table 3: Iterated values of vital population parameters used for producing per capita population growth rates (λ) at 0.96 to0.98. Age at first parturition (AFP) set at 6.5 years of age. Note that fertility rates are divided by two in the matrix to get female pups per female. *Fertility rates falling geometrically from 0.90 at seven years of age to produce a mean fertility rate at 0.5.

Parameters	λ=0.96	λ=0.97	λ=0.98
Survival (0-1)	0.329	0.4	0.485
Survival(-2)	0.6	0.6	0.6
Survival(-4)	0.8	0.8	0.8
Survival(-6)	0.9	0.9	0.9
Survival (>6)	0.96	0.96	0.96
AFP	6.5	6.5	6.5
Fertility	0.5*	0.5*	0.5*

Age distribution and reproductive values

A number of important population level characteristics can be described when parameterizing a projection matrix (eqn. 7) with relevant life history data (Caswell 2001). The dominant eigenvalue of a matrix is equivalent to the long-term population growth rate (λ), and the corresponding right eigenvector (**w**) gives the stable age distribution. The reproductive values of age classes are given by the corresponding left eigenvector (**v**).The projected stable age structures (AS) for Caspian seals at λ 0.96 to 0.98 are depicted in Fig. 8.

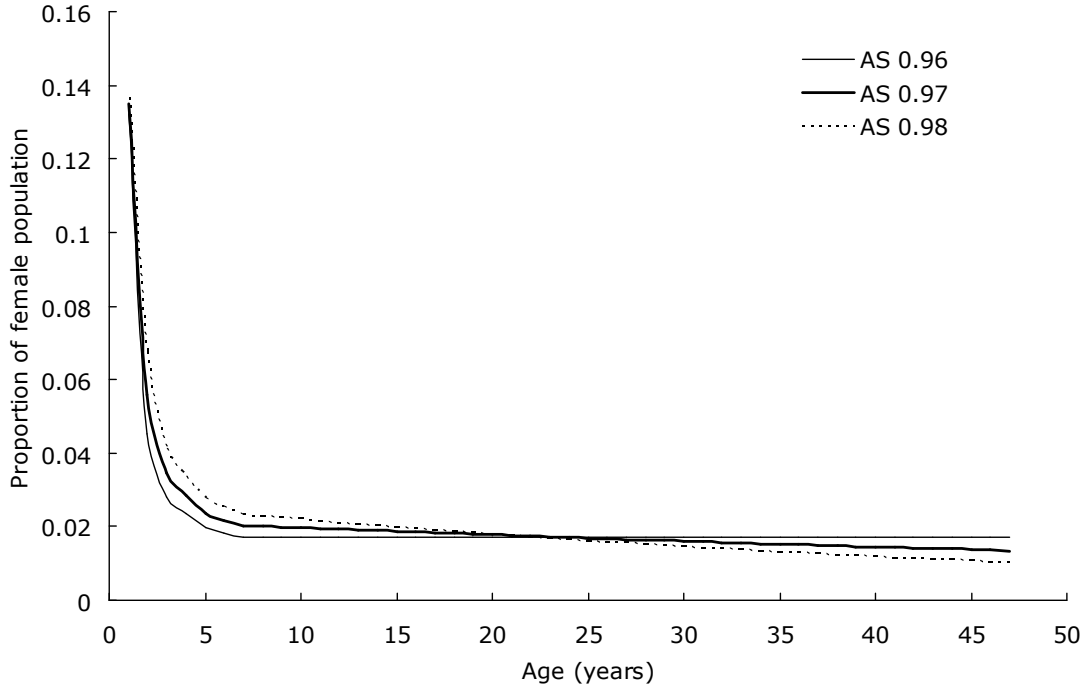

Figure 8: (Appendix 2) Projected stable age distribution (AS) of Caspian seals for parameter values given in Table 3 leading per capita population rates of increase at λ=0.96 to 0.98.

The proportions of adults in the population will depend on the age structure and the age when animals become mature (Fig. 9). We used the age of 6.5 years as the age

when females reproduce for the first time, but the share of the reproducing segment of the population can be found for any combination of parameters

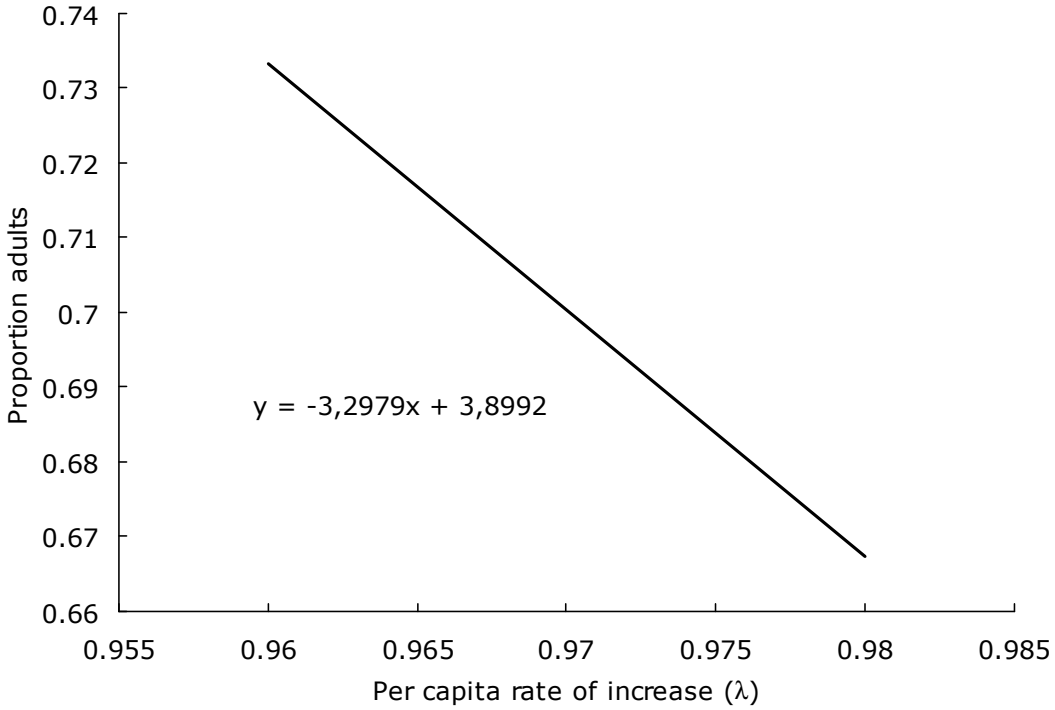

Figure 9: (Appendix 2) Proportion adults (defined as age at first parturition, AFP) in populations depend on the population growth rate (λ) and the AFP.

The cost of hunting

The age composition of harvested animals is likely to deviate from the age structure of the population. Since female seals of different ages have different reproductive values, and thus contribute to different extent to the population growth rate, the age structure of the hunt must be taken into account. In order to evaluate the effect of a given age composition in the hunt compared to a harvest of animals according to the age structure of the population, the value of the harvested animals in terms of the effect on the population growth rate (λ), can be compared to the reproductive value (**v**) (Fig. 10) of the same number of killed animals according to the stable age distribution (**w**) (Fig. 8).

$$y = \sum_{i=0}^{i=38} \mathbf{w}_{(i)} .* \mathbf{v}_{(i)} \qquad \text{eqn 8}$$

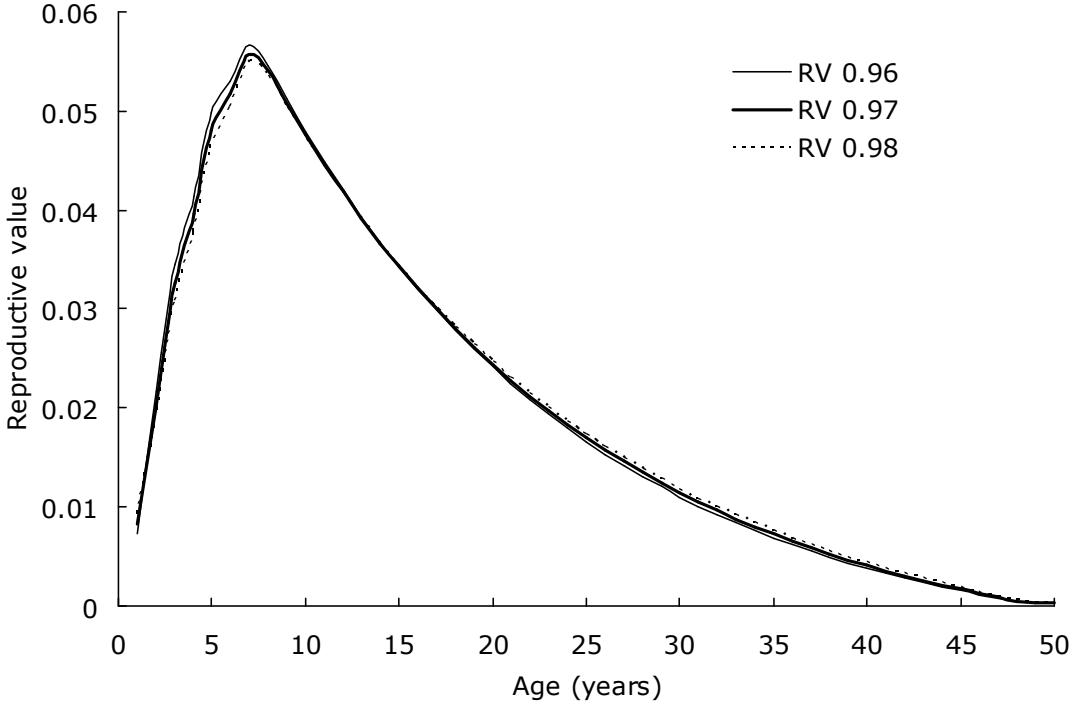

Figure 10: (Appendix 2) Age-specific reproductive values at per capita rates of increase (λ) in the range 0.96 to 0.98.

Thus, y is a sum of the products obtained by multiplying the age structure vector **w** with the vector of reproductive values **v**, for each single age class i. This sum (y) can be compared to the synonymous value of the actual hunt. The age structure vector of the harvested animals (**a**) is subtracted from the stable age structure (**w**) for each age class multiplied with their reproductive values, and then summed:

$$y_h = \sum_{i=0}^{i=38} \left[(\mathbf{a}_{(i)} . - \mathbf{w}_{(i)}) \; .* \; \mathbf{v}_{(i)} \right] \qquad \text{eqn 9}$$

The cost of hunt, C, in eqn 5 is the ratio of y_h/y , which gives the proportional difference for the cost of the hunt. By multiplying this factor with the number of killed seals, the hunt can be evaluated in terms of numbers of killed seal equivalents to the number of seals in a stable age structure.

We chose an approach where we assumed that the hunt was proportional to the age structure in seals older than one year of age, but the proportion of pups was allowed to vary in the hunt. Consequently, this would under-estimate the impact of the hunt if it was primarily directed towards adult animals. This is in line with our approach to provide minimum estimates of historical population sizes and rates of population declines.

Consequently, C =-0.7038p+1.0951 for the scenario of falling fertility rates, and C = -0.8262p+1.1109 according to Fig. 11, where p is the proportion of pups in the hunt. Consequently, for the first scenario eqn 5 can be written as:

$$N_{t+1} = ((N_{t+1} + K_t(-0.7038p+1.0951) + R_t K_t(-0.7038p+1.0951)) / (1 - R_t))$$

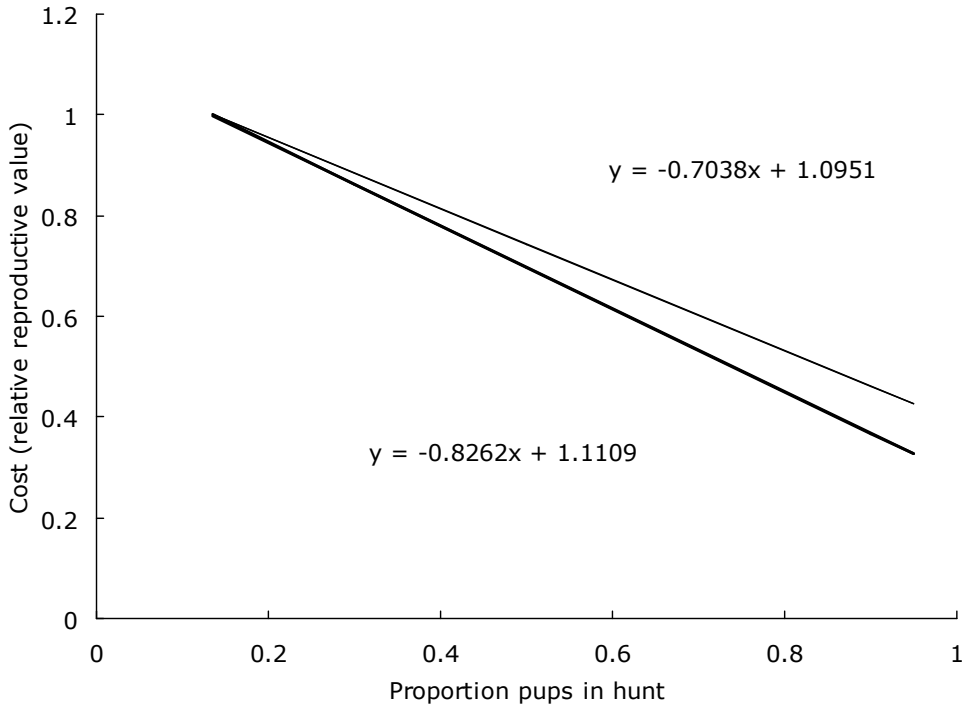

Figure 11: (Appendix 2) The cost of hunt at varying proportions of pups in the hunt given for the scenarios where $\lambda = 0.97$, but where female fertility rates fall geometrically with age (V) or female fertility rate is constant. At a pup proportion in the hunt at 0.135, the reproductive value of the harvest is equal to the reproductive value of the population, and the cost equals 1. The cost (C) is used in eqn 4 to compensate for the annually varying proportions of pups in the hunt.

Elasticity analysis

Elasticity is a quantity that expresses the proportional contribution of a proportional perturbation of each matrix element to the long-term growth rate of a population (Caswell 2001). Elasticity is calculated as the scaled sensitivity (the scaling factor is the parameter value of the matrix entry (a_{ij}) divided by λ).

$$e_{ij} = a_{ij} v_i w_j / \lambda \qquad \text{eqn. 10}$$

(Assuming the two eigenvectors **v** and **w** are scaled to sum 1.)

An elasticity analysis illustrates the relative importance for long term growth rate of single fertility and survival rates for the full age-structured model. As expected for long lived organisms such as seals, the rate of population increase is affected much more by changes in survival as compared to fertility in all age classes (Fig. 6).

Generation time

Based on the age structure (Fig. 8) and the age specific fertility rates, we estimated the generation time for Caspian seals as the mean age of females giving birth to a cohort:

$$T = (\sum_{x=0}^{x=49} x l_x m_x) / R_0 \qquad \text{eqn. 11}$$

Since we varied juvenile survival to get per capita rates of increase (λ) in the range 0.96 to 0.98, the generation time will be 16.28 for all three scenarios. An alternative measure of generation time, time for increase of R_0, will give estimates at 18.0, 17,5 and 17.1 for the same range of λ. Using the same fertility rate (0.5) for all age classes of females will increase the generation times at about two years in all scenarios.

To summarize the demographic analyses, we iterated possible combinations of age specific survival and fertility rates to produce long-term population growth rates ranging from 0.96 to 0.98. For each of these scenarios we calculated the stable age distributions, age specific reproductive values, and elasticities. Consequently, effects of possible errors in estimates of population sizes in 1960 and 2005, leading to this range (0.96-0.98) in λ should be covered within this range of parameters.

APPENDIX 3. TOWARDS DEVELOPMENT OF A CASPIAN SEAL CONSERVATION ACTION AND MANAGEMENT PLAN (SCAMP)

1. INTRODUCTION

A preliminary draft for a Caspian Seal Conservation Action and Management Plan (SCAMP) is presented here for discussion. It is suggested that SCAMP be drawn up in the form of a regional Agreement as a Protocol of the 2003 Framework Convention. The Agreement would best be implemented by a Network of regional Seal Centres (SCN) who would be accountable to the national governments of the contracting Parties to the Convention and thus to the Convention itself.

This discussion document first highlights the most relevant sections of the Convention. Next a draft Agreement is drawn up, with a preamble based on existing knowledge obtained mainly by the former ECOTOX project and by the newly completed aerial survey of the breeding Caspian seal population on the northern ice-field in the winter of 2005 by the Caspian International Seal Survey (CISS) team (see main body of this report). Finally the draft SCAMP is presented in tabular form.

2. FRAMEWORK CONVENTION FOR THE PROTECTION OF THE MARINE ENVIRONMENT OF THE CASPIAN SEA, 2003

The 2003 Framework Convention, now signed and ratified by all five Caspian littoral States, established the most appropriate context for a region-wide Agreement on the Conservation of Seals (ACS) and a Caspian seal conservation action and management plan (SCAMP). The full text of the convention may be downloaded from The Caspian Environment programme website or from:
http://www.crudeaccountability.org/docs/convention_text_en.pdf
and the most relevant sections of the convention for seal conservation are re-iterated below.

Article 5. Principles

(a) the precautionary principle, by virtue of which, where there is a threat of serious or irreversible damage to the Caspian Sea environment, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent such damage;
(b) 'the polluter pays' principle, by virtue of which the polluter pays the costs of pollution including its prevention, control and reduction;
(c) The principle of accessibility of information on the pollution of the marine environment of the Caspian Sea according to which the Contracting Parties provide each other with relevant information in the maximum possible amount.

Article 14. Protection, Preservation, Restoration and Rational Use of Marine Living Resources

1. The contracting parties shall have particular regard to the protection, preservation, restoration and rational use of marine living resources and shall take all appropriate measures on the basis of the best scientific evidence available to:

(a) develop and increase the potential of living resources for conservation, restoration and rational use of environmental equilibrium in the course of satisfying human needs in nutrition and meeting social and economic objectives;
(b) maintain or restore populations of marine species at levels that can produce the maxiumum sustainable yield as qualified by relevant environmental and economic factors and taking into consideration relationships among species;
(c) ensure that marine species are not endangered by over-exploitation;
(d) promote the development and use of selective fishing gear and practices that minimise waste in the catch of target species and that minimise by-catch of non-target species;
(e) protect, preserve and restore endemic, rare and endangered marine species;
(f) conserve biodiversity, habitats of rare and endangered species, as well as vulnerable ecosystems.

A Caspian regional Agreement on the Conservation of Seals (ACS) to fulfil the objectives of Article 14 of the Convention needs to be developed and agreed by all five littoral states. This is a pre-requisite for the development of an Action Pan (SCAMP) and is considered below. The Agreement should be drawn up as a protocol to the Convention, as provided for in Article 24 of the Framework Convention.

Article 24. Adoption of Protocols
1. Any Contracting Party may propose protocols to this Convention. Such protocols shall be adopted by unanimous decision of the Parties at a meeting of the Conference of the Parties. Protocols shall enter into force after their ratification or approval by all the Contracting Parties in accordance with their constitutional procedures, unless the protocol does not envisage a different procedure for adoption. Protocols shall form an integral part of this Convention.
2. The text of any proposed protocol shall be communicated to the Contracting Parties by the Conference of the Parties at least six months before the meeting of the Contracting Parties at which the protocol is proposed for adoption.

3. A DRAFT CASPIAN REGIONAL AGREEMENT ON THE CONSERVATION AND MANAGEMENT OF CASPIAN SEALS

A prerequisite for developing a Caspian SCAMP is a multilateral Agreement on the Conservation and Management of Caspian Seals, according to the parameters expressed in Article 14 of the Convention. A model for the agreement is suggested here, based on similar agreements elsewhere.

The context for conservation and management of the Caspian seal is an enclosed water body surrounded by five littoral states, now politically independent from each other. The entire seal population is thought to migrate freely throughout the Caspian, and is therefore the common responsibility of all five countries. This situation, although unusual, is not entirely unique. Precedents for effective agreements and conservation action plans exist in the Helsinki Commission (HELCOM) agreement on seals in the Baltic Sea (HELCOM Recommendation 9/1 (1988) - Protection of Seals in the Baltic Sea Area) and the Wadden Sea agreement (1991) under the Convention on Migratory Species (CMS).

HELCOM (Baltic Marine Environment (Helsinki) Commission) is the governing body of the Helsinki Convention (1974 and 1992), details of which may be accessed from http://www.helcom.fi/ . HELCOM Recommendation 9/1 (1988) introduced the plan for

Protection of Seals in the Baltic Area. The Baltic situation resembles the Caspian in that (a) the body of water is enclosed (although not totally), (b) the northern part freezes in the winter and is used for breeding by both the ringed seals and grey seals, and (c) there is a history of commercial seal hunting by independent littoral states, some of which were part of the former Soviet union. The Helsinki Convention has been signed and ratified by all nine littoral states (Russia and eight EU states: Denmark, Estonia, Finland, Sweden, Germany, Latvia, Lithuania and Poland) and also by the EU. The seal protection recommendation includes the ringed seal (*P. hispida*), the grey seal (*H. grypus*) and the harbour seal (*P. vitulina*).

The Wadden Sea Seal Agreement, details of which may be accessed from http://www.waddensea-secretariat.org/management/SMP/seals.html,was enacted on October 1, 1991 as the first agreement, as defined in Article 4, of the Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn Convention, 1979). The Seal Agreement was concluded between the countries adjacent to the Wadden Sea - Denmark, Germany and The Netherlands - with the aim to cooperate closely in achieving and maintaining a favourable conservation status for the common seal population of the Wadden Sea. The seal species involved are harbour and grey seals. The Wadden Sea is not enclosed (being the southern part of the North Sea) and is not ice-bound, but seals were formerly hunted commercially.

Draft of multilateral agreement on the Conservation of the Caspian seal

This draft Agreement, or Protocol under the Framework Convention, is modelled on a combination of the HELCOM and Wadden Sea agreements

RECOGNIZING that seals are an irreplaceable component of the Caspian ecosystem, are intimately linked with other components, and are of great importance as indicators of its condition;
RECOGNISING that the population of the Caspian seal (*Phoca caspica*) is currently declining
CONCERNED by the conservation status of the population, which has been reduced to the lowest level ever recorded
CONCERNED about recurrent large-scale natural mortalities (probably due to CDV)
CONCERNED about high levels of Persistent Organic Pollutants (POPs) in Caspian seals, which may be causing the reduced fertility observed, and immune suppression leading to increased susceptibility to infectious disease.
CONCERNED about the numbers of seals taken as incidental by-catch and by killing both in nets and in the vicinity of fishing operations
CONCERNED about the possible impact of *Mnemiopsis* and over-fishing on the density of prey for Caspian seals
RECOGNISING that seals are wildlife species and should as such, as an integral part of the natural ecosystem, be conserved, managed and utilised in a sustainable way

RECOGNISING that the Caspian seal moves freely within the Caspian, and therefore that the conservation of the seal is a common responsibility of all five countries bordering the Caspian
AWARE that seal hunting was formerly an important economic activity in the northern part of the Caspian
RECOGNISING that particular issues, such as the hunting of seal pups and seal-fisheries interactions, may have a local bias within the region
REALISING that, although hunting may have an incidental mitigating effect on seal/fisheries conflicts, nevertheless, hunting is not considered as a mitigating measure, and may have detrimental effects on population size and the long term survival of the species.
CONVINCED that marine mammals play an important role as biological indicators on the effects of certain types of marine pollutants, in particular POPs
WITH A VIEW to improving this conservation status through an agreement with all of the Caspian littoral States that they may together exercise common jurisdiction over the full range of the seal population and act together to improve its conservation status.
RECALLING the 2003 Framework Convention for the protection of the Marine Environment of the Caspian Sea and notably its Article 5 on general principles and Article 14 on Protection, Preservation, Restoration and Rational Use of Marine Living Resources
HAVE AGREED as follows:

1. The Convention parties shall cooperate closely with a view to achieving and maintaining a favourable conservation status for the Caspian seal population.

2. Implement coordinated monitoring programmes on seals, especially on population size, population trend and population structure, reproductive and mortality parameters, health condition and impacts on seal populations from fisheries including by-catch. The CISS group intend to lead and coordinate this work through a network of regional Seal Centres in the coming years. Collected data will be transparent, will be published in international, peer reviewed journals, and will become available to the Convention partners, national and international institutions and all relevant conservation and management authorities in the Caspian region.

3. Develop a Seal Conservation Action and Management Plan (SCAMP) based on the information from the 2000-02 ECOTOX project, and from CISS group surveys and monitoring programmes on the population, health and ecological status of the Caspian seal.

4. Suggest research be carried out (by satellite telemetry) on seal migratory movements throughout the Caspian, use of key habitats throughout the year, and on the role of seals in the ecosystem.

5. Suggest research be carried out on the population genetics of Caspian seals to identify the stock structure and any local potential local genetic subdivisions that may need to be accounted for in management plans.

6. Suggest research be carried out on the impact of industrial shipping and other commercial activities on seal habitat, particularly breeding habitat on the ice, and disturbance to seals, particularly breeding seals.

7. Implement, where appropriate, coordinated cooperation and management of seals dispersed across geographic regions or national territorial boundaries, e.g. seals breeding on the ice sheet between Russia and Kazakhstan.

8. Suggest research be carried out on the impact on seal behaviour from fisheriesactivities and develop an efficient reporting system on damages to fishing gear and catches caused by seals.

9. Develop and implement mitigation measures to reduce by-catch and damage such as modification of fishing-gear and scaring devices based on existing knowledge. Technical solutions are necessary elements in all successful long-term mitigation.

10. Establish seal reserves where necessary.

11. All hunting (for commercial or scientific reasons or to protect fisheries) should be banned at least until the population is demonstrated to be no longer in decline.

12. Non-lethal methodology for scientific sampling, to international scientific and ethical standards, should be introduced to the region by training young scientists and veterinarians in appropriate techniques and procedures. These techniques should supersede lethal sampling in future monitoring programmes.

13. If legal hunting should occur exceptionally, or be resumed when populations are deemed to be healthy at a future date, the following principles should be considered:

i) Taking should occur only if deemed by the Convention Partners to be in the common International Public Interest.
ii) Taking must occur in accordance with the ethical principles of animal welfare.
iii) Taking should be supervised and regulated by the responsible wildlife management authority.
iv) Taking of seals may not jeopardise the conservation of seal stocks and should not be conducted within seal reserves.
v) Taking should be coordinated with neighbouring countries managing the population involved.
vi) The numbers of seals taken in a certain area should be based on internationally reviewed scientific information on the seal population.

vii) Taking should be organised in a way that serves the needs of monitoring programmes in terms of relevant data and tissue samples being supplied to the Seal Centre Network.
viii) Permission for taking should be issued individually by the management authority.
ix) Permission should be issued for a specific number of individuals and within a specified time of the year in order to avoid disturbance in the breeding period.
x) Precondition for taking of seals should include that non-lethal mitigating measures have been considered.
xi) Annual reports on individuals taken should be presented to the Convention Partners, or the appropriate coordinating body (The Seal Centre Network).
xii) Continue to assess the condition of the Caspian seal populations and to implement when appropriate coordinated cooperation and management of seals dispersed across geographic regions or national territorial boundaries, on the basis of new evidence presented by the Seal Centre Network of the Convention Partners, and other relevant, verified information.

4. DRAFT CONSERVATION AND MANAGEMENT PLAN FOR THE CASPIAN SEAL 2005-2009

1. Agreement area: The concerned Agreement area is the Caspian Sea

Explanatory note: The measures of the Seal Conservation Action and Management Plan (SCAMP) are outlined according to the following scheme.

Seal Agreement	Required effort and objectives	Action 2005-2009
The objectives and obligations of the Agreement itself	The objectives and the individual activities and measures that need to be undertaken to achieve the objectives	• The activities and measures which multilaterally and/or of each Caspian littoral State shall implement in addition to the seal protection measures which already exist in the given State, in order to fulfil the Agreement • A Caspian Seal Centre Network (CSCN) shall be established with a Centre in each of the Caspian littoral States working with the approval of each State Government • The CSCN will consult with an International team of specialists (CISS – Caspian International Seal Survey) to determine and develop the necessary conservation measures and programme for research and monitoring
2. CONSERVATION AND MANAGEMENT MEASURES		
Habitats 1. The Parties shall take appropriate measures for the protection of habitats. They shall pay due regard to the necessity of identifying, creating and maintaining a network of protected areas, on land, sea and ice throughout the Caspian and of ensuring the preservation of areas which are essential to the maintenance of the vital biological functions of seals.	It will be necessary: To identify and create seal reserves and to take appropriate measures, i.e. • to ensure that the reserves cover the main birth, nursery, resting and foraging areas of seals and ensure that the reserves cover a sufficient proportion of seals in all seasons in all parts of the Caspian; • to ensure that designations of seal reserves are based on well-defined criteria of critical habitats	MULTILATERALLY • Define habitat and diet requirements for the different age groups. • Take appropriate measures to survey and identify seal breeding and resting sites in all seasons in all areas within the jurisdiction of each Caspian State. • Take appropriate measures to identify foraging areas, habitat and diet for juveniles and adults in all seasons in all areas. KAZAKHSTAN and RUSSIA Take appropriate measures to identify areas within which the highest densities of breeding seals are most likely to occur; MULTILATERALLY Develop measures to define reserves and define restricted activites within reserves. Define any remedial measures required to restore habitat.

Seal Agreement	Required effort and objectives	Action 2005-2009
2. The Parties shall preserve habitats and seals, within and outside reserves, from undue disturbance or changes resulting, directly or indirectly, from human activities.	It will be necessary: • To ensure that the seal reserves are created in such a way that human impact on disturbance to the seal population is limited to a minimum. • To reduce disturbance by ice-breakers and other shipping	KAZAKHSTAN AND RUSSIA • Create reserves within the ice-field where highest breeding seal densities most likely to occur. Use data from annual surveys to build flexibility into reserve definition to allow for shifting of areas of high density with annual variation in ice conditions. • Regulate shipping and other industrial activity to circumvent reserves and seal breeding areas as far as possible. TURMENISTAN • Create as appropriate new reserves at seal haul-out islands and surrounding water AZERBAIJAN • Create as appropriate new reserves at seal haul-out islands and surrounding water
	It will be necessary: • To reduce the number of seals caught as by-catch and ensure that seals are not deliberately killed by fishermen	IRAN • Release seals trapped in 'pareh' nets unharmed • Prevent deliberate killing of seals encountered during fishing operations such as kilka fishing MULTILATERALLY • Take steps to prevent illegal setting of nets which may entrap and drown seals • Research ways of reducing seal by-catch in legally-set fishing nets
3. The Parties shall identify areas of degraded habitat and explore possibilities for restoring such habitat or creating new habitat to compensate	It will be necessary: • To identify haul-out areas for resting and breeding which were formerly used, but which are now not used, or used less than formerly • To identify seal foraging areas and determine extent of obstacles created by fishing nets, industrial installations, etc • To identify areas where *Mnemiopsis* concentrations may be damaging stocks of fish which form part of the seals' diet	MULTILATERALLY • Chart, from historical records, sites used formerly and at present for seal haul-out, and indicate the causes for the current disuse; suggest remedial measures • Identify seal foraging areas by telemetry studies. Chart fishing nets, boats, industrial installations activity etc in those areas • Monitor seal diet seasonally, by means of analysing contents of seal scats collected from selected haul-out sites • Coordinate with regional *Mnemiopsis* monitoring programme to identify areas and stocks where *Mnemiopsis* impact may be

Seal Agreement	Required effort and objectives	Action 2005-2009
		severe, and determine whether these areas and stocks coincide with important seal foraging areas and prey species.
Pollution		
The Caspian littoral States are determined to do their utmost to further reduce pollution of the Caspian Sea from whatever source with the aim of conserving and protecting the fish stocks and the food chain in the Caspian. To this end they shall endeavour to identify the sources of such pollution	It will be necessary: • To use Caspian seals as indicators of the condition of the marine environment.	MULTILATERALLY • Collect blubber samples for analysis together with measurements of body length, blubber thickness and age from seals found dead from natural causes or in by-catch
	• To ensure that solid or liquid waste contaminated with POPs or other toxic substances will not be dumped into the Caspian Sea or into river catchment area of the Caspian	• Regulate the dumping of solid and liquid waste in such a way that it will not leach into the Caspian or its river catchment area
	• To ensure that harmful organochlorine pesticides, such as DDT, are prevented from being further used in the Caspian catchment area	
Overseeing		
4. The Parties shall take appropriate action to suppress illegal hunting and taking of seals.	It will be necessary To ensure the enforcement of the provisions of the agreement by an adequate management and overseeing system, which should – concerning all seal matters – be coordinated at state administrative agencies	MULTILATERALLY • Esrablish a region-wide law applicable to all Convention Parties, that disallows any deliberate injuring, killing or taking of seals without a permit being issued under the agreement • This law would include seals at haul-out sites, in seal-fisheries interactions and in scientific research • Establish overseeing of accessible seal reserves through the Caspian Sea guided by a common standard, to be developed by mutual agreement by CSCN KAZAKHSTAN and RUSSIA • Establish a system to ensure there is no illegal hunting in the seal breeding areas in the ice-field, by methods such as satellite surveillance and regulation of markets for seal products (such as sealskin)

Seal Agreement	Required effort and objectives	Action 2005-2009
3. RESEARCH AND MONITORING		
1. The Parties shall coordinate their research programmes and projects and their monitoring of the seal population to increase their knowledge of the biology and the habitat including harmful effects of human activities on the seal population to provide a basis for measures to improve its conservation status.	It will be necessary <u>Research</u> • To establish an overview of recent and ongoing research projects on seals to ensure information exchange	<u>MULTILATERALLY</u> • An inventory of recent, ongoing and planned research projects on seals in the entire Caspian Sea area should be compiled by CSCN with the assistance of CISS personnel • The results of the research projects on Caspian seals should be subject to evaluation by the CISS team • Respond appropriately to new findings on existing threats, or identification of new threats as determined by the research and monitoring programmes.
2, They shall, in particular, monitor and coordinate their research on, (a) population trends, through regular aerial surveys of the winter ice-field as well as counts at haul-out sites throughout the Caspian (b) Health surveys of live seals, and seal population parameters, using non-lethal methodology	• To follow closely the population trend according to a scheme outlined by the CISS team and following from the initial survey in February 2005 • To carry out a full survey of the entire winter ice-field each year • To carry out an annual health survey of the breeding seal population on the winter ice-field using non-lethal methods, according to a scheme outlined by the CISS team • To identify laboratories where samples may be analysed to international standards	<u>KAZAKHSTAN AND RUSSIA</u> • Facilitate the annual aerial survey of the breeding seal population on the winter ice field, to be carried out by the CISS team in the initial years • Ensure that young scientists are fully trained in practical and theoretical methodology to continue the aerial survey in future years according to international scientific and ethical standards • SCN to establish and maintain Excel spreadsheet for all aerial survey results • Annual report of health survey to be prepared, through SCN, to international standards, by CISS in initial years • Facilitate an annual health survey of the breeding seal population on the winter ice-field using non-lethal methods, to be carried out by the CISS team in the initial years • Ensure that young scientists are fully trained in practical and theoretical methodology to continue the health survey in future years

Seal Agreement	Required effort and objectives	Action 2005-2009
		according to international scientific and ethical standards • SCN to establish and maintain Excel spreadsheet for all health survey results • Annual report of health survey to be prepared, through SCN, to international standards, by CISS in initial years • Arrange for samples to be appropriately collected, stored and sent to laboratories for analysis • SCN to establish and maintain Excel spreadsheet for all health survey results • Annual report to be prepared through SCN, by CISS in initial years.
(c) Counts of seals at non-iced haul-out sites throughout the Caspian at different seasons	• To carry out a counts at seal haul-out sites in non-iced areas of the Caspian, simultaneously with the annual February survey and at other seasons	<u>KAZAKHSTAN, RUSSIA, AZERBAIJAN, TURKMENISTAN</u> • Facilitate and carry out counts at seal haul-out sites In non-iced areas of the Caspian, simultaneously with the annual February survey and at other seasons • SCN to prepare EXCEL spreadsheet and store counts • SCN to prepare chart of all non-iced haul-out sites in Caspian, each site given an ID name and number • SCN to prepare annual report of seal numbers at each haul-out site; data to be integrated with results of annual survey, where appropriate
(d) Investigation of all causes of seal mortality	• To describe, investigate and analyse all causes of mortality	<u>MULTILATERALLY</u> • Basic measurements and description of all seals found dead will be taken • Seals found freshly dead will be necropsied and samples taken for analysis of health status • The data from the above programme shall be maintained on an Excel spreadsheet and held by SCN

Seal Agreement	Required effort and objectives	Action 2005-2009
(e) Carry out a study of seal diet, using non-lethal methods	To develop a multilateral project on Caspian seal diet using non-lethal methods	AZERBAIJAN • The long-standing programme of seal mortality monitoring on the N. Apsheron Peninsula shall be continued • The data from the above programme shall be maintained on an Excel spreadsheet and held by SCN. IRAN • The mortality monitoring project, started in 2000-01, shall be continued • The data from the above programme shall be maintained on an Excel spreadsheet and held by SCN KAZAKHSTAN • develop an otolith guide for Caspian fish, under the guidance of the CISS MULTILATERALLY • Develop a project for investigating seal diet by (a) analysing faecal samples collected from haul-out sites and (b) analyse food remains from seals found dead due to by-catch and other causes. NB. No seals should be killed for the purposes of this study
(f) Carry out a study of seal migration and local movement patterns	To develop a multilateral project on Caspian seal movements, foraging areas and migration patterns using telemetry systems	MULTILATERALLY • Develop a tagging and tracking programme for Caspian seals using modern telemetry systems, under guidance of CISS team • SCN to develop and maintain Excel spreadsheet storing all tagging and telemetry data, under initial guidance of CISS team • SCN to report on all results of all telemetry results, initially under guidance of CISS team

Seal Agreement	Required effort and objectives	Action 2005-2009
		KAZAKHSTAN AND RUSSIA • Facilitate tagging of breeding seal population on the winter ice-field, to be carried out by CISS team in initial years
4. TAKING AND EXEMPTIONS FOR TAKING		
Taking 1. The Parties shall prohibit the taking of Caspian seals	The taking of Caspian seals shall be prohibited by the Parties	**NATIONAL LEVEL** Implement provisions in appropriate form in national legislation
Exemptions for Taking 2. The competent authorities may grant exemptions from the prohibition referred to in the first paragraph authorizing persons to take seals: • For regional Institutions or CISS team to be designated performing scientific research into the conservation of the Caspian seal population or the conservation of the Caspian Sea ecosystem, insofar as the information required for such research cannot be obtained in any other way; or • For Institutions to be designated nursing seals in order to release them after recovery, insofar as these are diseased or weakened seals or evidently abandoned suckling seal pups. • Seals which are clearly suffering and cannot survive may be humanely euthanized by a fully qualified veterinarian or biologist, provided (a) a necropsy and tissue sampling is carried out and (b) no parts of the body are given for sale or monetary gain • For Institutions to be designated as educational aquaria for the public	National Governments should be advised by SCN, under guidance from the CISS team in the early years • It is necessary to develop modern, non-lethal research methodologies, which are acceptable to the international scientific community. Deliberate killing for scientific research should be rarely, if ever, employed • Caspian seals should not be taken into captivity in order to carry out feeding or other experiments unless (a) stringent welfare conditions can be met and (b) the research is deemed to be (i) necessary for seal conservation, (ii) scientifically sound according to international standards • There are no plans at present to initiate seal rehabilitation facilities, although this may be debated at a later date • Seals should not be kept in public aquaria unless (a) modern stringent standards of animal welfare, display and educational criteria are met by the facility and (b) the facility is demonstrably in the regional public interest and serves a strong educational and conservation purpose	MULTILATERALLY • SCN should meet to consider any such applications from national institutions; the CISS team should be consulted in the initial years • SCN should develop programmes with CISS to train young scientists in modern, non-lethal research concepts and methodologies, such as are used in western Europe and the US. • Any exemptions for taking seals into captivity for research should be evaluated by SCN, under the guidance of the CISS team in the initial years • The behavioural ecology, known stranding pattern and prevalence of infectious disease (CDV) of Caspian seals mean that the seal is probably not generally a good candidate for rehabilitation programmes, although such a programme might, under CISS guidance, be developed as a conservation, welfare and PR tool. A rehabilitation facility and public aquarium might be combined, if deemed to be appropriate by SCN

Seal Agreement	Required effort and objectives	Action 2005-2009
6. PUBLIC INFORMATION		
The Parties shall take such measures as may be required to make the general public aware of the conservation status of the seal population, of the content and aims of the Agreement, including the Conservation and Management Plan, to improve the conservation status	It will be necessary • To inform the public throughout the region to contribute to the continuous implementation of the Conservation and Management Plan (SCAMP) • To recognise the fact that Caspian seals belong to one population and are an integrated part of the Caspian Sea ecosystem, • To ensure that at each Seal Centre in the SCN has a qualified, full- or part-time public awareness officer to take care of public information • To ensure that publicising information that could enhance the taking of seals will be avoided • To ensure that the public knows when they disturb seals and how they can avoid it • To ensure that the public knows what to do in the event of finding a live or dead seal on the beach	MULTILATERALLY SCN should establish and maintain a multilingual Caspian seal information website, as well as brochures, posters and leaflets to enhance public awareness
6. FINANCIAL IMPLICATIONS		
a. national The implementation of the common Seal Conservation and Management Plan (SCAMP) in national measures including monitoring to be financed by the contracting Parties **b. common** The implementation of multilateral measures in SCAMP to be financed by (a) contributions from Contracting Parties, (b) research funding from international sources to be sought by SCN with assistance and guidance from the Caspian Environment programme (CEP) and the CISS team		

APPENDIX 4. INPUT FROM THE BISRAG MEETING, 25-26th APRIL 2005, TO THE CISS SEAL SURVEY REPORT

INTRODUCTION

The BISRAG meeting consisted of three main presentation and discussion components: the status of Mnemiopsis and its control, the development of a Caspian biodiversity database and the seal survey report.

The purpose of this appendix to the CISS seal survey report is to extract from the contents of the meeting those aspects which are both directly relevant to the seal report and relevant in a more general way to the process of developing a seal conservation action and management plan (SCAMP).

THE CASPIAN SEAL SURVEY IN THE CONTEXT OF GEF II

The meeting began by Anders Poulsen (GEF II Biodiversity Expert) outlining the structure of GEF II and thus clarifying the context for these three discussion components.

GEF II has three output components, A, B & C, of which B2 relates directly to the Caspian seal, requiring a series of annual population surveys and a health monitoring programme leading to a SCAMP. The other GEF output components relevant to the seal include output A (assessment of habitats), output B1 (establishing an Econet) and output C (monitoring and control of alien species, *Mnemiopsis* in particular).

Seal habitat relevant to output A. The CISS seal survey reports not only on the seal population status, but also on its habitat. Caspian seal habitat is wide-ranging, including as yet undefined areas of open water (for foraging), offshore islands (for resting out of the water and for limited pupping) and the winter ice-field in the northern Caspian (for breeding).

The present survey report provides the first quantitative description of the distribution of the breeding seal population on the ice in relation to seal density and ice type. Further analysis of the data will be able to show, for example, the percentage of the total pups born on different ice types and in groups of different densities. Such data breakdown may be essential to defining the most critical ice habitat for breeding seals and its location, which information should assist in the future definition of protected areas for seals in the ice field. If the location of critical ice habitat is found, in future surveys, to vary significantly from year to year, it is possible that seal protected areas on the ice may have to be dynamic, defined annually by the distribution of ice types.

Future pan-Caspian ground and aerial surveys will define which non-iced islands and rocky ledges throughout the Caspian, and which parts of these, are used by how many seals at different times of the year. This information will obviously be vital to the definition of potential seal reserve areas. Some, though not all, of these islands are already known and some are already protected under national law. A pan-Caspian inventory of these sites needs to be developed.

The definition of critical habitat in open water will require telemetry studies of seals in order to locate their prime foraging areas and such studies are planned by CISS as soon as funding can be found. Favoured foraging areas may coincide with particular habitat types for favoured species of fish prey. Definition of such important foraging areas will assist in the definition of protected areas at sea where seals may forage free from high levels of deleterious interactions with fisheries. Information from areas where seal-fisheries interactions are prominent may help in this process and some work, still ongoing, was carried out in Iran for ECOTOX by a regional member of the present CISS team.

CISS survey work in the context of Output B. Output B2 requires a series of annual surveys to determine the population size as well as seal health monitoring programmes. The seal survey report presented at this meeting provides the first systematic population survey and reliable population estimate for the Caspian seal and this therefore constitutes the fundamental initial step for Output B2 to proceed.

The CISS survey work has also been making a major contribution to Output B1, the establishment of a biodiversity Econet. The CISS team has followed on from the work of the ECOTOX project (2000-2002) and its predecessor (The World Bank Bioresources Network, 1997) in establishing a cooperative network of seal biologists in the region. This is at present advised and coordinated by the CISS team, but will gradually evolve into an autonomous pan-Caspian network of seal centres, most probably led and coordinated by the Kazakhstan centre. This structure of the network should ensure integration of 'exploiters' and 'conservers' (in relation to Chris Matthews' comment at the meeting), since the centre network will be initiated through the Kazakh Fisheries Institute, and will include both seal conservation biologists and fisheries biologists working together. The CISS exit strategy includes the development of permanent links between seal centre scientists and international institutions and organizations. The seal centre network will be an integral component of the proposed biodiversity Econet.

Data collected by the CISS project as well as ECOTOX and earlier work on seals may also be prepared in a format suitable for inclusion in the new database currently being prepared for GEF II.

CISS survey work in relation to Output C. The ongoing GEF II work and debate relating to the impact of *Mnemiopsis* and its possible control by *Beroe* should maintain close links with the work of the CISS team, since the bottom-up effects of *Mnemiopsis* on Caspian seal prey species may pose a significant threat to seal survival in the short and long term. CISS work planned on regional and seasonal variation on seal diet and seal foraging areas will be highly relevant to the *Mnemiopsis/Beroe* debate, and vice versa.

CISS survey work in relation to the whole GEF project. From this description above, it seems evident that the contributions from the Seal Survey towards achieving the goals of the GEFII project deserve substantially larger investments and perhaps warrant a greater proportion of the Programme resources than has been allocated on this occasion (<2%). Possibly this might be taken into consideration for the future.

RESPONSE OF THE MEETING TO THE CISS SURVEY REPORT

The CISS team made three presentations on the second day of the meeting: the first of the main survey results, the second on the proposed SCAMP draft and the third on further proposed research with costings. Questions and comments on each presentation from the participants are summarised below. Responses to these, where appropriate, are given below. Responses at the meeting are in pink. Where there was not an opportunity to respond at the meeting, the response, composed afterwards, is in blue.

Presentation on the survey results.

RF: What proportion of the population is feeding (i.e. how many seals are not visible) during your survey?

R: The population estimate is based on the number of pups. All pups are visible during the survey because they do not leave the ice to feed until after weaning.

RF: How did you calculate the number of adults? A big number of seals is undercalculated.

R: The adult share of the population was calculated for females only. This was done by parameterising data from hunting records between 1960 and 2005 into a population modeling matrix, as explained in the report Appendix 2. This matrix gives a stable age distribution for the population, from which the adult share of the female population was calculated (0.62). The total female population size is then given by N = J/F*A, where J is the number of pups from the survey, F is the fertility rate (taken here as 0.5). A lower fertility rate would give a higher total population estimate, but this would merely imply a higher number of infertile adults. The effective adult population is equal to the number of pups born (breeding females) multiplied by two (assuming an approximately equal number of fertile males).

TK: The quality of this work is very high, and this population figure is more realistic than the figures we have previously received. Have you estimated the number of seals not migrating north?

R: We were unable to survey Turkmenistan or the remainder of the Caspian during the breeding season this year, owing to funding limitations. However, the numbers born are known to be very small (numbering in tens, or less), and would not have any significant impact on our estimate of the population size. A survey of seals not migrating north would be of interest mainly in terms of distribution and age class. The rate of successful weaning in pups born on islands south of the ice field would be of interest (a lower rate of successful weaning on islands than on ice would be predicted).

IR: To what percentage of the total Caspian population does your estimate of 125,000 refer?

R: Almost total.

IR: We carried out research into the density of seals inhabiting Iranian waters at approximately the same time as your survey and we estimated, from kilka boats, a density of 0.5 seals km^2. If we multiply this out to the area of Iranian waters, this surely refers to a large number of seals not counted by your survey in the north.

R: If there is a very large population of non-breeding seals in the south during the breeding season, this would mean the population could be close to collapse.

The population estimate of 125K includes all seals in the Caspian, including approximately 52K (including pups) on the ice. This leaves an estimated 73K seals elsewhere in the Caspian, including Iranian waters, which would include the seals you have seen from kilka boats. An explanation of this has now been included in the main survey report.

It should be noted also that although it may be possible to estimate seal numbers foraging on kilka in the vicinity of fishing boats (a very interesting study), it is not possible to estimate seal numbers in general from from such records of seals in the water.

Agip KCO: (Requests further information on hind-casting the female population.

R: Please refer to the main body of the report and to Appendix 2 also. Further references to this well-established methodology are included in the report.

NA (ECS): The more complex the organism (such as the seal), the more flexible is the organism in responding to anthropogenic changes in the environment, such as climate change. For example, the seals' seasonal migration north for breeding might be changing.

R: Evolution does not take place within 100 years. In fact, 30,000 years is insufficient time for seals to change their basic breeding system, as has been demonstrated in the case of the East Atlantic grey seals (which have reduced success compared to conspecifics on the ice). If the Caspian conditions become unfavourable (such failure of the ice-field to form in warmer winters), they will not be able to adjust in very short periods of time and the population will collapse.

CM (EU/TACIS): A fall in the population from around 600,000 to 60,000 in a hundred years is nothing short of catastrophic. Can you make guesses as to what is causing this disaster?

R: There are two major factors believed to have caused the decline in the seal population. One is a high mortality rate and one is a low fertility rate. An elasticity analysis (using again the population matrix, as described in Appendix 2 of the report) in fact shows that changes in survival affect the population trend (a decline) about ten times more than a similar proportional change in fertility. The decline will be most sensitive to the premature death of juvenile females, because if a juvenile female dies, she can never reproduce, while if she survives to maturity, she can produce 10 pups or more. The principal known causes of death of young females (in addition to 'natural causes in the neonatal period) are large-scale hunting of pups, canine distemper virus, and probably fisheries by-catch. Of these causes historically, large-scale hunting has

probably been by far the most important. At the present time CDV and by-catch may also be important.

KZ: Where did you get your hunting data from for your graph showing the population decline?

R: From Krylov (1990) and Sokolskii (2004).

KZ: I completely disagree with these exaggerated figures. The most competent specialists are working for our institutes and have given a very precise figure for the present population size of 380–400K. I know from the mass media that about 2,000 seals died in recent mortalities, but I know there hasn't been any major population reduction. Also your 11% coverage in your survey does not give a complete picture. Also white pups are very difficult to count from a plane. Also, back in 2000 the entire breeding took place on non-iced islands.

R: It has been carefully demonstrated in similar surveys that 10–15% ice coverage in a survey involving regular transects gives an extremely reliable estimate. The reliability is reduced for surveys involving less than 10% and does not improve significantly with higher fractions. Estimates of 380–400K have been obtained by surveys with non-transparent methodology, involving an unknown fraction of the ice, probably in areas with high densities of seals. Trained observers are able to count white pups on the ice with great accuracy. As explained previously, only insignificant numbers of pups are born off the ice when suitable ice cover is present, such as this year.

KZ: There has been no hunting of seals for the past 10 years.

R: Perhaps not all hunting has been widely publicised.

CM (EU/TACIS): I would like to suggest ecosystem modeling as a different type of approach to predicting future trends. For example, from a study of seal diet and biomass, it would be possible to make a prediction about what would happen to the seal population if the kilka stocks collapsed. Data from stomach contents could be used.

R: We will certainly look into this as an additional approach. We are currently planning a major seal diet study, using scats (not stomach contents) collected from seal haul-out sites throughout the Caspian. One of the reasons behind this study is to gain a better understanding of the annual, seasonal and regional variation in diet, and hence a better understanding of the possible impact of *Mnemiopsis*. If the type of analysis you suggest can take us one step further into making predictions, it could be extremely helpful.

RF: This is an interesting and exciting survey, but it is just *ad hoc*. Nothing is said on methodology and statistics. There are no grounds to disbelieve the work of Kaspnirkh. We know the distribution of seals - the mid and north Caspian is covered by our surveys. Kaspnirkh also has studies on feeding. We do not witness any mass deaths as in 2001/02. Seals flexibly change to feed on other fish. In the summer and spring seasons they eat pike and other kinds of fish. They have resolved the problem. We

cannot say the situation is near catastrophic nor that the seal should be entered into the Red book. In 2002 80% of the population of females didn't breed but next year only 47% didn't breed. We need to continue these surveys.

R: The methodology of the survey was clearly explained in the presentation. It is very simple, but very thorough and completely transparent, leading to an accurate count of pups and reliable estimate of pup production. Details of the population modeling needed to estimate the total population size are too complex to explain in the presentation, but are presented in detail in the main survey report and Appendix 2. The hind-casting method used here is well established in population dynamic modeling and has been used to great effect for seal populations in the Baltic, where it is has been reviewed and accepted by the international scientific community. Seal research and monitoring in the Baltic is many years in advance of the Caspian, but the same team that has led the Baltic research is now leading the CISS team in the Caspian survey.

IR: The whole region should gather information and archive data and we would have a much better picture.

KZ: This research should cover the entire territory.

Agip KCO: This is a high quality study and we have no reason to doubt it. We will continue to work with this team. Agip KCO has engaged different countries, especially Russia, in carrying out related work. Our company began a seal survey from 2000, but regrettably our methods don't enable us to look at the whole population of the seal….we need to look at the whole Caspian.

CM (EU/TACIS): I would like to express my appreciation of the work accomplished, using widely-used methodologies, to increase the reliability of the results. The weakness of the survey is that only one part of the Caspian was surveyed. We need to repeat the study with the whole Caspian.

TK: We (the TK team) expected to do a parallel survey in February this year, but couldn't because of funding constraints.

R: There may be some general misapprehension about what can be achieved by surveying the whole Caspian. The most important part of the survey is to obtain a good measure of pup production, since this is a direct indicator of the effective breeding population size. From this, the entire population structure and size may be estimated from the population dynamic models, as explained in our report and in publications on this subject referred to in the report. More than 99% of Caspian seal pups are born on the northern ice-field during normal winters with normal ice formations, such as this past winter of 2005. *Therefore, surveying seals over the rest of the Caspian will not make any significant difference to estimating either the total pup production or the total population.*

The total population of non-breeding animals (both juvenile and adult) cannot be determined by surveying the whole Caspian: all that can be said from a pan-Caspian survey is information on the distribution of seals and habitat used for haul-out, and perhaps also for foraging near the Iranian coast. Most seals will be at sea, foraging,

and invisible to the survey. The only part of the Caspian not covered by this survey which might have improved our estimate would have been the ice on the Russian side. We covered 27,360 sq km of suitable ice in Kakahstan waters, while omitting 3,675 sq km (11% of the total) on the Russian side. If we had been able to include the Russian ice, our estimate of the total would have been slightly more reliable, although the total estimate would most probably not have been significantly different from that which we have presented here. Nevertheless, it is our intention to ensure we have the funding next year to include the Russian ice in the survey. We also intend to survey the whole Caspian simultaneously in order to look at the distribution of subadult and non-breeding animals.

RF: The work that has been done here is very good, but costly. It would be best if the different countries could attract oil money for such surveys.

IR: Are you planning any remote systems studies?

R: Satellite telemetry studies are planned in order to study seal migration patterns, local movements and foraging areas. The CISS team includes the foremost European specialists in this field. These studies are already in our planned work schedule, but cannot take place until funding has been secured.

KZ: This work should be reviewed by scientists of different countries.
The work is currently been written up in publication format. It will then be submitted to international scientific journals, where it will go through an intensive peer review process. It is for this reason that we are asking our Caspian partners not to disseminate the results publicly through the media or websites until this process is completed (probably a few months). At the same time, our report will be distributed to all our colleagues in the Caspian for their review. During this process we are very willing to enter into email discussion of any questions or comments our colleagues wish to make. We would like to share all this study with our Caspian colleagues on a completely open and shared basis. The draft which will be distributed after the meeting will include some clarifications based on our discussions here today. The Russian translation will be prepared and distributed as soon as possible, we hope within two months.

R (HGh, PCU): We are planning for the study to be published. We are also planning for the survey to be formally discussed in a joint working committee with the CEP, Bioresources Commission and Agip KCO.

Presentation on the draft SCAMP

TK: Turkmenistan is ready to cooperate as soon as we can.

KZ: I have already articulated our opposition. We cannot have such a complex document. There are many provisions and points which belong in national legislation. We reject this preliminary plan of action, which will have to be revisited and completely changed. We propose to continue the surveys jointly with other stakeholders. There are good specialists in Azerbaijan.

RF: This document needs to be revisited and changed. Today's presentation is not final and should be discussed again with the Bioresources Group…….

Who initiated this plan of action? What is its relation with the SAP? Why do we have to review it? Who contracted this work?

R: (HGh, PCU): The issue of seal mortality engaged the interest of the international community of Caspian countries. The seal issue is included in the SAP which has been accepted by all the Caspian countries and is included in the GEFII project document. There is no doubt that the Caspian seal is a major issue that needs to be addressed. There is no contractor.

This is a set of recommendations which, when approved, need to be implemented by the littoral countries. The seal is under threat. Action is needed. It is 100% necessary for work to be done on the ice-breeding population during the winter. The Government of Kazakhstan must take this into their hearts.

One idea, as the document suggests, is to establish a regional network of seal centres with Kazakhstan taking the lead. The countries need to take this issue more seriously. The Governments of the Caspain Sea countries need to take action. Kazakhstan should take the lead since seals come there to breed. Therefore there should be a lead seal centre in Kazakhstan. Please consider this and talk to the oil companies.

The CEP is only as strong as the countries themselves make it. The CEP/GEF project has put considerable funding into this CISS work. We will continue our support for looking into the health issues and seal awareness programmes, but we need ideas to support this. We also need training ideas. Students may be supported using matched small grants for applied (not pure) research.

The Caspian Governments need to take action to protect the Caspian seal.

TK: Can we go through each point in the SCAMP?

RF: The Caspian seal is not in our Red book because it is a harvested species. Therefore adopting this plan would mean changing the status of the seal. Our national legislation requires us to monitor and conserve this species and do research. The problem with putting a species into the Red book is that is you want to kill it, you have to take it out again and we don't want to have to retrieve the Caspian seal again from the Red book.

Caspian seal commercial hunting reached its peak during the Soviet era when it was, as you correctly state, a 'harvested species', with the economic benefits of the hunt going to the USSR, or areas within it. Our hind-casting analysis has shown how this hunt was so poorly managed as to cause the steep population decline during those years. With the demise of the Soviet Union, the seal's status in Russia as a 'harvested species' has now changed. The seal is now a regional resource of all five Caspian littoral countries. In fact, a relatively small proportion of Caspian seals now congregate to pup in Russian waters. The terms of any future 'taking' of the seal by Russia, whether for commercial harvesting or for 'scientific' purposes, will therefore have to be agreed (under the terms of the Convention protocol now being developed)

with all other Caspian states, considered in terms of the international (regional) public interest (IPI), and with permits issued by Kazakhstan.

KZ: Seals are hunted by all the Caspian littoral states. To elaborate an action plan we need to continue working on a protocol and allow us to elaborate issues and integrate this into our national legislation.

R: Seals were hunted on a large scale mainly in the northern part of the Caspian, particularly on the northern ice-field, and mainly by people in the region now in Russia and Kazakhstan. Numbers hunted elsewhere were relatively small and opportunistically based.

IR: We need to take action before the seal goes on the Red list. We should leave the details for further scientific discussion.

TK: We should take the action plan into consideration.

AZ: We need to consider research activities. Regarding this figure of 125K seals – vene if the number is 3X this, we still need to conserve it.

CM (EU/TACIS):

1. There is a need for technical scientific work; this shouldn't be stopped
2. What will we do with those results?
3. Who will make that decision?
4.

We need to bring in resource scientists. The Bioresource AG and the Fish AG should support the technical work that is being proposed.

KZ: Does the State have a legal right to adopt this plan?

R (HGh, PCU): The SCAMP is not here for approval; it is a strategic plan for the guidance of the countries. The seals could be brought to the attention of the protocol group. We should take it back to our offices as a strategy document. But the main lines of action need to be taken and the plan endorsed. We need to decide if we should develop a seal network requiring a leading seal centre. Also continuation of the seal surveys as started by the CISS team.

RF: Should we emphasise the seals so much within biodiversity? Couldn't it be considered under the monitoring database? The actions proposed are quite acute. The bulk of the measures, such as reserve areas, would overwhelm our capacity to implement.

R: The seals have to be emphasized this much within biodiversity. The seal is the Caspian top predator and as such is a key flagship species for the whole Caspian. The size and health of the seal population reflects the abundance and health of Caspian fish populations, habitats, resource management and hence the management status of the whole Caspian ecosystem. The seal is therefore both central and pivotal to Caspian biodiversity conservation and management. It cannot and must not be sidelined into a monitoring database!

KZ: We agree with Turkmenistan not to put the seal in the Red list.

RF: In reality the Government has the right to determine on its own which species should be in the Red book and which should not, and which should not and should be exploited. How can we have reserves in the ice-fields?

R: We realize you are talking here of national Red book lists. Could we remind you that the Caspian seal has been on the international (IUCN) red book list since 1996 as 'vulnerable'. From the results of the present survey, it will probably qualify for 'endangered' in the 2006 re-evaluation.

It would be highly advisable for national Red book lists to follow the international Red book listing, since the conservation status of the Caspian seal is of both regional and national concern.

R: With regard to reserves in the ice-fields, we would suggest rectangular reserves defined in terms of latitude and longitude. These rectangles should include the pupping hotspots for the previous year(s). These can be seen for 2005 using the distribution map on Fig. 3(b) of the main report. Future surveys using this methodology will indicate the extent to which these hotspots vary in location from year to year; the reserve boundaries could be adjusted each year according to either the results of the previous year's survey, or the most probable range of hotspots over several years' previous surveys. It might be necessary to refine the boundaries each January according to the ice distribution that year.

(AFTER LUNCH)

KZ: KZ quotas are not used. Penalties are high for illegal taking.

TK: If there are no seals, then you just don't do it.

TK: If seals are in the Red book, taking catch is forbidden. Breeding areas are protected in practical terms…..we already have a kind of a ban

KZ: Seal Protection Areas – some in the North Caspian cover wide areas….special operation for hunting , vessels….if we describe which country does what, we won't progress. The seal population is more or less stable at the moment…fertility is falling.the draft action plan effectively addresses seal issues……we need to know the seal population and what negatively impacts on the population and what measures are needed to protect the seals, such as preventing killing of seals in the Apsheron peninsula. The surveys are not complete….we need more research…engaging national scientists…to provide a document for decision-making….medium-term plans for comprehensive studies.

R: The seal population is not 'more or less stable at the moment'. It has been declining for the past 45 years at an average of about 4% per year for breeding females (and it will take several more annual surveys with the same methodology as for 2005 to detect any statistically valid change in this trend). We have just carried out a survey to find out what the population is and have just pr4esented these results. We also know what negatively impacts on the population, and this has also just been

presented at this meeting. We do indeed need more research and monitoring, and this will include the training of young national scientists, but the present 2005 results give the best available information on the seal's status at present and this cannot be ignored.

R (HGh, PCU): It would not be economically effective to take seals at present. The report tells us that the seal population is declining. We need a recommendation (not a decision) from RAG.

Our collective conscience does not allow us to ignore the seal situation. There should be no taking…you disagree…so what suggestions do you have? The habitats of seals is a major issue. Actions are needed to preserve seals. We cannot claim that everything is fine.

IR: Suggest five points for recommendation which should be acceptable:

1. Research should continue
2. Countries should have more say and more activities
3. There is concern about the situation at the moment
4. There should be an emphasis on already existing measures to protect seals until we get a new international Agreement
5. We need to raise more $$ for research

R: It would indeed be very helpful if each country BISRAG representatives could compile a list of national legislation and reserves regarding seals and integrate it into a single document. This would facilitate the development of the action plan, and would also clarify what protection measures could be taken and developed on a national basis before the protocol Agreement is concluded.

IR: Seal specialists need to get together to discuss this issue and shape recommendations for the Governments.

R: Agreed. It would probably be helpful if an international CISS team specialist were to participate in such meetings in order to keep the discussions on track within the framework of the CISS survey methodology and results. Since these are not, as yet, well understood throughout the region, it is suggested that the first of such meetings might be combined with an information-sharing and training workshop led by the CISS team. We suggest that a first seal specialist group meeting/workshop be hosted by Kazakhstan and held in Atyrau in the Autumn of this year (2005).